In-Depth Reviews: Kurzweil K2000RS & E-mu Vintage Keys

Electronic Musician

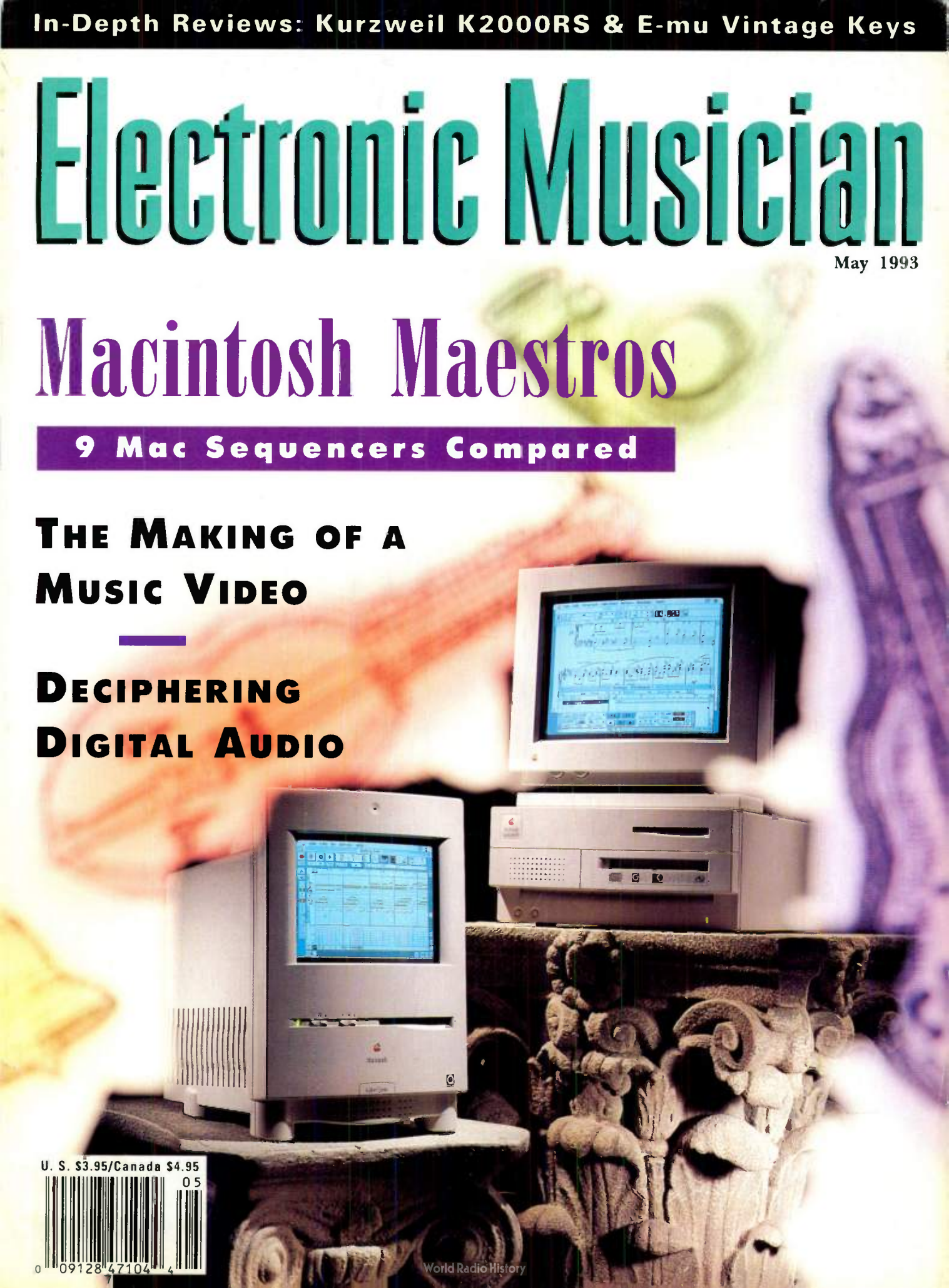
May 1993

Macintosh Maestros

9 Mac Sequencers Compared

The Making of a Music Video

Deciphering Digital Audio



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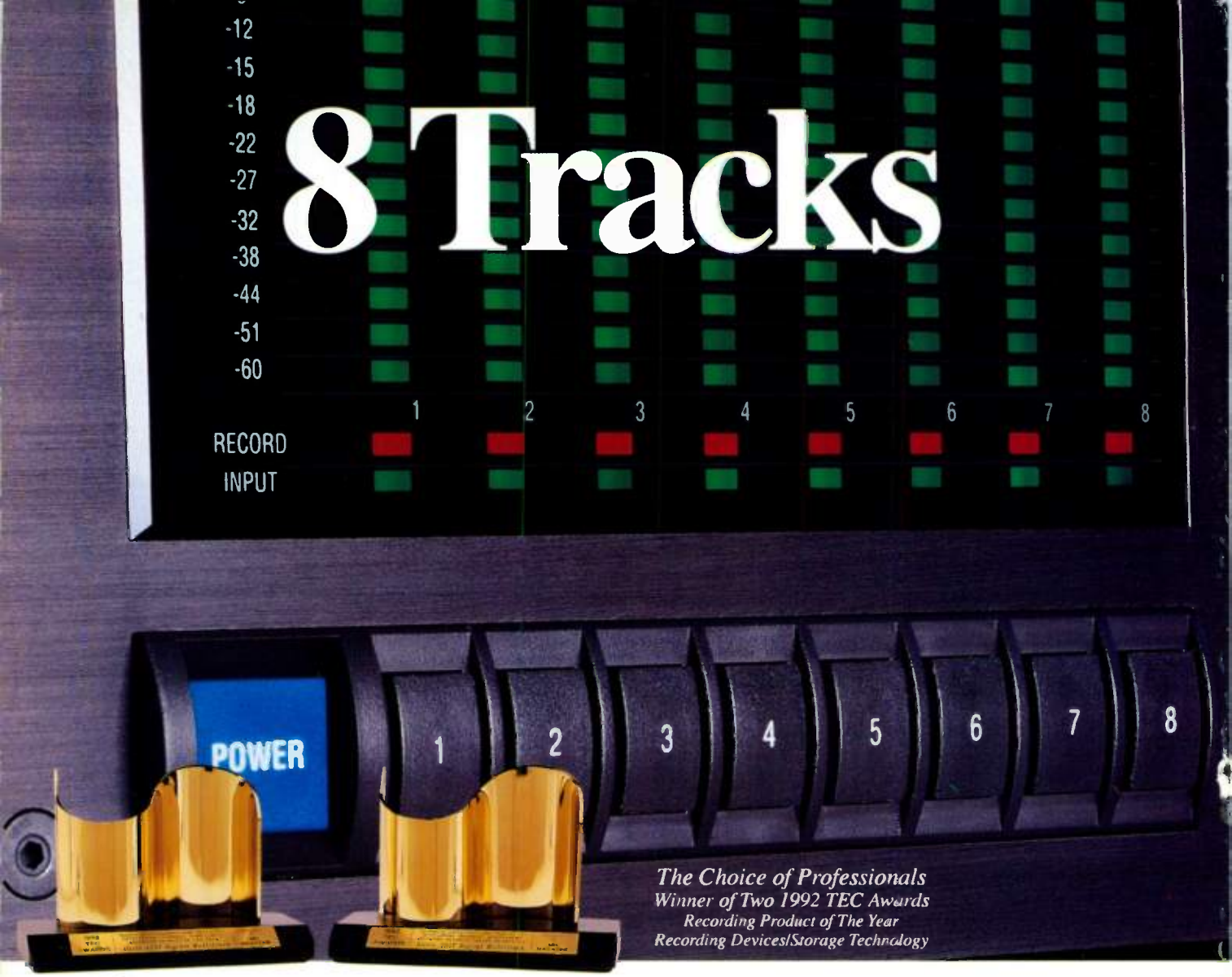

Demos to masters. Creativity to tape. Dreams to reality. Magic phrases for those who want to make music that sounds as good as it feels.

The inspiration for these thoughts is the **Alesis ADAT Professional Digital Audio Recorder**, a technological revolution that tears down the walls to your creativity while delivering world class master recordings. Too good to be true?

Here's the concept. ADAT fuses a supersonic Alesis-designed very large scale integrated chip set with the proven reliability of an industrial grade S-VHS* tape transport and a logical, sensible user interface. The result is a digital tape recording system that exceeds the most demanding requirements of professional audio and that can be used by literally anybody. Hard to believe?

Here's some specs. Bandwidth 20Hz to 20kHz ±0.5dB. Total Harmonic Distortion plus Noise 0.009%. Wow and flutter unmeasurable. ADAT uses the professional standard 48kHz sample rate and delivers better than 92dB dynamic range.

Here's some features. ADAT uses the familiar tape recorder controls that you already know how to use so recording is fast, intuitive, effortless. Connections are provided for balanced +4dBu levels on a single 56 pin ELCO** connector and unbalanced -10dBV signals on 1/4" jacks. And ADAT uses S-VHS tape because it's a proven, robust recording medium with wide 1/2" tape to solidly support ADAT's 8 recording tracks while delivering 40 minutes of recording time.

The best part. ADAT's Proprietary Synchronization Interface (Patent Pending) locks multiple ADATs, independent of the audio tracks, to single sample accuracy ±5% of 1/48,000th of a second! In other sciences this is referred to as 'air tight'. So multiple ADATs function in perfect mechanical and electronic unison: up to 16 ADATs without an external controller. That's 128 tracks!

More best part. ADAT's Proprietary MultiChannel Optical Digital Interface (Patent Pending) simultaneously sends all 8 tracks of recorded information out the Digital I/O for perfect safety tapes and perfect track bounces.

Even more best part. The optional BRC Master Remote Control opens a whole other door to the ADAT miracle. With it you can control up to 16 ADATs (128 simultaneous tracks) with full transport functions, track offsets, machine offsets,

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Also available: The AI-1 ADAT to AES/EBU and S/PDIF Digital Interface with sample rate converter.
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digital assembly editing via the Digital I/O, SMPTE and MIDI Time Code, Video Sync and more.

What does all this mean? Here's just a few benefits.

It's commonly known that many hours are wasted during expensive album projects while the artist, producer and engineer work in vain to reproduce the rhythmic feel and tonal nuance of demos. Demos that couldn't be used because they suffered from noise, limited bandwidth and overall sonic feebleness. Those days are over forever. ADAT's Sync and Digital I/O perpetually link your demos to your masters making them all part of the same creative process. Every track you record on ADAT is a master track that can be flown into any other ADAT recording, at any time. The best part is that ADAT can be there at any time to catch you at your best, flawlessly stored in the digital domain...forever.

Need more tracks? ADAT studios can be expanded at any time. The cost of a single ADAT is remarkably inexpensive and new ADATs can be added as budgets permit. Add the BRC at any time for more control and advanced editing. Producers please note: with ADAT, Megatrack™ recording is a reality.

Your favorite sax player lives in Idaho? No problem. Send 'Supersax' a formatted tape with a guide track of your song. You'll get back 7 tracks of burning solos you can fly back into your production. All in perfect sync, all in the digital domain. All dripping with soul. Want more tracks? Just send more tapes.

ADAT is not only a new recording medium, it is the new recording standard. Imagine a network of ADAT users from bands, composers and project studios to professional studios, video editing suites and broadcast production studios. All recording master quality tracks with full compatibility and no barriers between their creative disciplines. In fact, we're launching the ADAT Worldwide Network™ multitrack recording group to facilitate communication between ADAT studios.

In time we'll all start taking these little miracles for granted. Before that inevitable event, unpack your first ADAT and track a minute of single notes and chords on your favorite instrument. Play loud, play soft. Play it back and listen really close. It's always a good feeling to have your mind completely blown.

See your Alesis ADAT Dealer today and start Megatracking on ADAT.

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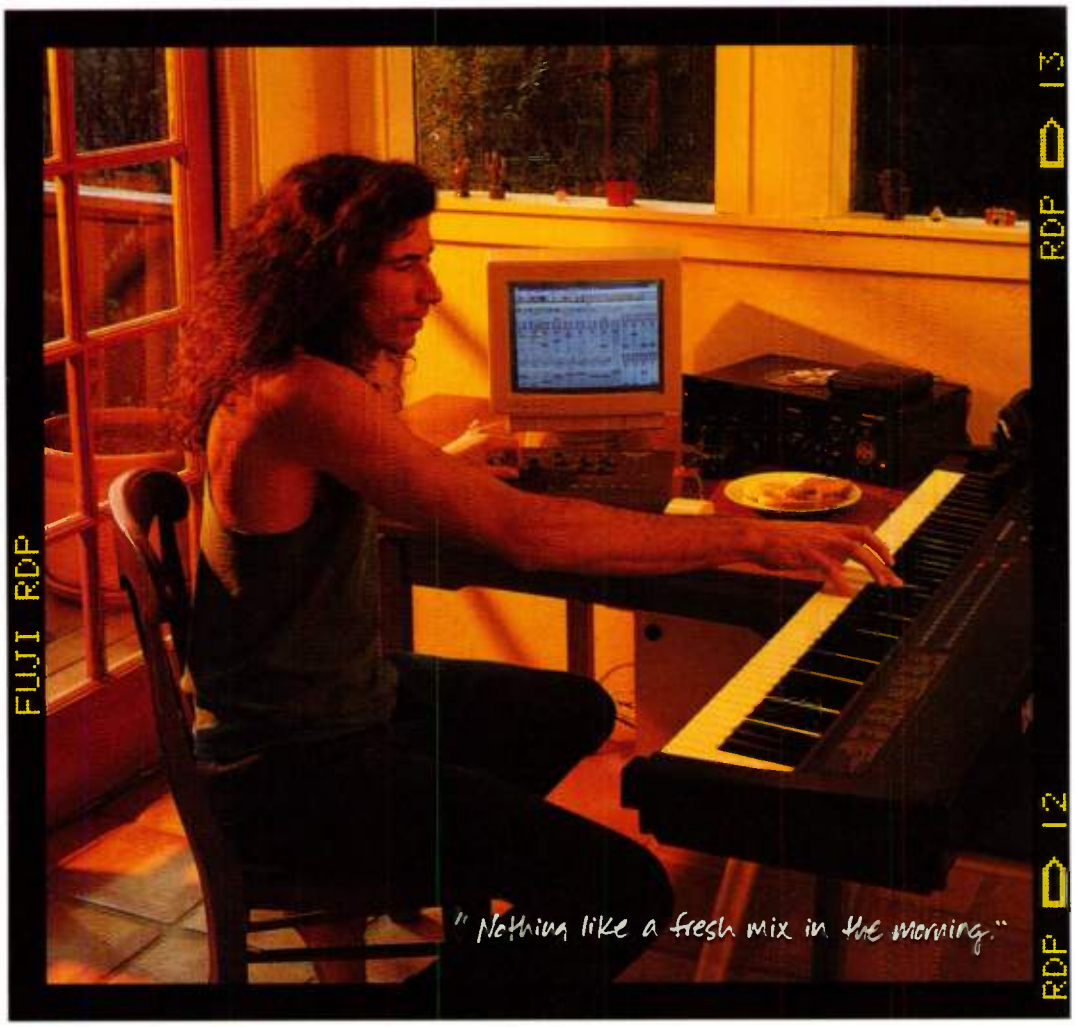

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REVIEWS

DEPARTMENTS

Cover: Photo by Stan Musilek. Special thanks to Apple Computer.

Smart Sequencers

Sequencing programs are entering a new age.

ANNE HAMERSKY

If you're like most **EM** readers, sequencers are the heart of your musical life. You use them to record and arrange your ideas, to play back the compositions of others, as a diagnostic tool for system troubleshooting, and probably in a host of other creative ways.

Lately, sequencing programs have undergone some dramatic developments that make them even more powerful. Many of today's programs let you print your music in standard notation, store and edit patches from your synths, automate effects and mixdown, and even edit digital audio recordings, in addition to their MIDI recording, editing, and playback capabilities. (See this month's cover story, "State of the Art Sequencing" on p. 38 for more on the latest Mac-based offerings.)

Not surprisingly, this added power takes its toll on the user-friendliness of many programs. Word processors that incorporate desktop publishing and graphics functions often become overwhelming; similarly, sequencers that sport all the latest features can get a bit unwieldy. Nevertheless, developers continue to refine their programs, making notation, patch editing, digital audio, and studio automation a natural extension of the sequencing environment.

Reflecting on these developments suggests a subtle but profound change is occurring in the way developers and users think about sequencers. These programs are moving beyond their utilitarian role as recording and playback mechanisms to become collaborative partners. Functions such as Groove and Match Quantize in Steinberg's *Cubase* and similar features in Emagic's *Notator Logic* let you save and apply a musical "feel" from one sequenced section to another. This implies a level of abstraction and musical intelligence that sequencing programs have previously lacked. So far, only a few steps have been taken in this direction, but it seems the sequencing paradigm is shifting in a major way.

This isn't the first time such a change has occurred. When graphic note and controller editing was first added to sequencers, it was like lifting a veil. Suddenly, average musicians saw the power of MIDI sequencing. Interminable event lists were relegated to a supporting role, replaced by attractive, informative graphics that put notes and other MIDI data into an understandable, musical context. It made sense. The paradigm had shifted.

The current developments will undoubtedly have an even greater impact on the way we approach sequencing, but more needs to be done before a complete paradigm shift can happen. Recent advances in computer-based musical analysis and algorithmic composition indicate that it's possible to quantify musical styles and use that information to generate more music (see this month's fascinating "Computer Musician" column on p. 80 for more). Instead of analyzing and storing rhythmic feels, as some current programs do, the next generation of sequencers may be able to analyze your harmonic and melodic styles and use that information to generate truly satisfying original music.

The same tools could also create a database of your own stylistic elements to form the foundation of an interactive piece of music, or an interactive music program, much like a personalized version of Laurie Spiegal's *Music Mouse*. The piece would be different each time it has performed, but the stylistic characteristics would be similar enough to ensure that it was perceived as your work. The possibilities and implications are staggering.

Changes like these won't happen overnight. But as they do, you'll never be able to look at your sequencer the same way again.

Bob O'Donnell

Electronic Musician

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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.

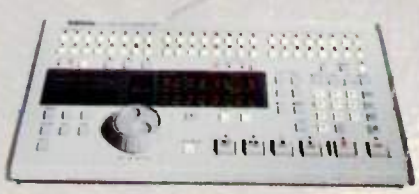
That's not all, you also can set your pitch (± 6%), sample rates (44.1 or 48K), as well as crossfade and track delay times. All from the front of the DA-88.

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.

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KAWAI

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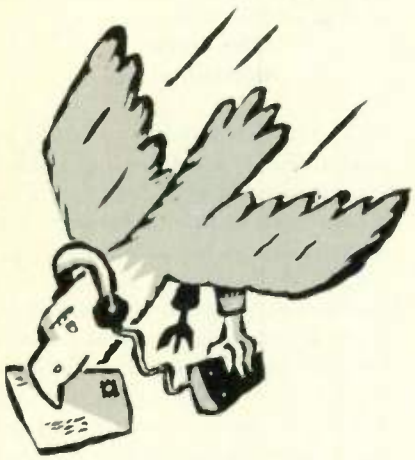
LETTERS



IT'S A HIT

I was thrilled to see "Recording a Hit Record" in your March 1993 issue. I am currently enrolled in college as a Recording Engineering major. My classmates and I found the article extremely informative and insightful, in that the "best/most expensive" is not always the norm in the real world. The sound is what ultimately matters.

We're looking forward to future installments in the "All-Access Pass" series. Keep up the good work.

John W. Rettberg
Haymarket, VA

MICRO MUSINGS

While I have enjoyed many articles in EM, Scott Wilkinson's "The Microchip Muse" (March 1993) was very interesting. The impact of technology on creativity in all forms cannot be overlooked, taken for granted, or ignored. It will probably never be fully understood, either. One enticement that technological musicians must surely guard against is the desire to become completely independent of other musicians through the use of modern musical technology. I, too, have almost succumbed to this desire, especially after a bad experience with a U.S. Air Force field band.

In addition, though I have developed a great love and respect for modern musical technology and the tremendous impact it has had on the art of musical creativity, I still find myself returning to my one favorite piece of gear: a Holton TR181 bass trombone.

Dave Ivy
Fisher, IL

I was very impressed with "The Microchip Muse." There are so many angles and dilemmas concerning the arts both in ourselves and in society. Reading different approaches gives us the necessary perspective to make our own decisions.

After reading the article I thought of an idea for your magazine that you can take or leave. Would you consider having a "Readers Forum" once a month where you ask a new question and have readers respond? This could offer the same kind of perspective "The Microchip Muse" presented. Sample questions could be: "What is the hardest thing about working in your studio?"; "When are you most creative?"; "What innovations would you like to see?" This would also give readers more of a sense of involvement in the whole process.

Thanks for a great magazine and the continuous moral and technical support.

Dagen Julty
Rock Hill, NY

Dagen—Thanks for the idea. I would also be interested in such responses from readers. Before we implement it, though, I would like to know what other readers think. Would you be interested? Let us know.—Bob O'D

OLDFIELD AND OCR

Your March 1993 "Pro/File" on Michael Oldfield was interesting, though you misspelled *corpus callosum.*

While I'm writing, do you know of anyone who has an OCR program for the PC to scan sheet music? David Stuart Prerau wrote a program for a larger machine quite some time ago ("Computer Pattern Recognition of Standard Engraved Music Notation," M.I.T. doctoral dissertation, 1966). The late Jim Miller (creator of *Personal Composer*) told me in 1989 that he was working on such a program, but it must have gone to heaven with him.

Louis Barton
Theodosia, MO

Louis—Several companies are, in fact, working on musical OCR. Musitek (tel. [800] 676-8055 or [805] 646-8051) announced and demoed a Windows *program called* MIDIScan *at the January NAMM Show that converts TIFF images of sheet music into a Standard MIDI File. In addition, Coda (tel. [800] 843-2066 or [612] 937-9611) announced that they had licensed technology from a British university that they would make available to* Finale *users, first as a per-page service, then as an add-on to* Finale, *and ultimately as a stand-alone product. See the April 1993 "Technology Page" for more on both of these developments.—Bob O'D*

ADAT ADDENDUM

I read three glowing reviews of the Alesis ADAT, including one in EM (October 1992). I was all set to buy when I noticed something all three overlooked. Say you record a part on track one and another on track two, and then you want to bounce these to track three within the digital realm. OK, so far. But how do you set the relative levels of tracks one and two? Answer: You don't. You either live with the relative levels at which they were recorded, or you go out of the ADAT through its DACs (digital-to-analog converters) to an analog mixer and back in through one of the ADAT's ADCs (analog-to-digital converters). In other words, you must leave the digital realm with the result of some generational loss.

This is a shortcoming not present in most hard-disk recording systems.

James Hober
Los Angeles, CA

James—You are correct. Currently, the ADAT cannot submix internally within the digital domain. However, Alesis' much-anticipated BRC (Big Remote Control) for the ADAT allows internal digital submixes

AD Mc CAULEY

with level control. This application was mentioned in the "How It Looks" section of my review. But until the BRC is released (hopefully by the time you read this), I wouldn't worry about leaving the digital domain. I've done hundreds of submixes on the ADAT through our Trident Model 65 mixer and sonic quality has remained pristine. The generation loss you speak of is, for practical purposes, nearly imperceptible—Michael M.

K2000 FREEBIES

Thank you for an excellent article on the Kurzweil K2000 (March 1993). If I may be so bold, I would like to add an entry to your list of resources for the K2000.

The Kurzweil archive features almost 100 megabytes of K2000 patches, programs, and samples. The sounds range from cellos to drum machines. Best of all, the archive is completely free (no dial-up or use charges), open 24 hours, available internationally, and its contents are entirely public domain. Its purpose is to help K2000 owners make the most of their powerful instrument. Visitors are invited to take whatever they like and, in exchange, add their samples and programs to the archive's library when they can.

You can only reach the archive through the Internet (the international computer network), which links thousands of universities, companies, and government facilities together. You access the archive using what is called "FTP," or file transfer protocol, which is the Internet's equivalent to a computer bulletin board (BBS). You can access the Internet through an account at your university or work, or through the many inexpensive dial-up bulletin boards with an Internet connection. When you are on the Internet, there are no long distance call charges, and you can stay on as long as you like.

To access the archive, type "ftp ftp.uwp.edu" at your prompt. If your computer answers with something like "unknown command," talk to a system administrator about running FTP on your system. If you get a "host unknown" message, try "ftp 131.210.1.4". However, if that works, you'll be greeted with a "username" prompt. Type "anonymous" and, as a password, type "youraddress@yoursite" (e.g., jsmith@ucla.edu). Now you're on! The Kurzweil files are stored in a subdirectory you can reach by typing "cd/pub/music/lists/kurzweil." Type "dir" to get a listing of available files, or type "help" if you're lost. Try to persevere! There's the equivalent of a couple thousand dollars worth of sound here, so it's worth learning about. While you're at it, snoop around the other directories: You'll find several hundred megabytes of music-related stuff at this ftp site, including the largest collection of song lyrics anywhere!

John Buckman
Kurzweil Archiver
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HAPPY CAMPER

I would like to thank you for your articles on entry-level MIDI and request more of the same. I particularly enjoyed your January 1993 articles: "The Musician's Apprentice" (on software that improvises music), David Pogue's "Multimedia Minus One" (music for multimedia), Scott Wilkinson's "From the Top: A Disk for the Teacher" (music-tutoring software), and John R. Quain's "Computer Musician: Multimedia PC Sound Cards" (synthesizer cards for PCs).

Your April 1992 "Back Page" by Jack Jarrett, "Music Education as a MIDI Marketplace," was also thought-provoking, especially his discussion of the need for a "true orchestral synthesizer" (of which the Proteus/2 comes closest). This article leads me to ask, "How is the workload between the sequencer and the synthesizer best divided in order to reproduce the specific nuances of traditional instruments?" I gather from the article that the current barrier to realistic orchestral sounds exists principally because the stringed instruments sound quite different, depending on the quantity of musicians playing in unison and the quality of sound produced by the individual musicians' techniques (pizzicato, staccato, legato, sul ponticello, col legno, muted, etc.). MIDI probably doesn't have codes to describe all of these techniques, so how can MIDI begin to approximate the sound of an orchestra? Instead of sending MIDI commands requesting the different combinations of unison group size and individual techniques, is the most feasible approach to use the sequencer to simply request entirely different programmed voices from a library of similar voices, previously programmed into the synthesizer? In future articles, could you elaborate on the internal workings of synthesizers and how they are used to approximate the sounds of traditional instruments?

John Ferral
Huntsville, AL

John—Your deduction is correct. MIDI itself cannot describe the differences in sound between these playing techniques; you need to have access to different pre-programmed synthesizer voices that offer these different sounds. However, simply having access to them does not guarantee that one will be to be able to accurately re-create these timbres. The notes need to be played in a way that's sensitive to the type of sound you're using. To translate that into musical terms using your sequencer, you need to have some knowledge of MIDI. For example, muted string parts should generally not have velocity levels in the 120-127 range, which would basically defeat the purpose. Similarly, you can get around the lack of certain sounds by playing existing sounds in an appropriate way. For example, staccato notes can be simulated with a regular string patch both by making sure that note durations recorded in the sequencer are short and by shortening the attack and decay time of the sound within the synthesizer. If your instrument supports it, you can also switch between sounds with different note velocities. To learn more about the internal workings of synthesizers, see our beginner-oriented "From the Top" column on synth programming in the February 1991, June 1992, and July 1992 issues.—Bob O'D

KUDOS

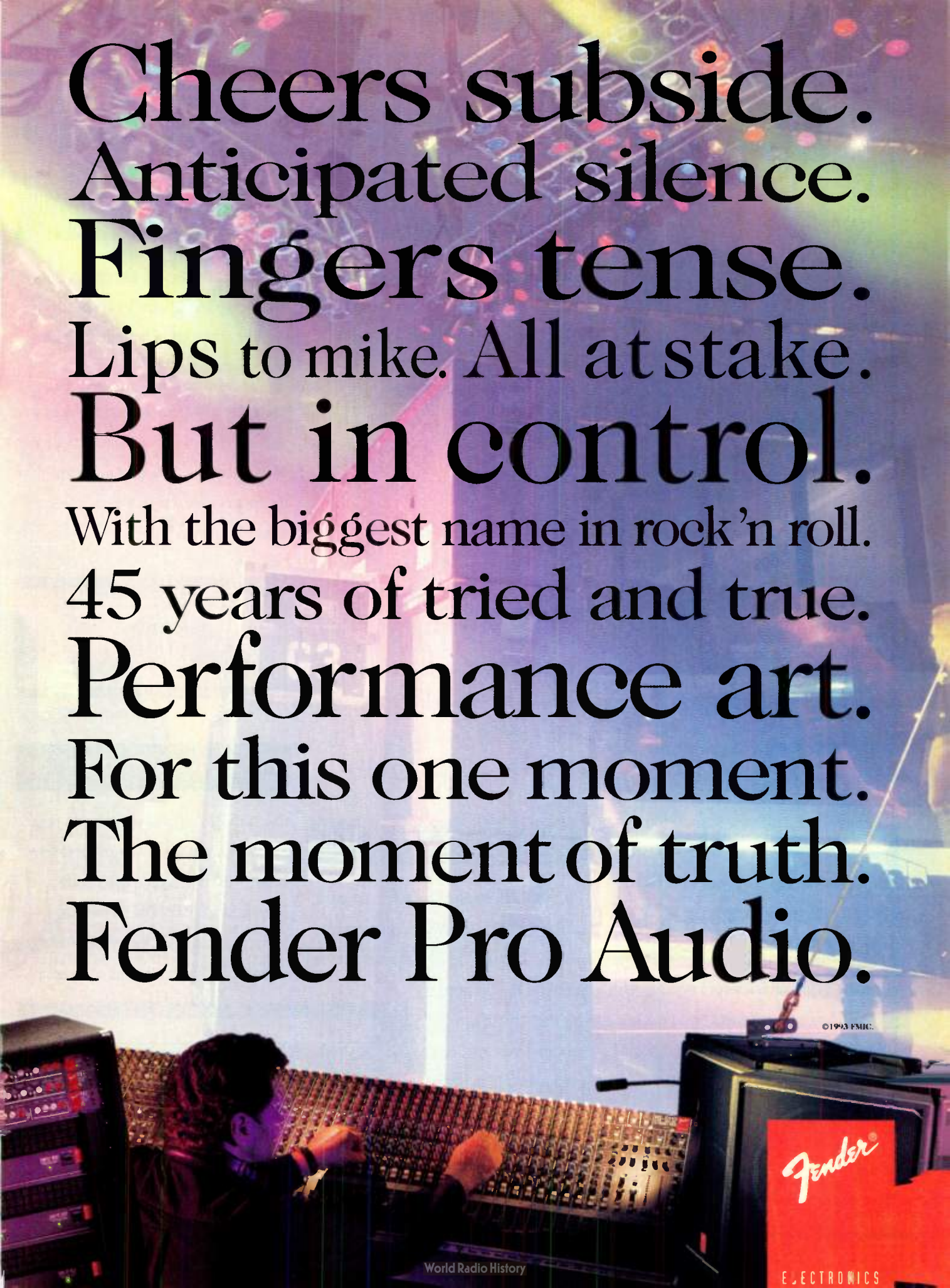
I'm a music technology instructor working in cold Wisconsin, and I just wanted to say I love your magazine. I often assign students to review articles out of it. Keep up the good work.

Mark Wolter
Madison, WI

ERROR LOG

April 1993, "Letters," p. 11. The art was created by Ad McCauley.

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.



FACE IT. YOU NEED

It's enough to drive you crazy.

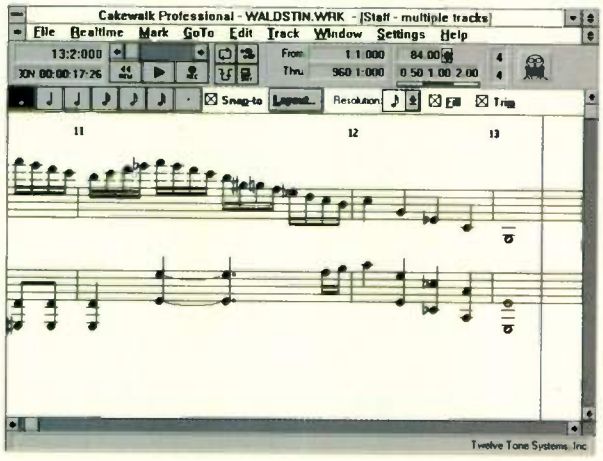
You've been searching for software that will help you turn your musical ideas into polished performances. But the first program you tried wasn't powerful enough. And the other was so complex, you didn't know where to start.

Maybe it's time to see a Professional.

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

Express Yourself

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



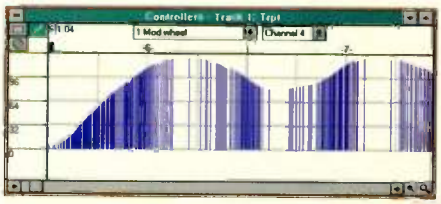
Staff view

Tempo

Take Control

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

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



Controller view

Professional Staff

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

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

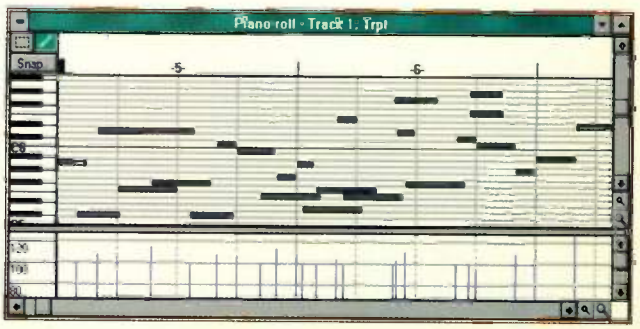
Markers

Get On Track

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

Professional Experience

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



Piano-roll view

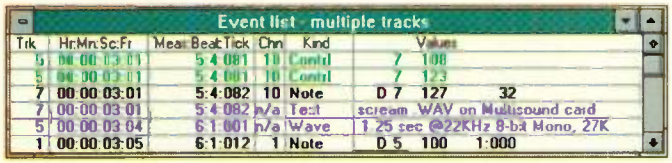
PROFESSIONAL HELP.

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

Faders view

CAL-
SWING 16.CAL

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



Event-list view

Sysx

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

Meter/Key

Own Another Sequencer?

CALL ABOUT OUR TRADE-IN OFFER!

Get Help Fast

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

Comments

See A Professional Today

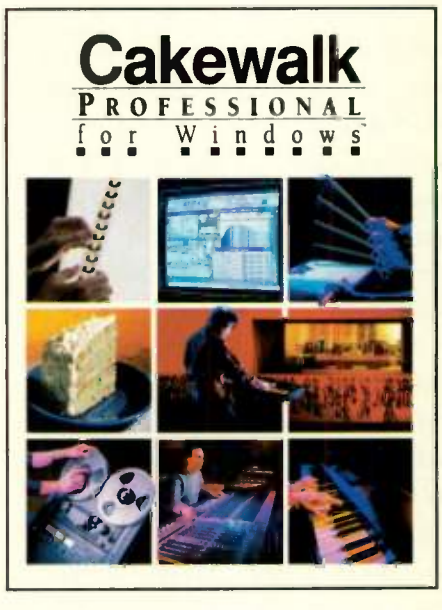
Cakewalk Professional for Windows ($349) is sold at finer music and computer stores worldwide. For more information, or for the name of a dealer near you, call

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

A demo disk is available for $10.

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

Twelve Tone Systems, Inc.
P.O. Box 760 Watertown, MA 02272
Fax: 617-924-6657



Twelve Tone
SYSTEMS

The New S-series Samplers: S2800, S2800STUDIO, S3000, S3200

32-voice professional samplers starting at under $3000.00

The engineers at Akai have years of experience in designing extremely high quality digital samplers. Which in turn, has led to an on-going tradition - namely, the world-famous S-series professional sampling instruments.

Now, the latest generation has arrived in the forms you see pictured above, the S2800, S2800STUDIO, S3000, and S3200. These new models build upon the solid foundation of their predecessors, while offering even better audio quality and more powerful sound editing capabilities than ever before.

Akai samplers have always been associated with superb sound quality and clear, intuitive user interfaces, and these new S-series machines are no exception. Each features 16-bit sample resolution, with 64-times oversampling and 28-bit internal processing to ensure the crystal clear sound you expect from Akai.

In addition to Akai's legendary sound, all of the new S-series are loaded with features you need including 32-voice polyphony, resonant filters, digital effects, time compression/expansion, auto sample normalizing, sectional editing of samples, APM (Assignable Program Modulation), and much more. There's even built-in Help screens!

Naturally, the new series of samplers is fully compatible with the Akai S-series sound library, as well as libraries created by leading third-party sound developers. Gigabytes of sounds can be accessed via floppy disks, removable hard disks, magneto optical disks, and CD-ROMs.

The new S-series line is structured so that if your needs don't require the high-end power of the S3200 or S3000, the basic S2800 package still gets you into the upper echelon of sampling for less than $3000.00. The S2800 is equipped with 2 MB of RAM (expandable to 16 MB), and four polyphonic outputs (stereo + 2 assignable). The S2800STUDIO is supplied with 8 MB of RAM, and adds both SCSI and Digital I/O interfaces, so you're ready for connection to mass storage devices, CD-ROM, computers, and digital audio sources.

Moving up to the next level, the S3000 sports ten outputs (stereo + 8 assignable), and is supplied with 8 MB of RAM (expandable to 32 MB), SCSI, and Digital I/O. Options include a 105 MB internal hard disk and SMPTE time code I/O for creating cue lists.

The flagship S3200 comes equipped same as the S3000 while adding the SMPTE interface as standard, multi-mode filtering, stereo reverb, and stereo direct to disk recording. In place of the optional internal hard disk, a 3.5" magneto optical disk drive may be installed. Never before has there been a sampler like this!

Visit your nearest Akai dealer soon for a demo of Akai's latest triumph of innovation, the new S-series.

AKAI
professional

1316 E. Lancaster P.O. Box 2344
Ft. Worth, TX 76113 817-336-5114
Fax: 817-870-1271

S3200 model shown with optional MO disk drive

WHAT'S NEW

▲ YAMAHA QY20

Following the success of its palmtop QY10, Yamaha introduced the QY20 Music Sequencer ($599), which features a new user interface with an 8-line, graphic LCD. The 32-note polyphonic, 16-part multitimbral device includes 100 AWM sounds and eight drum kits, stored in 2 MB of ROM.

The 8-track sequencer includes four regular tracks that can be used with the QY20's 2-octave, polyphonic micro-keyboard or an external MIDI instrument. It offers 100 preset patterns and records up to 100 user patterns (up to twenty songs and 28,000 notes), in real time or step time, with 96 ppqn resolution. An Edit Insert mode lets you add notes, Program Changes, and common controller messages such as Sustain, Pitch Bend, Modulation, Pan, Expression, and Volume anywhere in the pattern. You also can modify note duration, pitch, gate time, and Velocity. Four additional accompaniment tracks use Yamaha's auto-accompaniment system to provide a bass line and chords, drawing on a library of 25 preset chords. Yamaha Corp.; tel. (714) 522-9011; fax (714) 739-2680.

Circle #401 on Reader Service Card

▼ DISSIDENTS MIDI SAMPLE WRENCH

Dissidents announced version 2.0 of *MIDI Sample Wrench* ($299; upgrades $20), its 16-bit sample editor for the Commodore Amiga. Samples can be cut-and-paste edited, and you can draw waveforms freehand with the mouse. DSP features include fully parametric digital EQ, amplitude compression, FFT analysis, waveform mixing and crossfading, gain scaling, and sample-rate conversion. Other tools allow pitch-shifting without changing duration and time compression/expansion. The program permits up to 256 loops and 256 markers per waveform and offers a variety of looping tools, including a dedicated loop-splice window and several types of crossfade looping. Waveforms can be measured in terms of sample points, seconds, or SMPTE frames, with support for 24, 25, 30, and 30 drop-frame time code. A time offset can be applied to the waveform for referencing "fly-ins." *MIDI Sample Wrench* includes a frames/seconds/sample points conversion calculator. It supports a wide variety of samplers and file formats, including SMPL, AIFF, 8SVX, and *Sound Designer I*. It also supports the ARexx scripting language and is AmigaDOS 2.0-compatible. dissidents; tel. (315) 797-0343.

Circle #402 on Reader Service Card

▲ SAMSON AUDIO MPL 2242

Samson Audio introduced three mixers: the MPL 2242 ($1,129), MPL 1602 ($699), and MPL 1502 ($399). The MPL 2242 has ten mono channels with unbalanced, ¼-inch line inputs and six stereo channels with two unbalanced, ¼-inch inputs each. All 22 channels have 4-band, fixed EQ, six aux sends (one pre-fader, five post-fader), and four stereo aux returns. The mixer has four subgroups, PFL, and in-place soloing, all of which can be metered with the LED display. The unit has a rotating jackfield so it can serve as either a tabletop, or 9U rack-mount unit.

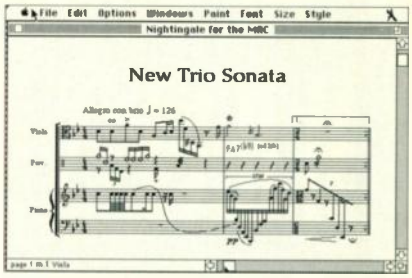
The 16-channel MPL 1602 uses the same basic electronics as the 2242, but with 3-band fixed EQ, three aux buses, and two subgroups. The 15-channel MPL 1502 has five XLR mic inputs and five ¼-inch, TRS stereo inputs. It has 3-band EQ, two aux sends with stereo returns, a peak overload indicator, and tape in/out. All three mixers have inserts on the XLR mic channels; ¼-inch, TRS, balanced master outputs; a bandwidth of 15 Hz to 30 kHz; and a S/N ratio of 128 dB. Samson Audio; tel. (516) 932-3810; fax (516) 932-3815.

Circle #403 on Reader Service Card

▶ TEMPORAL ACUITY PRODUCTS NIGHTINGALE

Temporal Acuity Products is distributing *Nightingale* ($495), a music-notation program for the Macintosh that lets you create scores of up to 64 staves, using up to 100 voices. Music can be input in real time (with or without strict meters and time signatures), or step time, from either a MIDI instrument, or the Mac keyboard and mouse. The program also can import and export Type 1 Standard MIDI Files. MIDI playback includes automatic page-turning, dynamics, tempo changes, and instrument assignments.

You can edit notes, text, tempos, and all performance information with custom control over the appearance and placement of the symbols. The program can automatically space notes, reformat and justify the score, align lyrics with the notes, and lay out pages. An unlimited number of pages can be open at one time. *Nightingale* supports any Mac-compatible printer, requires a Mac Plus or higher with 2



MB of RAM, and is System 7-compatible. Temporal Acuity Products; tel. (800) 426-2673 or (206) 462-1007; fax (206) 462-1057.

Circle #404 on Reader Service Card

▲ KAT POLEKAT

KAT is offering three new electronic percussion triggers. The poleKAT ($149) is shaped like a cylinder with two edge-like playing surfaces (which use force-sensing resistors) and is intended for triggering hi-hat, cymbal, and effects. The miniKICK ($169) is a bass-drum trigger that works with your regular kick-drum pedal. It can be used with either a single pedal or a double pedal. The KDT200 ($64.95) is an acoustic drum trigger with a built-in clip that locks onto the rim of the drum. According to KAT, this mounting design provides a positive connection to the head for an accurate trigger response. KAT, Inc.; tel. (413) 594-7466; fax (413) 592-7987.

Circle #405 on Reader Service Card

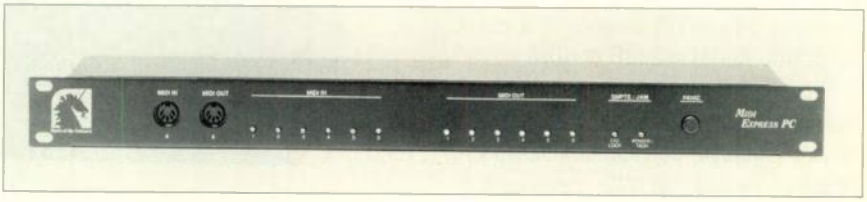
▼ MARK OF THE UNICORN MIDI EXPRESS

Mark of the Unicorn's MIDI Express ($349) and MIDI Express PC ($295) are multi-cable MIDI merger/patch bay/MIDI interfaces for the Mac and PC, respectively. The single-rackspace devices offer MIDI data-filtering, a SMPTE synchronizer with adjustable freewheeling, a front-panel Panic button, a click-to-MIDI converter, and a footswitch input. Control software is provided for both interfaces.

The Mac version has four independent MIDI In ports and six independent Outs, for 64 incoming and 96 outgoing channels. A 16-scene memory can be controlled from the front panel or the computer, as can the SMPTE-striping feature. The device has an internal power supply. Non-Mark of the Unicorn software (such as Opcode's *OMS*) can address the MIDI Express' multiple ports as if it were a MIDI Time Piece.

The Express PC has six MIDI Ins and six Outs and includes an ISA card that fits any 8- or 16-bit slot. It is powered from the PC. A *Windows MME* driver provides compatibility with a variety of software. Mark of the Unicorn; tel. (617) 576-2760; fax (617) 576-3609.

Circle #406 on Reader Service Card



▼ MARANTZ PMD740

Marantz Professional introduced the PMD740 ($949), a 4-track cassette recorder with 6-channel mixer. Channels 1 through 4 have XLR inputs with trim, unbalanced ¼-inch inputs, insert points, and 3-band EQ. The EQ has sweepable mids with bandwidth control. The other two channels have ¼-inch unbalanced inputs and high and low shelving EQ. Each channel has pan, one aux send, and a 60 mm volume fader. It also features a stereo pair of RCA aux line inputs, with level pot.

The master section includes a master fader and controls for the aux master send, the stereo aux returns, and two headphone mixes. Rotary pots provide a separate cue mix. The RCA line outputs are accompanied by RCA tape outs, the tape cue out, and sync I/O. All connectors are on the rear panel except the two headphone outputs and the Pause and Punch In/Out footswitch jacks.

The tape deck features Dolby HX Pro, which extends the high-frequency headroom, and defeatable dbx noise reduction. Channels can be assigned to tape tracks by direct assignment, or via the L/R bus. The transport operates at two speeds, with pitch control, and features autolocate with two memories. Four backlit, mechanical VU meters display track, cue, L/R master, and effects-bus levels. Marantz; tel. (708) 820-4800; fax (708) 820-8103.

Circle #407 on Reader Service Card

▶ INNOVATIVE QUALITY SOFTWARE SAW

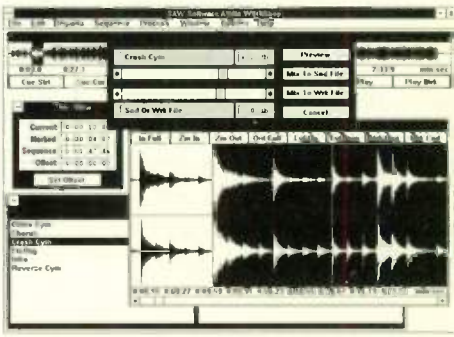
Innovative Quality Software is shipping its *Software Audio Workshop* (*SAW*; $599) 2-track, digital-audio recording and editing software for *Windows*. The program lets you nondestructively cut, copy, paste, and combine Regions from up to 40 different soundfiles at once. Its real-time digital-mixing preview lets you audition levels, mixes, and fades "on the fly" before saving the file. The program provides four virtual tracks, which allow simultaneous real-time mixing of up to four sequence playlists.

You can destructively process fades, volume, and balance changes in real time, but there is no EQ or time compression/expansion.

The user interface makes a lot of information available at once. A Full View window shows a complete soundfile in miniature at all times, and the SoundFile View window can zoom from a complete file to one sample per pixel. You can view and manipulate sorted Region lists and sequence playlists simultaneously.

SMPTE and MTC support are provided for chase-trigger and MIDI triggering of Regions and play sequences. The program currently requires Digital Audio Labs' CardD recording hardware. Support for other recording cards is planned. Innovative Quality Software; tel. (909) 695-1744; fax (909) 695-1747.

Circle #408 on Reader Service Card

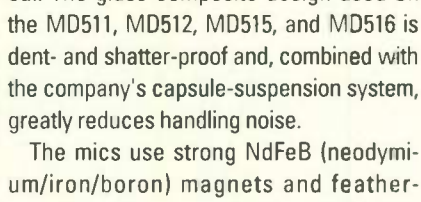


▼ BEYERDYNAMIC HEM 190 AND 191

Beyerdynamic is shipping two new gooseneck-mounted, headworn, electret-condenser mics. The HEM 190 ($619) has a cardioid polar pattern, and the HEM 191 ($619) is omnidirectional. The gooseneck mount is extremely thin and flexible for easy positioning.

Both mics come with headbands for mounting to Beyer DT 100 and DT 150 headphones or other headwear. Frequency response is rated at 20 Hz to 20 kHz. Beyerdynamic; tel. (516) 293-3200; fax (516) 293-3288.

Circle #409 on Reader Service Card



▲ SENNHEISER PROFORCE

Sennheiser is offering its new ProForce line of dynamic microphones, designed for live applications where feedback resistance at high volume is critical. The glass-composite design used on the MD511, MD512, MD515, and MD516 is dent- and shatter-proof and, combined with the company's capsule-suspension system, greatly reduces handling noise.

The mics use strong NdFeB (neodymium/iron/boron) magnets and featherweight membranes and voice coils, which is said to provide excellent bass response. The MD511 and MD512 ($149 and $169, respectively) have cardioid polar patterns and are well-suited to miking spread-out sound sources. The two models are identical except for the MD512's noiseless on/off switch.

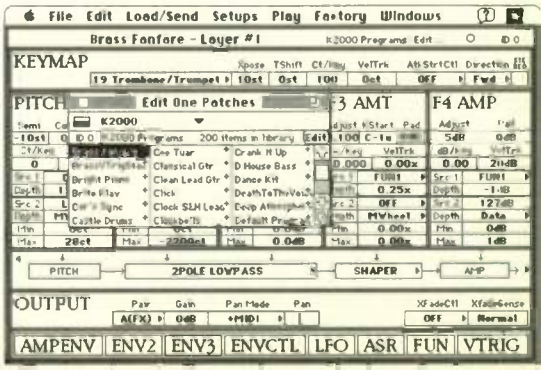
The MD515 and MD516 ($199 and $219, respectively) are supercardioid mics, but otherwise are identical to the MD511 and MD512. The only difference between the two supercardioids is the MD516's on/off switch. The ProForce line also includes the MD527 ($299), which uses all-metal construction and a triple-mesh inlet basket for maximum durability and moisture rejection. The MD527 offers a highly frequency-independent supercardioid polar pattern, providing excellent feedback rejection. Sennheiser; tel. (203) 434-9190; fax (203) 434-1759.

Circle #410 on Reader Service Card

▶ OPCODE SYSTEMS EDIT ONE

Opcode Systems is shipping *Edit One* ($149.95), an editor/librarian designed to control patches from a single MIDI device. Derived from Opcode's *Galaxy Plus Editors*, the new program is compatible with the same devices supported by the senior program. When first installing the program, you choose which device you wish to use; the master disk then permanently configures itself for that device. *Edit One* requires a Mac Plus or better with 1 MB of RAM, is System 7-compatible, and supports *OMS*. Opcode Systems; tel. (415) 856-3333; fax (415) 856-3332.

Circle #411 on Reader Service Card



▶ JBL 4400A SERIES

JBL Professional announced three new studio monitors. The 2-way 4408A ($650/pr.) features an 8-inch woofer and is recommended for small rooms. The 3-way 4410A ($900/pr.) has a 10-inch woofer and is designed as a vertical line array; the manufacturer claims outstanding transient response and spatial detail.

The 4412A ($1,350/pr.) is a 3-way system with 12-inch woofer and is designed for maximum low-frequency response. A new titanium-dome tweeter is said to deliver smoother, clearer highs than previous models. The tweeters are oriented to create "left" and "right" models for mirror-imaged speaker pairs. Frequency response is rated at 50 Hz to 20 kHz (±2 dB) for the 4408A and 45 Hz to 20 kHz for the 4410A and 4412A. JBL Professional; tel. (818) 893-8411; fax (818) 893-3639.

Circle #412 on Reader Service Card

▼ DIGITECH TSR-24

DigiTech unveiled the TSR-24 ($800), a programmable, expandable, digital effects processor. The 1U rackmount device offers true stereo processing and four discrete outputs and provides such effects as reverb, pitch-shifting, delay, flanging, chorusing, phasing, and parametric and graphic EQ. The device also offers sampling with editable start/stop points and multiple samples. It is based on the company's proprietary S-DISC system, which lets you create an unlimited number of custom effects configurations, with effects located at any point in each chain (including redundant effects). An onboard MIDI processor provides input filtering and MIDI continuous control over all effects parameters. The TSR-24 can be expanded with either of two optional parallel processing cards. The PPC-100 card contains an S-DISC chip and adds 64 KB of dynamic RAM, doubling the memory and processing power of the TSR-24. The PPC-200 is similar to the PPC-100, but has 256 KB of RAM. DigiTech/DOD; tel. (801) 268-8400; fax (801) 262-4966.

Circle #413 on Reader Service Card

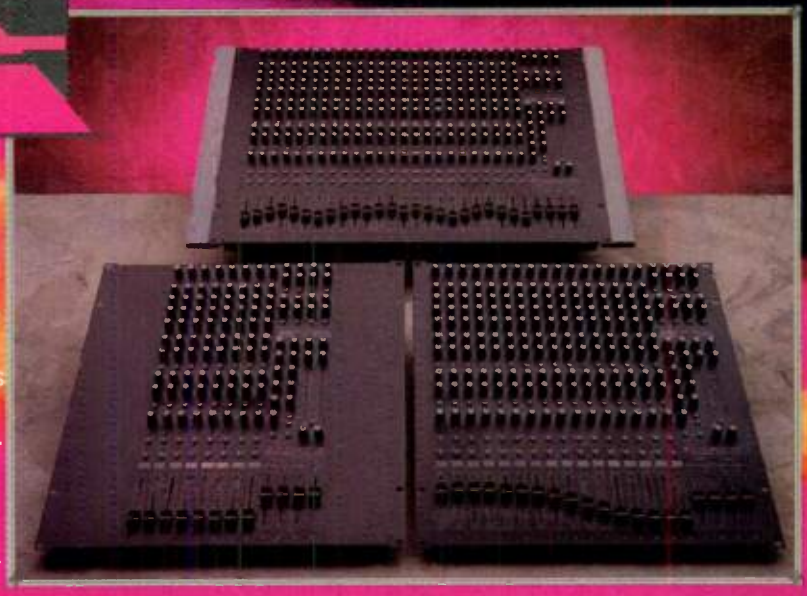
▶ TASCAM PORTA 07

Tascam is shipping the Porta 07 4-track cassette ministudio ($449). The unit features unbalanced, ¼-inch mic/line inputs with trim sliders on channels 1 and 2 and unbalanced, ¼-inch line inputs on channels 3 and 4. All channels have 2-band EQ (fixed at 10 kHz and 100 Hz), pan, and one aux send. The master section includes a level pot for the stereo returns, and faders provide channel level control. Rotary pots control the tape-cue mix, and the monitors can be switched between the cue mix, effects bus, and main L/R bus.

The deck features pitch control (±12%), a punch in/out jack, return-to-zero, and defeatable dbx II noise reduction. Channels are directly assigned to tracks, and you can record on up to two tracks at a time. LED level meters display either tape tracks, or the main L/R bus. The frequency response is rated at 40 Hz to 16 kHz (±3 dB, dbx out), S/N ratio at 85 dB (dbx in), and THD 1% at 1 kHz. The transport operates at 3¾ ips. Tascam; tel. (213) 726-0303; fax (213) 727-7656. ●

Circle #414 on Reader Service Card

A.R.T. SHATTERS THE PRICE OF PROFESSIONAL MIXING TECHNOLOGY!!!



THE PHANTOM

PROFESSIONAL SERIES CONSOLE

Every once in a while a product comes to market that offers a brilliancy in design that seems beyond human engineering. The Phantom Series consoles offer the performance and features of mixing boards costing thousands of dollars more. They are rugged enough to take the pounding of steady live use. They are also so transparent and utterly free of noise that they are the first choice for precision multitrack recording! From a four track home studio to 32 channel digital, the Phantom consoles offer a level of performance that is inspiring. A.R.T. has taken the fidelity of world class recording mixers and made the technology available in a professional console that is as silent as its' name implies. Production unit will vary slightly from photo.

- 16/24/32 CHANNEL VERSIONS
- ULTRA LOW NOISE LINE AND XLR BALANCED MIC INPUTS
- 8 AUXES
- 8 DIRECT OUTPUTS
- 16 PATCH POINTS
- 4 SUBGROUPS
- OVER 20 MIX OUTPUTS
- COMPREHENSIVE 4-BAND EQUALIZATION
- PHANTOM POWER
- MAIN-SUB SELECTOR SWITCHES
- 8 CHANNEL DEDICATED TAPE RETURN SECTION
- BOTH PRE AND POST-FADE MONITOR AND AUX SENDS
- CLIPPING INDICATOR LIGHTS EACH CHANNEL
- FULL CHANNEL SOLOING
- FULL CHANNEL MUTING
- LONG TRAVEL SHIELDED FADERS
- SWITCHABLE OUTPUT METERING
- SWITCHABLE MONITOR METERING
- ISOLATED 2 TRACK MONITOR TAPE RETURN
- SEPARATE STEREO CONTROL ROOM OUTPUT
- ASSIGNABLE TALKBACK-MAIN, MONITOR, AUX.
- INDEPENDANT SOLO LEVEL
- SEPARATE HIGH POWERED HEADPHONE OUTPUT
- RUGGED ALL STEEL HEAVY DUTY CHASSIS
- SLEEK,WOOD END PANELS (OPTIONAL)
- LINEAR CAPACITIVE ULTRA LOW NOISE CIRCUITRY
- HIGH-HEADROOM INPUT PROCESSING
- ADVANCED INPUT/OUTPUT COMPARATIVE DESIGN PROVIDES EXTREMELY WIDE DYNAMIC RANGE
- SEALED BODY LOW NOISE POTS
- 100% R.F. SHIELDING VIA METAL ENCLOSURE
- HEAVY DUTY HARDCONTACT SWITCHES THROUGHOUT
- COMPUTER CONTROLLED PRECISION SOLDERING
- PRECISION AUTOMATED ASSEMBLY INSURES CONSISTENCY
- MIL-SPEC GLASS EPOXY CIRCUIT BOARDS
- HIGH FIDELITY EQUALIZATION CIRCUITS
- NEW DESIGN AND ASSEMBLY TECHNIQUES PROVIDE THE TRANSPARENCY OF CONSOLES COSTING THOUSANDS OF DOLLARS MORE.
- AUTOMATED ASSEMBLY AND COMPUTERIZED TESTING MAKE THE PRICE UNBELIEVABLY LOW.

ART

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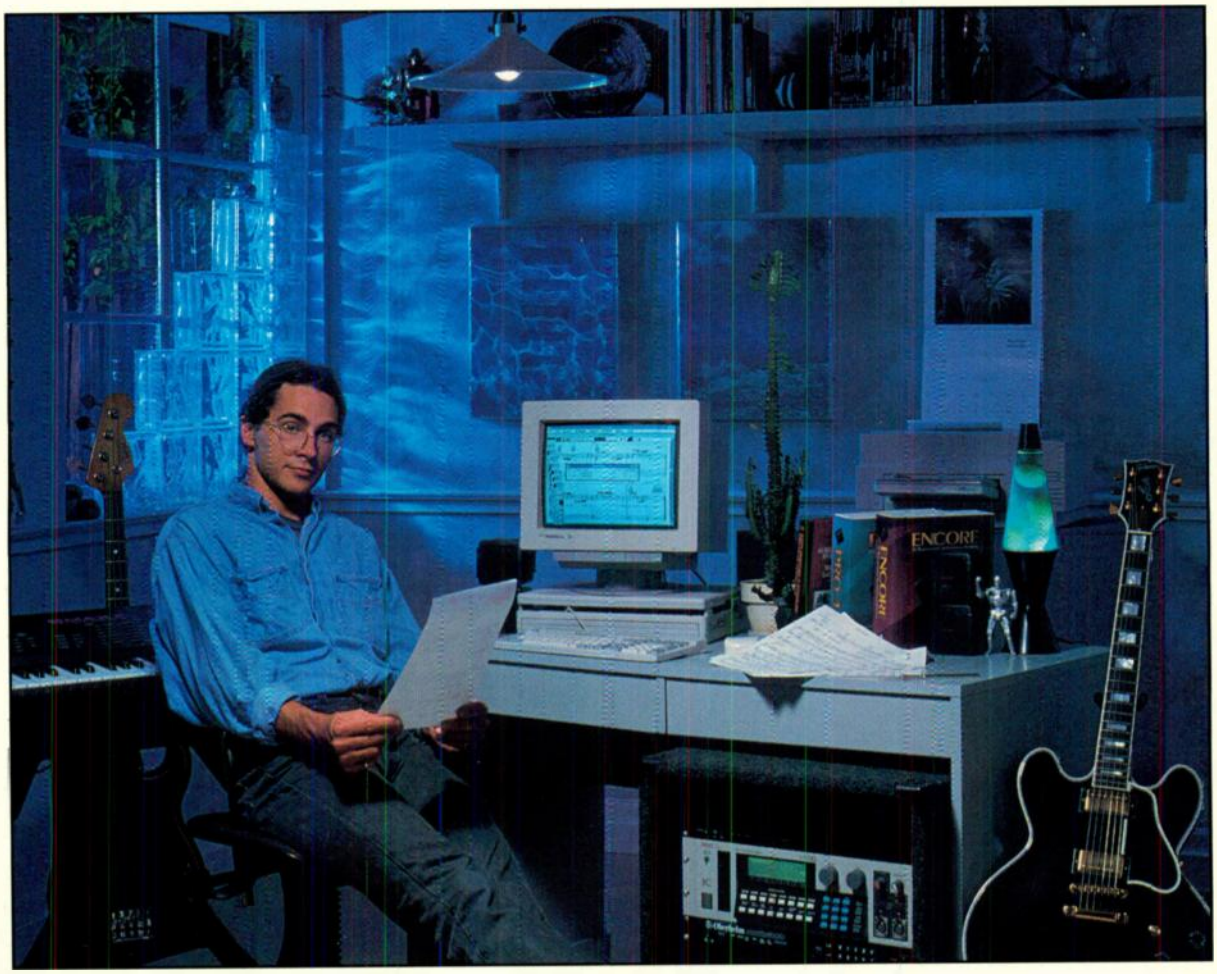

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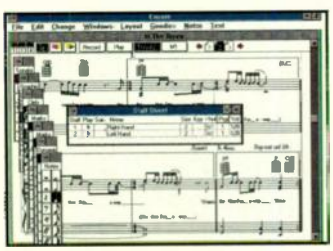

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By Larry "the O" Oppenheimer With Scott Wilkinson

The Digital Puzzle

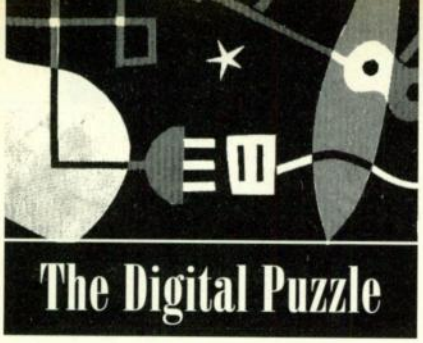
A digital audio interfacing primer.

We all hoped it would be like connecting the dots. After all, we're just trying to shuffle a bunch of ones and zeros around; what's so difficult about that? Now, besieged by error messages and ugly glitches, you feel more like a marine running an obstacle course in boot camp. And when the welcome relief of lunchtime finally comes, you find the blueplate special is the same as yesterday's: alphabet soup. In case you haven't figured it out, I'm talking about the process of sending digital audio between different devices without leaving the digital domain. To put it simply, making digital connections.

With analog signals, connecting equipment is a no-brainer. If you run into an interface problem, a simple adapter will normally do the trick. If things get really difficult, you might need a level-matching amplifier.

Unfortunately, hooking together two digital devices isn't so easy. You can't just use an adapter to transfer from a S/PDIF signal on an RCA connector to an AES/EBU XLR connector. The complex nature of a digital audio signal, multiple and overlapping

Illustration by Michael Bartalos



The Digital Puzzle

standards, and a variety of interfacing schemes sporting arcane acronyms have combined to turn simple out-to-in connections into a nightmare of frustrations and confusion.

LAYING THE GROUNDWORK

Most electronic musicians are familiar with the basic concept of digital audio. Sound waves are converted into an electrical signal by a microphone or pickup; synthesizers produce the electrical signal directly. This signal is a fairly accurate representation of the sound wave that varies smoothly in time and is therefore called an *analog* signal. An analog signal can be converted into digital form by measuring the instantaneous level of the signal many times per second and storing the resulting stream of numbers in computer memory. To reconvert the signal into analog form, simply reverse the process. (For more digital audio basics, see "The Legend of Digital Audio" in the October 1990 **EM**.)

Like analog, digital signals are usually transmitted electrically. However digital signals quickly jump between two distinct voltage values to represent a stream of binary numbers instead of smoothly varying in a manner analogous to the original sound wave, as analog signals do. Digital signals can also be transmitted optically over fiber-optic cables by pulsing a laser or photo-diode on and off.

To transmit a digital audio signal from one device to another in real time, designers of this equipment must address many software and hardware considerations. In terms of software, how many bits are used to represent each instantaneous level measurement? Is the digital data represented in a linear fashion, or is it data-reduced (i.e., digitally compressed)? How many channels of audio information are carried in the signal? What information besides audio data is conveyed? How is all this information formatted (arranged)?

On the hardware side, what kind of cables and connectors are used? What is the transmission rate? How are the electrical considerations of impedance and termination in cables addressed? What kind of coding is used to impose the information on an electrical signal? And perhaps most importantly, how is the datastream synchronized between devices? (For more on connections, see "Keeping it Digital: Digital Audio Interfacing" in the October 1990 **EM**.)

Thankfully, as an end-user, you generally don't need to worry about these questions because they are addressed by your equipment's digital audio transmission standard. Unfortunately, digital audio hasn't been around as long as analog, so there has been less time for real standards to emerge. In addition, manufacturers of digital audio gear often don't implement their chosen standard completely, or they develop a proprietary system that works only with their products. Consequently, you can run into some difficult situations. To help you through some of them, we've compiled a historical list of digital audio transmission standards (see the table "Summary of Formats" on p. 28).

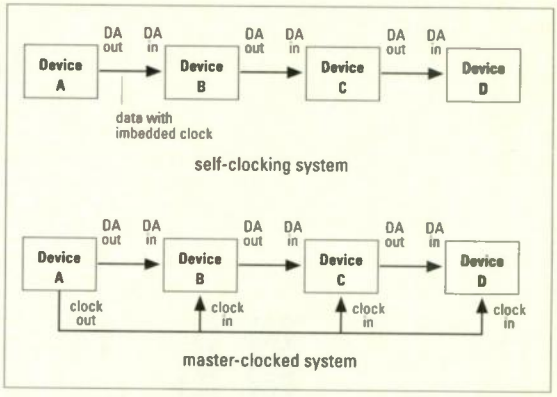


FIG. 1: In a self-clocking system (above), the clock signal is embedded in the digital audio (DA) data. In a master-clocked system (below), one device sends a separate clock signal to all other devices.

SYNCHRONIZATION AND FORMATTING

The most important concerns for digital audio interfacing are synchronization and formatting. In fact, from the user's point of view, the primary difference between connecting analog and digital signals is that digital signals require a timing reference, or clock, in addition to the audio. All digital audio devices have an internal clock that regulates the rate at which bits are transmitted and received. In any digital audio system, the clocks in all devices must be synchronized if the data is to be successfully transmitted from one device to another. Do not confuse this with time-code synchronization, such as SMPTE or MIDI Time Code, which operates at a much coarser resolution than digital-audio synchronization.

To synchronize all the clocks in a system, a clock signal must be distributed to all devices. This is analogous to a click track: All musicians play at the same tempo and agree on the location of the downbeat. The most common type of shared clock signal is called *word clock*. A word-clock signal is often a TTL (5-volt peak-to-peak) square wave at a frequency equal to the sample rate. Each cycle of the clock signal corresponds to one word of sample data.

There are two ways to distribute clock signals throughout a digital audio system. If you want to simply send digital audio data from one device to another, the easiest method is *self clocking*. In this process, the clock signal from the transmitter is embedded in the audio data. The receiver decodes the clock signal from the audio data and synchronizes its internal clock accordingly (see **Fig. 1** top). Self clocking is used in semi-pro and consumer equipment, as well as many professional products.

What if you want to send digital audio data from more than one source, perhaps through a digital mixer? How can the clocks from multiple sources be synchronized? In this scenario, a *master clock* must be used (see **Fig. 1** bottom). In a master-clocked system, the clock signal from one device is distributed to every other device, all of which must have a separate clock input and the ability to understand the master-clock signal. Until recently, master-clock systems were primarily implemented in manufacturers' proprietary schemes for interfacing their own products, but they are now gaining general acceptance.

For years, video houses have used a similar system called "house sync." In this type of setup, a sync signal, often a dummy video signal with no video information, is distributed throughout

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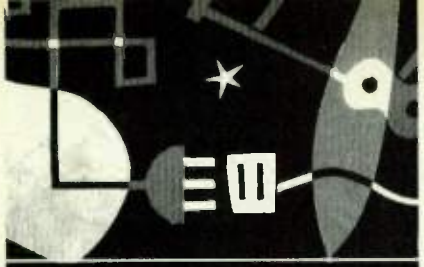

The Digital Puzzle

the facility. Similarly, a few large digital audio houses now use either SDIF2 word clock or video sync for master clocking.

Self-clocking systems work well, but they have several drawbacks. For one, each device regenerates its own internal clock based on the incoming clock signal. This process leads to a phenomenon called "jitter," which may result in data errors, or a poor-quality analog audio signal after D/A conversion. In fact, every time a digital audio signal passes through another device, the overall jitter can increase additively.

Additional concerns include proper termination to avoid reflections and waveform degradation due to cable capacitance. As a digital audio signal passes through a series of devices, errors from all these sources accumulate. In short, a self-clocking system with a large number of devices may suffer from a significant number of data errors.

As mentioned earlier, the biggest problem with self clocking is apparent in a system with more than one source. In this case, self clocking doesn't work at all. You must use a master-clock signal, or resort to sample-rate conversion, with its inherent difficulties.

Formatting presents an entirely different set of problems. Important issues include the number of bits per sample, whether the LSB (least-significant bit) or MSB (most-significant bit) is sent first, the use of status flags such as copy prohibition, the use of emphasis, whether the sending device is professional or consumer, and so on. Some devices send no status information, only audio sample data. Even when all other factors are compatible, if one aspect of the formatting is different between devices, there are bound to be problems.

Given all these difficulties, you may occasionally decide to hell with it, you'll just convert the digital signal into analog form, transmit it from one device to the next, and then convert it back into digital form. Of course, by doing this, you must run through multiple analog-to-digital (A/D) and digital-to-analog (D/A) converters, which will result in some amount of signal degradation. One of the main ideas behind digital audio is to eliminate degradation as the signal passes through multiple devices, something that can't be done with analog connections. Nevertheless, in some cases converting back to analog is the best way to go. For example, some devices use internal sample-rate converters to side-step clocking issues, which can lead to signal degradation. In these instances, analog transfer through high-quality converters is preferable.

AES/EBU AND S/PDIF

For most users of digital audio equipment, the most critical application is transmitting two "simultaneous" channels of data between devices. Finally, after years of evolution and a number

Summary of Formats

Name	Year	P/C	B/U/O	Conn	Clock	s/f length	Differences and Notes
TWO CHANNEL							
SDIF2	1981	P	U	(3) BNC	Mas	20/32	Channels not multiplexed
Melco (PD) Dub-C	1982	P	U	CB-25s	Mas	16/24	Channels not multiplexed
S/PDIF (CD)	1984	C	U	RCA	Self	24/64	Similar data format to AES3, except 12 16-bit status words & no pro/consumer flag bit
AES3-1985	1985	P	B	XLR	Self	24/64	24 8-bit status words
EBU 3250	1985	P	B	XLR	Self	24/64	Identical to AES3 except requires use of input transformers
CCIR 647	1986	P	B	XLR	Self	24/64	Identical to AES3; uses term "broadcast" in place of "professional"
EIAJ CP-340 Type I	1987	P	B	XLR	Self	24/64	Functionally identical to AES3; uses term "broadcast" in place of "professional"
EIAJ CP-340 Type II	1987	C	U	RCA	Self	24/64	Same as S/PDIF except for some differences in status bits; incorporates pro/consumer flag bit.
Yamaha Y1	1987	P	B	8-pin DIN	Mas	24/64	Same as Y2, but channel 2 data disregarded
Yamaha Y2 (Cascade)	1987	P	B	8-pin DIN	Mas	24/64	No status bits; data sent LSB first
IEC 958 Consumer	1989	C	U	RCA	Self	24/64	Identical to CP-340 Type II
IEC 958 Pro	1989	P	B	XLR	Self	24/64	Identical to CP-340 Type I; uses term "broadcast" in place of "professional"
MULTICHANNEL							
Sony	1981	P	B	D-sub	Mas	20/32	Multi-pin SDIF2, with each channel carried on a separate balanced line
Melco Dub-A/Dub-B	1982	P	B	D-sub	Mas	16/24	Essentially a balanced version of Dub-C, plus channel record status bits
Yamaha	1989	P	B	D-sub	Mas	24/64	Multi-pin Y2, with four pairs of channels on separate balanced lines
MADI	1991	P	U	BNC	Mas	24/2194	Carries 56 channels; data format nearly identical to AES3; uses 4-to-5 bit encoding
Alesis	1992	P	O	optical	Self	24/256	Proprietary 8-channel format
Tascam	1993	P	B/U	D-sub	Self/Mas	n/a	Proprietary 8-channel format

Key: P/C = professional/consumer; B/U/O = balanced, unbalanced, optical lines; conn = connector used; clock = self-clocking or master-clocked system; s/f length = subframe/frame length

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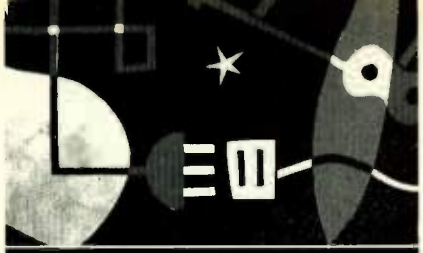

The Digital Puzzle

of different monikers (see sidebar, "The Long and Winding Road"), two similar 2-channel standards have emerged: AES/EBU for professional applications and S/PDIF for consumer devices. To be precise, "AES/EBU" is a misnomer because there is no document issued jointly by the Audio Engineering Society and the European Broadcasting Union. These two organizations have published separate, but essentially identical, specifications. However, the term "AES/EBU" is a common colloquialism.

As the most common professional standard, AES/EBU (actually titled "AES3-1985: Recommended Practice for Digital Audio Engineering—Serial Transmission Format for Linearly Represented Digital Audio Data") warrants some detailed explanation. The full name of this standard provides two important pieces of information about it. First, it is a serial transmission format because parallel formats require thick, ungainly cables. Second, it requires linear representation of audio data. (Since its 1985 publication, the AES3 standard was revised once in 1992. See sidebar, "The Long and Winding Road.")

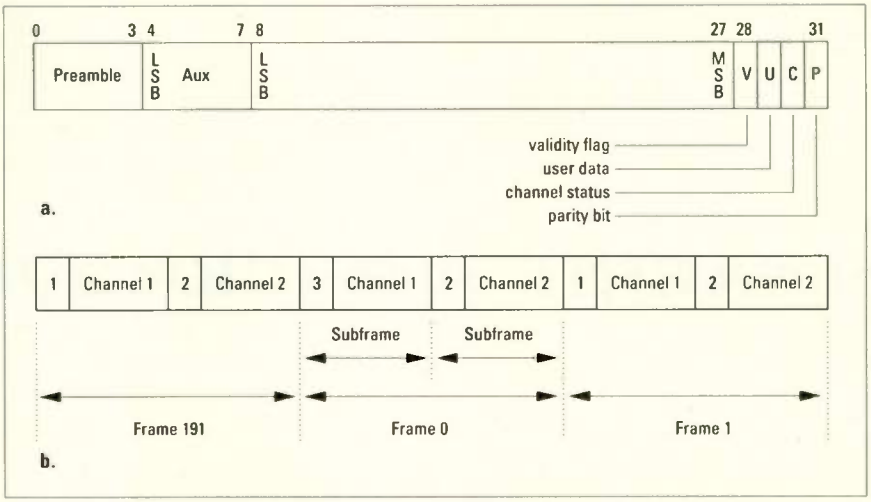

FIG. 2: Each subframe in AES/EBU (a) represents one audio channel and consists of 32 bits. The first four bits are called the preamble, followed by four bits used to accommodate larger sample resolutions. The next twenty bits include the basic sample from one channel, sent LSB first. The last four bits convey housekeeping information. Two subframes are combined into a full frame (b), and 192 frames are combined into a block. The start of each subframe, frame, and block is identified by the preamble.

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Among other electrical specifications, AES/EBU dictates the use of balanced lines up to 100 meters in length, no equalization, and regular 3-pin XLR connectors. Several manufacturers have implemented optical schemes to transmit AES/EBU-formatted data, although there is no provision for it in the AES3 specification.

The AES/EBU data transmission rate is 64 times the sampling rate, which must conform to an earlier recommended practice (called AES5-1984) of specifying preferred sample rates: 48 kHz for "professional" use, 44.1 kHz for "consumer," and 32 kHz for "broadcast." With a sample rate of 48 kHz, the AES/EBU data transmission rate is a whopping 3.072 megabits/second.

Each sample from each channel is packaged with a number of status, synchronization, and auxiliary bits into a "subframe" of 32 bits, with two subframes (one for each channel) making a "frame." Thus, a frame containing one sample from each of two audio channels has a total of 64 bits. When transmitted at 64 times the sampling rate, this means a sample from each channel is available for recording, processing, or digital-to-analog conversion during every sample period. Presto! Real-time transmission.

Now let's look at the formatting (see

THE LONG AND WINDING ROAD

In 1977, Sony introduced SDIF1 (Sony Digital Interface Format) on its first generation of digital audio processors (see Fig. A). Now long obsolete, it was a 2-channel, master-clocked system that transmitted sixteen bits of audio data per channel in parallel. When Sony released the second-generation PCM-1610 in 1981, SDIF2 was introduced. This system transmits data serially through three BNC connectors: one for left-channel audio data, one for right-channel, and one for word clock. At the same time, Sony introduced a multi-pin, balanced version of SDIF2, with a single clock line and 24 data lines, for its PCM-3324 digital multitrack recorder.

Around 1982, Mitsubishi implemented the Melco interfaces for its digital 2-track and multitrack machines, which used the ProDigital or PD recording format. The Melco interfaces, called "Dub-A," "Dub-B," and "Dub-C," are master-clock systems that carry each channel on its own data line, along with a separate clock line. Dub-A is still used by Otari in their PD machines, most notably the DTR900.

In the early 1980s, it became obvious that digital interfacing would be a substantive issue, so the Audio Engineering Society (AES) set up a working group in 1981 to define a standard recommended interface. Working closely with the European Broadcast Union (EBU) and the Society of Motion Picture and Television Engineers (SMPTE), the AES published its specification in 1985, calling it AES3-1985. The EBU simultaneously released a document (EBU 3250), which is identical to AES3-1985 except that it requires the use of transformers on the input and output to reject DC and common-mode interference; this was optional in the AES version.

As AES3 was being drafted, Sony and Philips were working on a proprietary specification that led to the Sony/Philips Digital Interface Format, known as S/PDIF. Of course, Sony and Philips were aware of the AES deliberations, and S/PDIF is almost identical to AES3; to be precise, they have a common ancestry because many Sony and Philips engineers were also involved with AES3. Other than the electrical and status bit differences mentioned in the article, the lack of a pro/consumer flag was the only other significant difference between the two formats.

In 1986 the DAT Conference was held in Japan. It included many manufacturers from around the

Fig. 2a). At the beginning of each subframe are four bits called the "preamble," which unambiguously designate the subframe type: 1, 2, or 3. The number "1" indicates the beginning of a subframe carrying data on channel 1, while "2" indicates a subframe carrying information on channel 2. The "3" designation indicates a channel-1 subframe that is also the beginning of a block (more on this in a moment).

AES3-1985 specifies twenty bits as the standard sample resolution, sent LSB first, although it provides four auxiliary bits immediately after the preamble that can be used for 24-bit sample resolution. (Unused bits are set to zero.) The last four bits in each subframe indicate the validity of the audio sample, user data, channel status, and subframe parity. Of these last four bits, the only one of crushing significance at the moment is the channel status bit.

A single status bit can't do anything more than indicate Yes/No or On/Off status for one parameter. But what if the status bits from a number of successive frames are compiled into a larger binary number? In AES3, channel status bits are accumulated from 192 successive frames, which are collectively called a "block" (see Fig. 2b). At the end of a block, there are 192 status bits for each channel, which are organized into 24 bytes of eight bits each. The collected channel status bits carry vital information such as a consumer/professional flag, channel emphasis flag, stereo/mono source material flag, use of auxiliary bits, channel status validity, and CRCC (cyclic redundancy check code) error correction.

S/PDIF hardware is different from AES/EBU in several ways, including unbalanced lines with RCA connectors, a much lower voltage level, and an optical specification in addition to the electrical one. (The electrical spec is sometimes called "coax" S/PDIF in reference to the use of coaxial cable.) These differences are comparatively trivial to overcome.

Although few in number, software conflicts are the primary point of contention. The real hurdle is the difference in the formatting of channel status bits. In S/PDIF, the 192 status bits are organized as twelve 16-bit words, which is totally incompatible with AES/EBU. Despite their similarities, reliable connections between AES/EBU devices and S/PDIF devices (or between any two different formats) can only be

world, and the Electronics Industries Association of Japan (EIAJ) acted as recording secretary. The members of the conference wanted to see AES3 adopted for professional use and

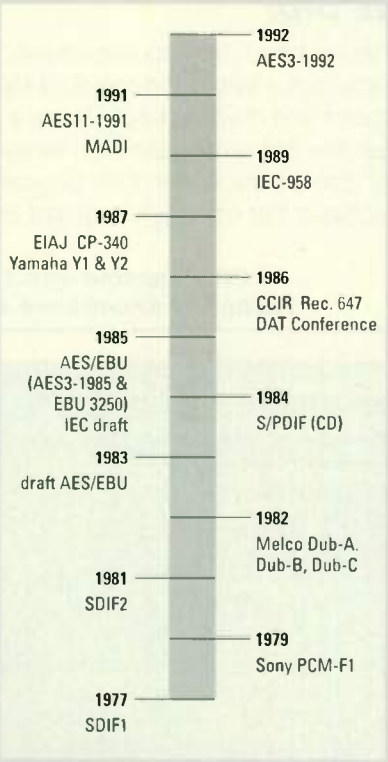

FIG. A: Evolution of the 2-channel digital audio interface.

S/PDIF for consumer products. In the end, the conference participants decided to adopt a version of S/PDIF for consumer use with one change: It shuffled the status bits to add the pro/consumer flag.

In 1987, EIAJ published its two final standards as EIAJ CP-340. This document specifies AES3 for professional use, calling it EIAJ CP-340 Type I. The DAT Conference standard, including an optical version in addition to the electrical spec, was adopted for consumer use and called EIAJ CP-340 Type II. From that point on, equipment said to have a "S/PDIF" interface is actually CP-340 Type II. In 1989, the International Electrotechnical Commission (IEC) adapted EIAJ CP-340 and published its own version, IEC 958.

After five years of development, one problem that remained in 1991 was synchronization. In response, AES issued a recommended practice for synchronization called AES11-1991, which suggests the use of a Digital Audio Reference Signal (DARS) as a master clock. This is similar to the house sync signal found in video production facilities; an AES3 signal is distributed, and any audio data is ignored.

By 1992, the AES had heard about the shortcomings of AES3. For example, users encountered problems when connecting devices with different partial implementations. Some manufacturers wanted to look "professional," so they implemented one or another of the consumer interfaces with XLR connectors on their equipment and called it "digital I/O," which was true, but misleading.

AES3-1985 never mandated the use of the pro/consumer flag, so it is impossible to provide a reliable dual solution that detects whether the source is pro or consumer and interprets the data accordingly. Other problems included misinterpretation of the standard, resulting in improper implementation, or insufficient engineering of the electrical specifications, especially with respect to multiple receivers and a single transmitter.

Consequently, the AES issued a revision to its standard, known as AES3-1992. The major points in this revision include requiring the use of the pro/consumer flag; recommending the use of AES11-1991; specifying three levels of implementation (minimum, standard, and enhanced), and requiring at least the minimum; modifying and clarifying the electrical specifications; and implementing new status codes for new applications.

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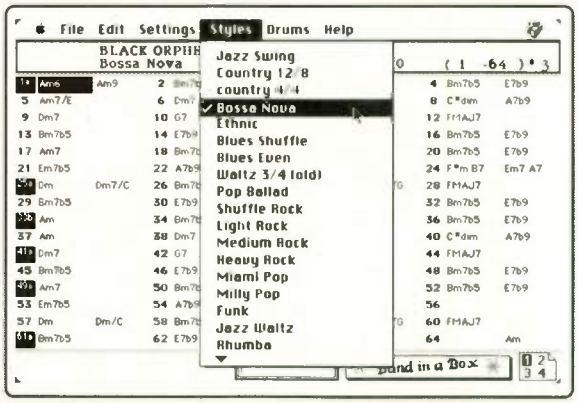

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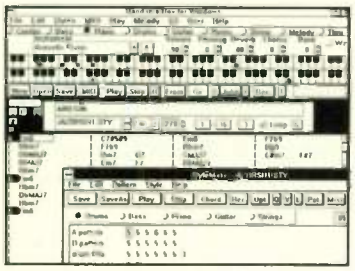

- *The "Wizard" (intelligent playalong features)*
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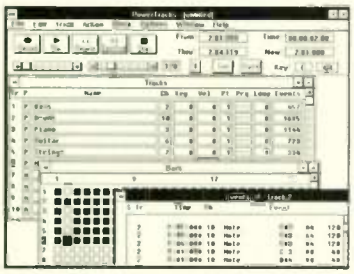

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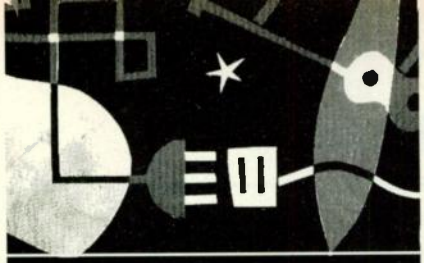

The Digital Puzzle

accomplished with a format conversion box (see sidebar, "Interformat Interfacing"). Without proper format conversion, the results of interfacing S/PDIF to AES/EBU can be unpredictable, and might include anything from audible glitches to not working at all.

MULTICHANNEL FORMATS

Multichannel digital audio formats have traditionally been proprietary for a particular manufacturer's equipment. Some of these formats (SDIF2, Melco/ProDigital, Yamaha) are often little more than balanced, multi-pin versions of one of the 2-channel formats. Recently, Alesis and Tascam joined the fray. The ADAT made Alesis a real player in the multitrack digital-recording market. The ADAT's digital interface multiplexes all eight channels of 16-bit audio and some user bits into a self-clocking datastream running at twice the rate of AES/EBU.

Tascam's DA-800 digital multitrack tape recorder uses multichannel SDIF2, but their recently announced DA-88 uses a proprietary interface that utilizes a 15-pin connector, balanced or unbalanced lines, and either self- or master-clocking. Alesis and Tascam will make format converters to translate between their formats and AES/EBU using multiple AES/EBU datastreams to convert all eight channels. (Tascam's converter will include S/PDIF capability, as well.)

The obvious question is: What about a multichannel version of the AES/EBU standard? As the 1980s drew to a close, it was evident that AES/EBU would be accepted, quickly leading to a demand for a multichannel version. Several large manufacturers, primarily Sony, SSL, Neve, and Mitsubishi, pooled their resources and devised the MADI (Multichannel Audio Digital Interface) spec. MADI is designed as a superset of AES/EBU in that it retains the subframe format of AES/EBU, but it runs at a fixed rate of 100 megabits/second, allowing up to 56 channels to be multiplexed onto the line.

Accommodating such a high transmission rate dictated some other differences between MADI and AES/EBU. The data is transmitted asynchronously (with no clock signal) over a video-style, 75Ω coaxial cable that uses BNC connectors. Synchronous operation for D/A conversion is accomplished using a separate line to carry an AES3 master clock signal, and an optical specification is still under discussion. The datastream is subjected to an encoding method known as "4-to-5 group coding." This method reduces the possibility of transmission errors from DC offsets, and makes it easy to "pad out" the datastream if all 56 channels are not being used. Finally, the first four of the 32 channel bits are assigned differently to provide additional synchronization and status information. To date, only a few manufacturers, notably Studer, Sony, and Neve, have introduced MADI-equipped devices.

In case you hadn't heard, nothing in life is easy. However, armed with the proper information and a clear understanding, many things are manageable, including digital audio interfacing.

Larry "the O" Oppenheimer *is amazed that he understands this stuff, given that he barely made it out of high school.*

INTERFORMAT INTERFACING

Do you need to interface professional digital gear with consumer products? Perhaps you want to connect your Yamaha digital mixer to your Lexicon digital processor. This may not be as easy as you think, even when transferring between devices that ostensibly have the same interface format. The problem here is that manufacturers sometimes fail to implement the entire AES/EBU or S/PDIF specification. A device with a partial implementation might not work well with another device that includes a different subset of the same spec.

Even with full implementation, the small matter of connecting devices that use different formats remains. As long as differences in electrical specifications, sample and/or transmission rates, status bits, and so on are common, it is evident that specialized devices are necessary to connect dissimilar digital audio interfaces.

Fortunately, there are a number of solutions available for converting between interface formats. Often, manufacturers using proprietary interfaces on their equipment make optional boxes to convert their format to others. For example, Yamaha makes the FMC1, FMC8, FMC9, IFU5A, and IFU5B for connecting and patching 2-channel and multichannel digital audio products from Yamaha to other manufacturers' equipment using AES/EBU, S/PDIF, SDIF2, and Melco formats.

Alesis recently released the AI-1 to convert two channels of audio between ADAT and AES/EBU; you need to use four of them to convert all eight channels. Tascam is offering two converters: the IF-88AE to convert between the DA-88 and four streams of AES/EBU or one stream of S/PDIF, and the IF-88SD to convert between the DA-88 and SDIF2.

There are several ways to interface the more standard 2-channel formats. One solution is a standalone box. Lexicon's LFI-10 and the Harmonia Mundi Acoustica bw102 (to my knowledge, the first commercially available format converter) are high-end, 2-channel format converters that go between AES/EBU, S/PDIF, and SDIF2, with numerous utility functions for dealing with the fine details. Audio & Design makes the ProBox 1, ProBox 3, and SmartBox for going between AES/EBU, SDIF2, and S/PDIF. Of particular note is NVision, which offers a wide variety of interfacing products, including format converters, AES/EBU routers, sync generators (master reference clocks), and more.

A less-powerful, but simpler (and cheaper) way to go is to take advantage of certain devices, such as the Lexicon 300, that have the ability to convert between different interface formats. Not every box with both AES/EBU and S/PDIF will perform this function, however, and you should be certain that the device in question properly implements both interfaces.

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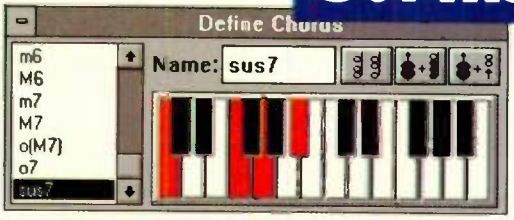

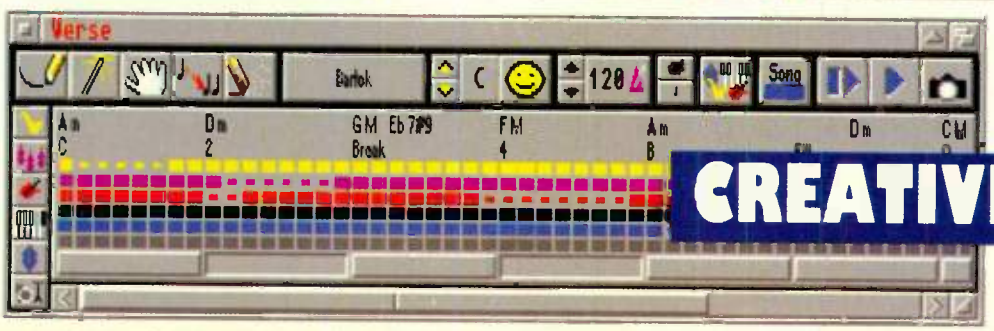

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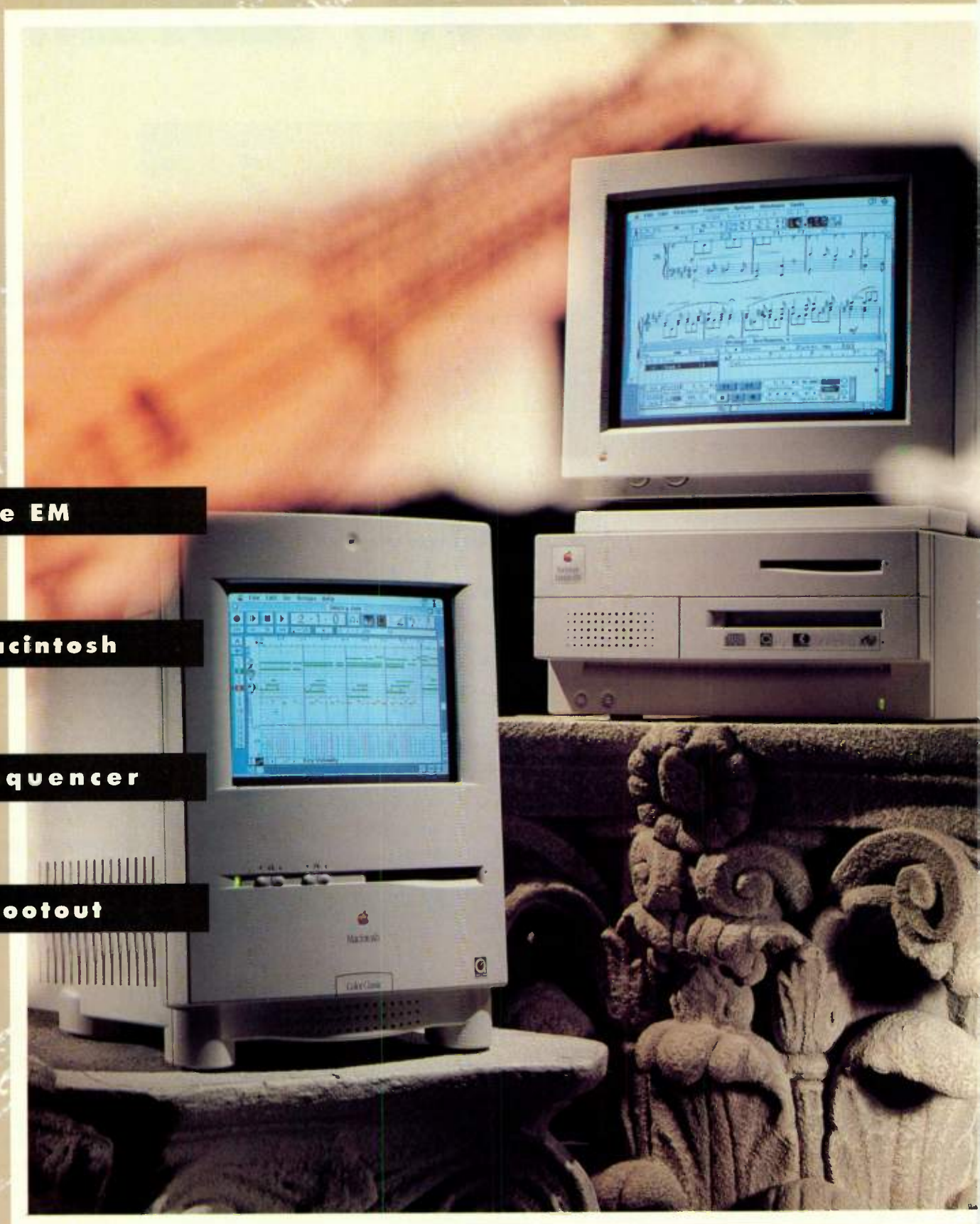


STATE-OF-THE-ART

Sequencing

Photograph by Stan Musilek

Life used to be simple. Ice cream was either vanilla or chocolate, and sequencing programs recorded the MIDI events you played, let you alter the notes with an edit list, and then spit them back on command. Period.

Today, low-fat Swiss-almond vanilla frozen yogurt with swirled-in Reese's Pieces is *de rigeur*, and sequencing programs have morphed into entire compositional environments, complete with sound storage and editing, music-notation editing and printing, digital audio recording and playback, tape-transport control, and automated mixing. Truthfully, there isn't much you *can't* do from the appropriately equipped sequencer.

Most of these developments occurred first on Macintosh sequencers. With a few exceptions, programs for the Mac have consistently blazed ahead of sequencers on other platforms. In fact, MIDI sequencing on the Macintosh is almost as old as MIDI itself. Pioneers such as Hayden Software's *MusicWorks MIDI*, Southworth Systems' *Total Music*, and Opcode's *MIDI Mac Sequencer* offered electronic musicians some of the first glimpses into the power of computer-based recording

By Christopher Yavelow

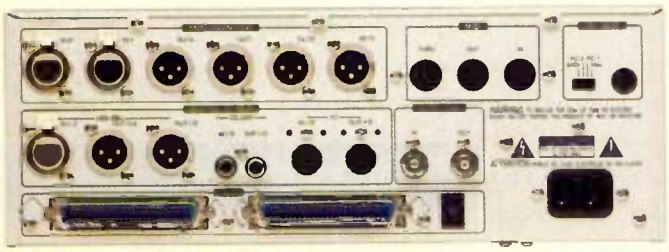
Since then, Mark of the Unicorn's *Performer*, Opcode's *Vision*, and Passport's *Pro 5 (Master Tracks Pro)* have battled for the hearts and dollars of musicians everywhere. They've

Digital Recording for Computers in the Real World.

If you're thinking about hard disk recording, you've probably heard that you'll need to buy a bigger, faster computer, with more slots and accelerators, that will end up costing you a whole bunch of money.

Until today!

The new Yamaha CBX-D5 Digital Recording Processor, developed in cooperation with premier hardware and software designers throughout the world, can be immediately interfaced with the most popular and affordable computers being used today. This impressive list includes Atari (ST, TT, and the new Falcon), Apple Macintosh (SE30, all II models, Quadras, and PowerBooks), IBM PS2, and even clones running Microsoft Windows 3.1.



detail of back panel

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

Cooperative design input from companies such as Mark of the Unicorn, DynaTek, and Steinberg made this all possible. The CBX-D5's modular format also provides a logical upgrade path with the ability to add more tracks, more storage, and more computing power without disrupting, scrapping, or obsoleting the rest of the system.

See the Yamaha CBX-D5 Digital Recording Processor in action at your local Yamaha Dealer or call 1-800-932-0001, extension 500 for more information.

YAMAHA

duked it out in the features department, as well, with one company delivering a knockout feature that was soon incorporated into the others' programs, and then another, and then another, in an ever-ascending spiral.

Today, cost-conscious semi-pros have a wide variety of impressive entry-level programs to choose from. And, in the pro market, the supremacy of the American-made Macintosh sequencer is being challenged by European imports.

Nine MIDI sequencers are shipping for the Macintosh. Differences in synchronization features, number of tracks, Standard MIDI File (SMF) compatibility, and event editing divide the choices into five professional-level programs—Steinberg's *Cubase*, Emagic's *Notator Logic*, Mark of the Unicorn's *Performer*, Passport's *Pro 5*, and Opcode's *Vision*—and four entry-level programs: Dynaware's *Ballade*, Opcode's *EZ Vision*, Freq Sound's *One-Step*, and Passport's *Trax*. There are even several shareware options, *MIDI Companion* and *MiniTrax*. More Mac sequencers are in the works, including *Multitude Pro*, from Canadian-based Oktal Software, and OSC's *Metro*, a direct descendant of Dr. T's *Beyond*.

Some entry-level sequencers are merely "junior" versions of professional sequencers offered by the same company. Opcode's *EZ Vision* has many of the same options as their *Vision*. Passport's *Trax* is their *Pro 5* professional-level sequencer with a restricted feature set.

If you're interested in incorporating hard-disk recording into your system, there are versions of *Cubase*, *Performer*, and *Vision* that support 16-bit, 44.1 kHz digital audio tracks (*Cubase Audio*, *Digital Performer*, and *Studio Vision*, respectively). Emagic has also announced *Logic Audio*, a digital audio version of *Notator Logic*. For lower-cost, lower-level multimedia work, Passport's *Audio Trax* supports 8-bit, 22 kHz digital audio tracks and offers the MIDI capabilities of *Trax*.

TOP-DOWN, BOTTOM-UP, AND IN BETWEEN

Sequencers typically take one of three approaches to the organization of MIDI data. Channel-oriented software often requires you to equate a MIDI channel with a track. Thus, sequences may contain sixteen tracks, one for each channel. Track-oriented software, on the other hand, lets you easily reassign output channels to tracks. Usually, you can set a track to play back on multiple channels, or separate tracks to play on the same channel.

Pattern-oriented software organizes a number of building blocks (called Sequences, Chunks, Parts, or SubSequences) within the context of a larger entity (a file, song, or arrangement) that specifies their playback order. In this case, the building blocks themselves consist of channel-oriented or track-oriented sequences. Fortunately, many sequencers now let you manipulate your music as channels, tracks, and patterns.

The interface for most channel- and track-oriented sequencers encourages you to work from the bottom upward, first dealing with the detailed level of individual events, then defining separate sequence objects you can combine into songs or higher-level constructs.

▼

The European sequencers take the top-down approach, and the American programs favor the bottom-up approach.

Conversely, pattern-oriented sequencers assume you are working from the highest level downward. In both instances, you first work at the track level to record data; but once that's done, pattern-oriented programs make it easy to define the building blocks of your composition. The European sequencers take the top-down approach, and the American programs favor the bottom-up approach.

RECORDING

Most sequencers provide more than one way to input MIDI data into a sequence. Real-time recording is typically accomplished by playing along with a definable metronome click (emanating from the Macintosh speaker or assigned to a MIDI note); however, *Cubase*, *One-Step*, *Performer*, and *Vision* provide a mechanism for recording without a click and later determining the beat lines. You'll find an option to record in Overdub, rather than Replace mode, in all except *Trax*. Automatic punch in and out is standard to all but *One-Step*, and drum machine-style Cycle or Loop options are common to all but *Ballade* and *Trax*. *Cubase* provides options to create a new "take" track with each successive cycle. Input filters of varying complexity are found in all but *EZ Vision* and *One-Step*.

Another input method is onscreen faders that can be assigned to many different types of MIDI data. Algorithmic generation of MIDI data is available in *Cubase*'s Interactive Phrase Synthesizer and, to a lesser extent, in *Vision*'s "generated" sequences and *Performer*'s Randomize command.

Importing and exporting Standard MIDI Files is as standard as the name implies. But *One-Step* can handle only Type 0 MIDI files (single-track, multichannel), rather than the much more popular Type 1 (multi-track, multichannel). *EZ Vision* and *Vision* can import Electronic Arts *DMCS (Deluxe Music Construction Set)* notation files, and *EZ Vision*, *Performer*, and *Vision* import Mark of the Unicorn's almost extinct *Professional Composer* file format.

DATA DISPLAY

The Macintosh's superior graphic capabilities have lead developers to seven types of data display. Most sequencers offer at least two of these, while some provide for any representation of your data. Zooming in and out is a standard function in graphic displays.

- **Event List.** An alphanumeric listing of all MIDI events, typically including start times, event parameters, and duration.
- **Piano roll.** A proportional matrix of pitch, where one axis is time and the other is note number (resembling a player-piano roll).
- **Graphic Controller Editing.** A proportional graph, or histogram of nonnote parameters (such as Velocity, Volume, Pan, etc.), where one axis is time and the other is the parameter value. Such charts use bar, scatter, line, and area displays common to spreadsheet software.
- **Overview.** A graphic timeline that

shows the density of musical events. Some overviews incorporate structural information (i.e., verse, refrain, etc.) while others merely show a zoomed-out version of the sequence illustrating where there are notes and where there is silence.

• **Patterns.** Icons, blocks, or other graphic symbols representing sequence objects, each of which denotes an entire musical passage or event.

• **Music notation.** *Ballade*, *Cubase*, *Notator Logic*, and *Performer* all provide editable notation displays that also let you print music. By the time you read this, Opcode will be offering notation in a new version of *EZ Vision* called *Musicshop*.

• **Drum.** A special hybrid display where one axis lists drum sounds and the other shows note attacks over time. *Ballade* and *Cubase* offer similar drum-track displays. Such tracks are insulated from transposition. (*Vision* and *Notator Logic* also provide mechanisms for insulating a track from transposition.)

EDITING

Most standard word-processor editing options—cut, copy, paste, insert, and clear or erase—have analogies in music and are fundamental to today's MIDI sequencers. Paste-merge is also universal in sequencers, and paste-repeat (*n*-times) is a useful musical variant missing only from *Ballade* and *Trax*. Paste-to-fill-region is found only in *Cubase*, *EZ Vision*, *One-Step*, *Pro 5*, and *Vision*.

An important measure of a sequencer is its variety of musically relevant editing operations. Many sequencers let you fit a Velocity curve to a series of notes to simulate a crescendo; but in non-sequenced music, crescendos still maintain the accent pattern of the prevailing meter. The only way to preserve this type of metrical feeling during a crescendo is to scale velocity values from a percentage of the original to a percentage of the final value. Otherwise you will simply have a series of notes that get louder and louder, with no relationship to the meter. *Trax* lacks this option.

Because MIDI data is merely a string of numbers, most sequencers allow you to apply typical mathematical operations to selected data types. Setting all events to a specified value, adding or subtracting a constant from a group of events, or scaling values by a percentage (i.e., multiplying) are child's play. Limiting values to a specified minimum or maximum (for compressor/limiter and normalization effects) can only be assumed in the professional-level sequencers, as can various forms of randomization ("Humanization").

Chromatic transposition simply adds numbers to pitch values, which is easy. Diatonic transposition to a particular scale is more musically useful, however. Unfortunately, it's not available in *EZ Vision*, *One-Step*, or *Trax*. The professional-level sequencers even offer transposition to custom pitch maps that can be saved for later recall. The most obvious use of this feature is to convert a drum track recorded on one machine to play back on another.

Most standard word-processor editing options—cut, copy, paste, insert, and clear or erase—have analogies in music and are fundamental to today's MIDI sequencers.

Before you can edit, you must be able to select what you want to edit. While *Ballade* and *EZ Vision* limit you to selecting a region delineated by bar lines, beats, and ticks, the other programs provide for selection criteria as a specified range of pitches, durations, velocities, or a combination. Selecting events based upon metric placement to add, for example, stress to the third beat of every measure is only available in *Cubase*, *Notator Logic*, *Pro 5*, and *Vision*. *Vision* and *Cubase* offer the most options of this kind, allowing you to specify only events that are preceded or followed by other specified events.

Quantization, which lets you align MIDI messages to a user-defined timing grid, is an area where the European sequencers differ radically from their professional-level American counterparts. American programs have settled on a variety of standard options, including the ability to quantize note attacks, releases, and durations with specified sensitivity, strength, offset, and swing.

In place of (or in addition to) some of these choices, the Europeans add the more powerful, but initially confusing, Groove Quantize, Match Quantize, and Analytic Quantize. Groove Quantize lets you adjust the timing of every note in a measure to create a certain feel, save that as a template, and then apply the groove to other material. In a similar way, Match Quantize allows you to apply the feel and accents of one part to another. Finally, Analytic Quantize is an intelligent quantizing option that can do things like quantize eighth notes and triplets in a single pass. These types of options, again, have a more global effect on the music as opposed to note-specific changes.

Another important difference is that with the exception of *Vision* and *EZ Vision*, all quantization in the American sequencers permanently alters the data. The European programs, on the other hand, favor non-destructive quantization that occurs only during playback, unless you intentionally Freeze or Normalize the result. Non-destructive quantization allows you much more flexibility if you to decide you need to change the rhythmic feel of your existing sequences a few months down the road.

VIRTUAL INSTRUMENTS

Virtual instruments are available in a wide variety of formats, all of which allow you to refer to sounds by name rather than number. In *Notator Logic*, *Performer*, and *Vision*, virtual instruments are named constructs that often consist of multiple channels or devices. You can designate a virtual instrument that is made up of, for example, channels 7 and 9 on a synthesizer attached to cable 3 of an interface connected to your modem port, plus channel 1 of the device attached to cable 7 of your printer-port interface. Assigning a track to that virtual instrument will send its MIDI data to all the component destinations, often with different velocity

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scaling, transposition, or panning settings for each device. *Notator Logic* adds a host of MIDI processing features to its virtual instrument definitions. *Vision* also offers MIDI processing if used in conjunction with *OMS* and a Studio 4 or Studio 5 MIDI interface.

ONSCREEN FADERS

Onscreen faders are present in most Macintosh sequencers, if only for manipulating MIDI Volume (Controller 7) to automate your final mixdown. Assigning faders or other virtual controllers to different MIDI messages adds considerable power to this concept. *Cubase, Notator Logic, Performer,* and *Vision* offer outstanding options in this regard. Although you can only move one onscreen fader at a time with your mouse, *Cubase, Notator Logic, Performer,* and *Vision* provide mechanisms to map hardware controllers, including MIDI fader boxes, to the virtual faders. *Cubase, Notator Logic,* and *Performer* allow you to group faders, set scaling factors between grouped faders, and invert one fader or fader group relative to another.

REMOTE CONTROLS

A common option lets you map your sequencer's transport controls to MIDI messages from a controller. *Ballade, Cubase, Performer, Pro 5,* and *Vision* have carried this idea to its logical conclusion, allowing you to trigger almost any sequencer function from a MIDI controller.

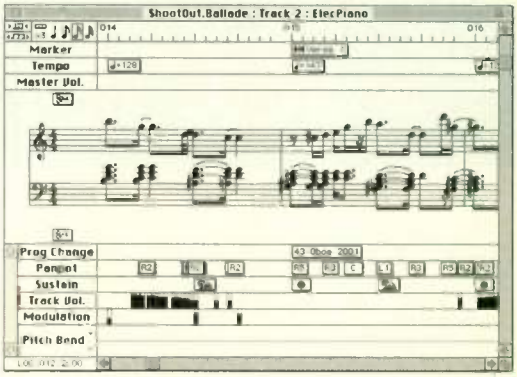

FIG. 1: Dynaware's *Ballade* lets you edit and print your music in standard notation.

PATCH NAMING AND LINKING

With the vast number of sounds available on newer electronic instruments, it has become common for sequencers to let you refer to patches by name, rather than number. To send a Program Change message, you select the desired sound from a pop-up list containing all the patch names for the current instrument. *EZ Vision* and *Vision* allow you to create dynamic links between sequencer tracks and patch lists resident in Opcode's *Galaxy* patch librarian and *Galaxy Plus Editors* universal editor/librarian. *Performer* provides this feature for Mark of the Unicorn's *UniSyn* universal editor/librarian (developed from Dr. T's *X-oR*). A related feature, available in several programs, lets you define names for individual notes. This is particularly useful for drum tracks and sound effects editing, where each note might trigger a different sound.

EM Macintosh Sequencer Shootout

Product/ Version	Tracks/ Maximum Channels	Max Clock Resolution/ Max Tuplet Definition	Quantization Types[1]	External Sync Options (including human triggered)	Editing Views[2]	Patches by Name/ Link to Librarian	Graphic Faders: Number/Assign Data Type/ Hardware Mappable	Virtual Instruments: Names & Destinations Only/ Set Playback Parameters
Ballade 1.05	16/32	48/3:2	I, A, B, D	MIDI, MTC	N, E, D	Y/N	16/N/N	Y/N
Cubase 2.5	64/512	384/3:2	I, N, A, B, D, C, S , F, M, G, P, E	MIDI, MTC, Human	E, P, G, N, C, O, D, S	N/N	1,024/Y/Y	Y/Y
Cubase Score 1.0	64/512	384/3:2	I, N, A, B, D, C, S, F, M, G, P, E	MIDI, MTC, Human	E, P, G, N, C, O, D, S	N/N	1,024/Y/Y	Y/Y
EZ Vision 1.0	16/32	480/3:2	N, A	MIDI	P, G, C, (N coming)	Y/Y	16/N/N	Y/Y
Notator Logic 1.2	UL/512	960/8:8	N, A, D, G, M, J, E, T	MIDI, MTC	E, P, G, N, C, O, D, S	Y/N	UL/Y/Y	Y/Y
One-Step 1.0	16/16	96/24:24	A, R, B, D, S, F, O, (P)	MIDI, MTC, Human	P, G	N/N	none/N/N	N/N
Performer 4.1	UL/512	480/99:99	I, A, R, B, D, C, S, F, O, J, P, (E)	MIDI, MTC, DTL, DTLe, Human	E, P, G, N, C, O, S	Y/Y	UL/Y/Y	Y/Y
Pro 5 5.2	64/256	240/16:16	I, A, B, S, F, O, J	MIDI, MTC	E, P, G, O, S	Y/N	64/N/N	Y/N
Trax 2.0	64/256	240/16:16	I, A, B, S, F, O	MIDI	P, O	Y/N	64/N/N	Y/N
Vision 1.4	98/512	480/99:99	I, N, A, R, D, S, F, O, J, P	MIDI, MTC, Human	E, P, G, S	Y/Y	32/Y/Y	Y/Y

KEY: () = partial implementation, 1) I = on input, N = on output (non-destructive), A = Attacks only, R = Releases only, B = Attacks with releases, D = Durations only, C = Deflam chords, S = Set sensitivity, F = Set strength, O = Set offset, J = Set swing, M = Match quantize, G = Groove quantize, P = Post determine beat lines, E = Analytic ("intelligent" — floating quantum value) quantize, T = max tuplet different than quantum unit, 2) E = Event list (alphanumeric), P = Piano roll, G = Graphic (controllers, etc.), N = Notation, C = Patterns or chunks, O = Overview, D = Drum, S = SysEx

PRINTING

The latest craze to hit the world of sequencing is score printing. More programs are starting to incorporate lead sheets and score-printing options that were once reserved to dedicated notation programs. If your notation needs are sophisticated, you'll probably still need a notation package, but for many users, the printing capabilities of sequencers will be plenty. *Ballade*, *Cubase Score*, Opcode's *Musicshop* (the notation-equipped version of *EZ Vision*), *Notator Logic*, and *Performer* let you view, edit and print notation to varying degrees.

To give you a better idea of how the various Mac sequencing programs compare, we've compiled a chart listing salient features across the top and product choices on the side (see above). In addition, the following capsule descriptions of each program highlight many of the important features.

BALLADE

The primary representation of MIDI data in Dynaware's *Ballade* is conventional music notation in its Score Editor window (see **Fig. 1**). The available recording options are real-time and step-time recording, playing an onscreen keyboard, or clicking notes on staves with the mouse. Real-time recording is also available in *Ballade*'s Mixer window.

Ballade's Score Editor forces you to work with a single track at a time, but you can select material on multiple tracks for certain editing operations. A grand staff view with assignable split-point is available for each track. The program provides a good deal of additional information while you view a staff. Global events appear at the top of the window, while events that affect only the current staff appear at the bottom. The latter includes a graphic display of controller data that you can quantize just as you would notes. Quantizing controller data automatically thins the event stream to your selected quantization value.

Ballade was designed to support General MIDI instruments such as Roland's CM-64, CM-32L, CM-32P, and MT-32, though you are not required to use them. Extra features are available if you have an instrument such as the SC-33, SC-55, and SC-155 (Sound Canvas series), JV-30, and JW-50, which conform to Roland's General MIDI-compatible GS Standard.

The Mixer window offers sixteen modules, each assigned to a track and MIDI channel. Volume and Pan faders can be recorded, and their movements are animated during playback. Unfortunately, you cannot assign these to hardware controllers. *Ballade* includes a powerful "snapshot" implementation that allows you to save and recall mixer

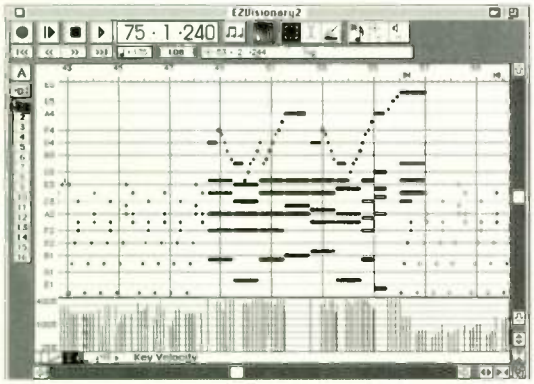

FIG. 2: The main window from Opcode's *EZ Vision* incorporates piano-roll editing and graphic controller editing.

Graphic Pattern Editing/Define Individual Playback Parameters	Graphic Controller Editing/ Real-Time Editing/ Conditional Editing	SysEx Editing/ Send SysEx during Playback	Looping: Region/ Track/ Sequence	Digital Audio Version	Special Features	EM Review	Copy Protection Type/Demo Version	Price
N/N	(Y)/(Y)/N	Y/N	N/N/Y	n/a	Optimized for GM & GS synthesizers; notation printing	March 1993	N/Y	$195
Y/Y	Y/Y/Y	Y/Y	Y/Y/Y	Cubase Audio ($799)	Patch editor, fader construction kit; interactive phrase synthesizer; MIDI Machine Control options	(Cubase Audio Dec. 1992)	Disk (Dongle for Audio)/Y	$499
Y/Y	Y/Y/Y	Y/Y	Y/Y/Y	Cubase Audio Score ($999)	All Cubase 2.5 features plus PostScript scoring	n/a	Dongle/N	$699
Y/N	Y/Y/Y	Y/Y	N/Y/Y	n/a	Color used to delineate data; integration with Galaxy and Galaxy Plus Editors	Sept. 1990	N/N	$149
Y/Y	Y/Y/Y	Y/Y	Y/Y/Y	Logic Audio ($999; to be shipped in May 1993)	MIDI processor construction set; notation printing; MIDI Machine Control options; online help	n/a	Dongle/N	$699
N/N	Y/N/Y	Y/Y	(Y)/(Y)/(Y)	n/a	Shading indicates velocity; tempo-stretchable bar lines	n/a	N/Y	$69
Y/N	Y/Y/Y	Y/Y	Y/Y/Y	Digital Performer ($895)	Patch editor, fader construction kit; elegant interface; notation printing; online help	March 1990 (Version 3.3)	Disk/N	$495
N/N	Y/Y/Y	Y/(Y)	N/Y/Y	n/a	Intuitive interface; velocity stems; window layering ("see through" windows)	March 1990 (Pro 4)	N/Y	$495
N/N	N/N/Y	N/N	Y/N/Y	Audio Trax (8-bit) ($199)	Intuitive interface	(*Audio Trax*, March 1992)	N/Y	$99
Y/Y	Y/Y/Y	Y/Y	N/Y/Y	Studio Vision ($995)	Integration with Galaxy and Galaxy Plus Editors; OMS support; generated sequences: nine virtual "players" available; online help	Aug. 1989 (Version 1.0; Studio Vision, Feb. 1991)	Disk/N (video available)	$495

settings. When you have a GS device assigned to a track, additional controls appear for Reverb (time) and Chorus (depth), allowing you to alter these parameters on the fly. Virtual LEDs display the MIDI activity on each track.

Ballade's nod to large-scale pattern editing is an option to save any region as a pattern for later recall and insertion anywhere in your score. The package includes a number of rhythmic patterns (preassigned to drum setups on devices supported by *Ballade*), as well as rudimentary melodic accompaniments. You can preview patterns in the Open File dialog box before you commit to placing them on a track.

The first sentence in *Ballade*'s manual is "Be prepared for fun." *Ballade*'s friendly floating-palette approach to user-interface items (assuring that tools and edit options don't get misplaced), coupled with the program's conventional music-notation display and strong support of GS and General MIDI, helps make learning MIDI sequencing enjoyable.

EZ VISION

As the name implies, *EZ Vision* is a "junior" version of Opcode's professional sequencer, *Vision* (see **Fig. 2**). Opcode recently released *Musicshop*, a version of *EZ Vision* that provides full notation display and editing. *EZ Vision* offers sixteen tracks and lets you assign any track to any MIDI channel. The program is fully compatible with *MIDI Manager* and provides an elegant interface for pattern-chaining.

Like *Vision*, *EZ Vision* provides a graphic interface for editing non-pitch data. Shift-clicking on tracks displays their data simultaneously, in different colors if you have a color Macintosh. An I-Beam tool lets you delineate data to cut or copy, and you can reshape, insert, or otherwise transform data with a Pencil tool.

The Pencil Tool lets you scale data by a percentage, add or subtract a constant, and set minimum or maximum limits. A Thin function is provided for Control Change data, Pitch Bend, and Aftertouch. Note durations can be extended or shortened with a sweep of the mouse using the Legato function. You can apply a variety of edit curves with the Pencil Tool, including straight lines, free lines, parabolic lines, flat lines (strictly horizontal), and randomization boxes.

EZ Vision supports Opcode's proprietary Publish and Subscribe (not to be confused with System 7's features of the same name). This lets you establish a link between *EZ Vision* and *Galaxy* or *Galaxy Plus Editors*.

Pattern editing in *EZ Vision* deserves a special commendation. Each file can include up to 25 sequences, all of which may be referred to either by name or by a letter from A to Y. The letter Z accesses the Arrangement Window, where you chain the 25 sequences in any combination, including repetitions. The A to Y sequence patterns can be dragged to any position with the mouse and copied by dragging with the option key pressed. You can change the length and time signature of any chunk in this window; in fact, it is the only place you can change meter. Double-clicking a sequence in this window opens its Edit window. An elegant touch is that the measure numbers of the current sequence are automatically offset to reflect its position in the context of the arrangement.

The Mixer window displays onscreen faders that record MIDI Volume (Controller 7) data, or scale the Velocity of the notes on their designated track. There are also Pan, Mute, and Solo controls although only Pan data is recorded. As in *Ballade*, you can take a snapshot of any fader setting. These snapshots can be inserted anywhere in any of the 25 sequences.

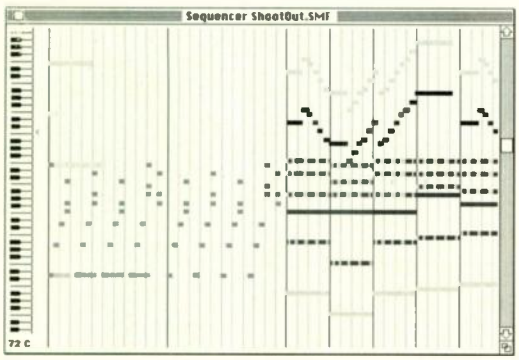

FIG. 3: Freq Sound's One-Step can display different tracks or velocities in different shades of gray.

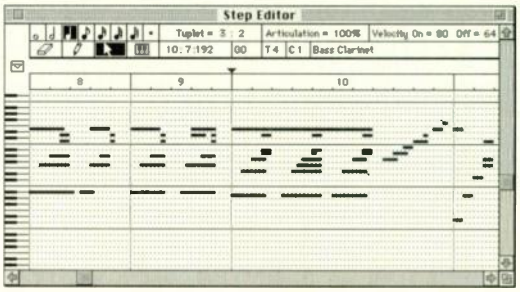

FIG. 4: The Step Editor in Passport's *Trax* offers a straightforward graphic interface for note editing.

ONE-STEP

Freq Sound's *One-Step* is a powerful sequencer that lacks some of the features that have become standard since the demise of its original developer, Southworth Systems. Noticeably absent are *MIDI Manager*-compatibility, dual serial-port support, importing and exporting type 1 SMFs, and pattern manipulation. SMPTE synchronization requires a JamBox, without which you must be content with SPP synchronization.

The main windows of *One-Step* and *EZ Vision* are similar (see **Fig. 3**). *One-Step* enhances the display of multiple tracks by highlighting the active input track with black bars, while the other tracks are gray. (With a color monitor, *One-Step* displays non-active tracks in different colors.) The program shades piano-roll note events to indicate loudness and lets you assign the maximum Velocity values to particular shades.

One-Step's interface to editing tempo is particularly innovative. A Grabber tool lets you grab beat or bar lines and drag them to new clock times (tempo adjustments are inserted automatically). In this manner, you can quickly align a beat to a particular note or time.

TRAX

Originally marketed as *Master Tracks Jr.*, Passport's *Trax* employs a user-interface that is almost identical to that of *Pro 5* (see **Fig. 4**). This interface is so well-designed that you can probably get up and running without reading the manual.

More than any of the other non-professional sequencers, it is easy to see *Trax* as simply the senior program with a lot of options removed. Missing from *Trax*, but present in *Pro 5*, are overdub record, loop record, multitrack recording, event list display, graphic display of controller data and tempo map, and time scaling. *Trax* also lacks *Pro 5*'s

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Change Filter (selection filter), simultaneous dual-port output, chase controllers, SMPTE/MTC synchronization, song chaining, virtual fader animation, and the ability to open multiple files. Unlike *Trax, Pro 5* features edit operations such as incrementing data smoothly by a percentage over time, setting minimum and maximum value limits, and humanization/randomization. Keeping these differences in mind, read the description of *Pro 5* for additional information about *Trax*.

AudioTrax, the recently discontinued digital audio version of *Trax*, can record and play back 8-bit digital sound files. *AudioTrax* will accept input from any 8-bit digitizer, including Macromedia's MacRecorder, Articulate Systems' Voice Impact and Voice Impact Pro, and the built-in microphone on newer Macintoshes. The program plays back via the Mac's sound chip.

CUBASE

Steinberg's *Cubase* was ported to the Macintosh from the Atari in 1990. Many of its features, while familiar to Atari users, represent a fresh way of looking at music on the Macintosh (see **Fig. 5**). *Cubase Audio* adds support for 16-bit digital audio tracks to *Cubase*, and *Cubase Score* adds notation to the package.

In addition to its MIDI sequencing functions, *Cubase* integrates a mixing console/patch editor construction kit, a conditional music-transformation editor (the Logical Editor), two algorithmic Interactive Phrase Synthesizers, a MIDI processor, a chord analyzer, a simple notation program, and more. This musical-toolkit approach makes some Macintosh sequencers seem like glorified event recorders.

Cubase makes practically no distinction between recording, editing, and playback modes. You can even open, close, and save files during playback without the music glitching.

Cubase, like its fellow European import, *Notator Logic*, takes a top-down approach to MIDI sequencing, in which you manipulate chunks of music as objects in the structural hierarchy of your composition. In ascending hierarchical order, *Cubase*'s objects include Parts (into which you record MIDI events), Ghost Parts (linked aliases), Tracks (made up of Parts and Ghost Parts), Groups (shared agglomerations of Parts and/or Ghost Parts), Group Parts (Groups that are used in an Arrangement as if it were a single Part), Group Tracks (Tracks that contains Group Parts), and Arrangements (up to 64 Tracks or Group Tracks in any combination). You can have up to sixteen Arrangements per Song file. The program's operation continually reminds you of the multidimensional structure of a work.

Unique playback settings can be assigned to each object. Parameters you can set on an individual basis include virtual instrument assignment, MIDI channel and cable, transposition, velocity scaling, delay, duration scaling (length), compression, Program Change, and MIDI Volume. In addition, each Part has an associated Parameter window that lets you filter Note-On, Poly Pressure, Control Changes, Program Change, Channel Aftertouch, and/or Pitch Bend.

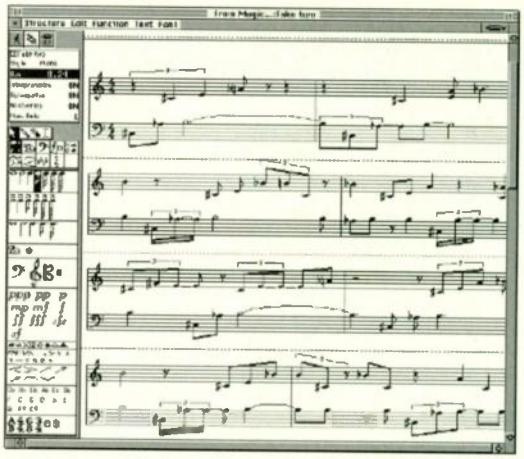

FIG. 6: Emagic's *Notator Logic*, the newest Mac sequencer, incorporates many sophisticated notation features.

At the event level, *Cubase* offers four graphic editors for displaying and manipulating your data: Key Edit (piano roll), Score Edit (music notation), Grid Edit (event list with graphics), and Drum Edit. While you are in any of these editors, pressing the escape key lets you undo all edits made since you first entered that particular editing window, a feature that fosters creative experimentation.

Cubase's MIDI Processor can simulate a number of popular digital signal-processing effects by transforming your MIDI data during playback. In this way you can add echo, chorus, and arpeggiation effects without a peripheral device. The MIDI processor accepts input from a MIDI controller, or you can route an existing track or tracks through it. The processor's output can be directed to any virtual instrument, track, MIDI channel, port, or cable, or back to another track.

The Mixer Editor lets you create virtual control panels for any MIDI device. As the name implies, you can also use it to build virtual fader consoles, or even full-blown patch editors. In this case, you could group your most frequently required functions from all your devices onto a single control panel and create a variety of master controls that operate on all your instruments at once.

Cubase provides two tantalizing Interactive Phrase Synthesizers (IPS) that can process or generate separate datastreams. Alternatively, you can link them together and double their power to create variations in real time. Output

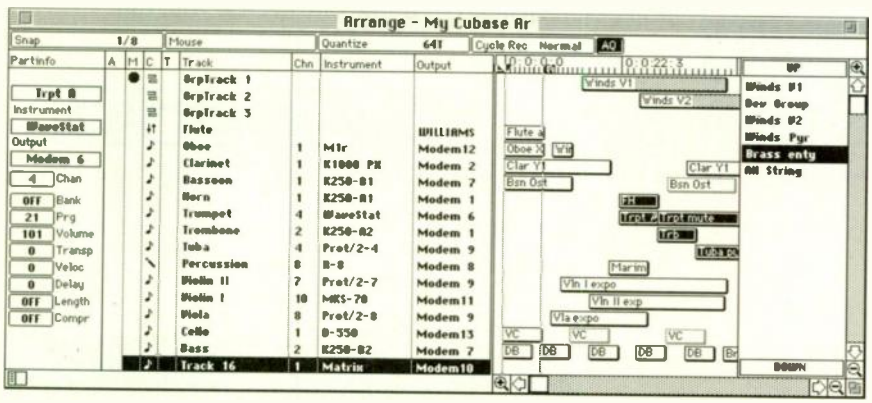

FIG. 5: German import *Cubase*, from Steinberg/Jones, offers powerful features for rearranging the structure of your music.

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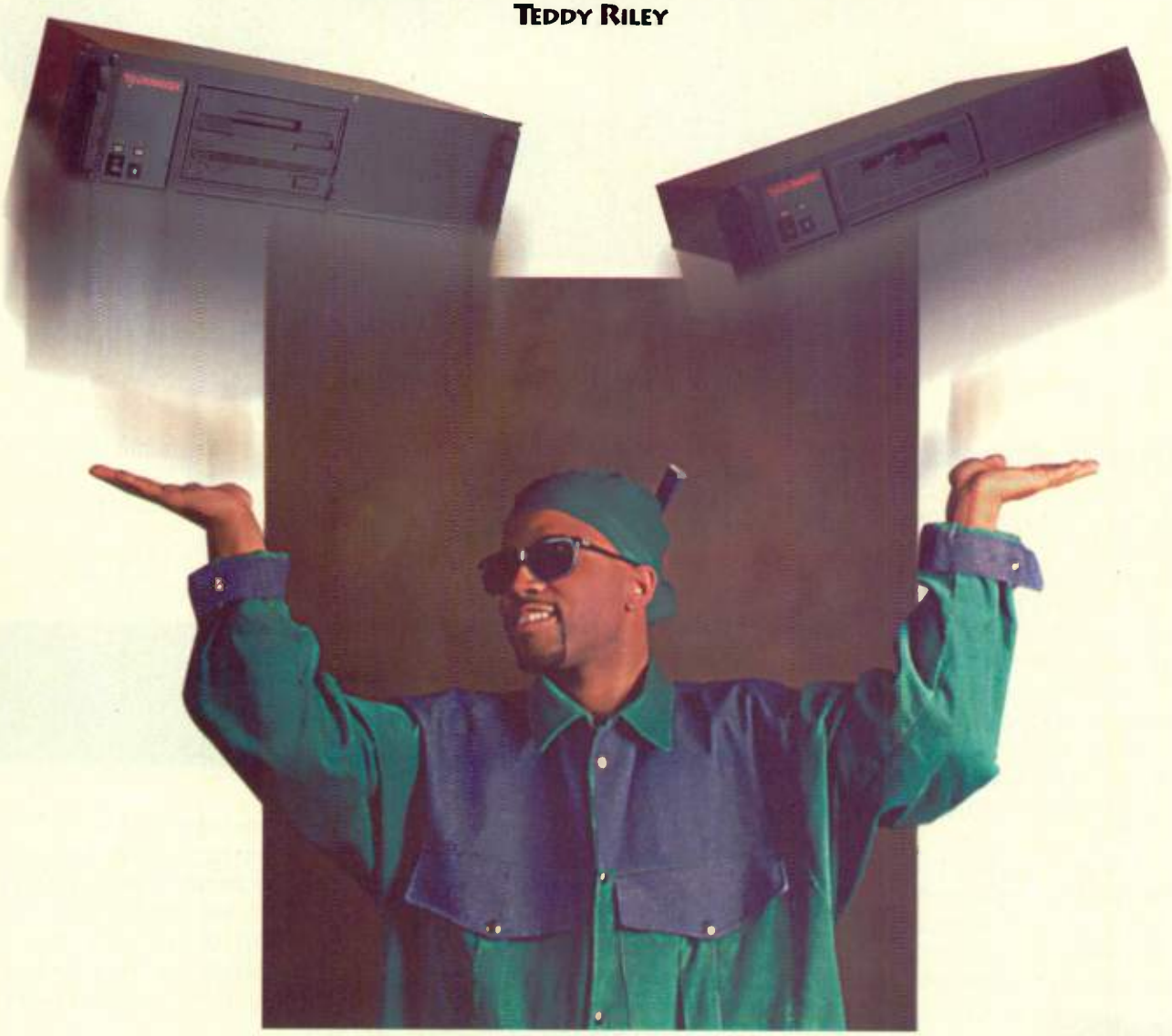

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of the IPS can be directed to a track or the MIDI interface. Input can originate from a MIDI controller, a sequencer track, or a library of Phrases you create and access with IPS.

Unlike other sequencing programs, *Cubase* has generated some third-party products. Notable among these is WC Music Research's *DNA*, a set of quantization templates created from the analysis of several professional drummers that take advantage of *Cubase*'s Groove Quantize option. You can load these templates into *Cubase*, apply them to any passage, and the resulting music sounds like it has been played by the drummer whose style was analyzed to create the template.

Cubase Score enhances the notation-editing capabilities that are already present in *Cubase* by adding additional symbols (some of which can affect playback), voice distribution, page formatting, chord symbols, block text, lyrics, and PostScript printing options.

NOTATOR LOGIC

Emagic's *Notator Logic* is one of the newest entries into the Macintosh sequencer market (see **Fig. 6**). Like *Cubase*, the other European import, *Notator Logic*'s top-down approach radically departs from what musicians have come to expect from American-made programs. The first sentence of the manual highlights this point: "*Notator Logic* creates a three-dimensional view of musical structures."

One important measure of a sequencer is its variety of musically relevant editing operations.

Your main work base is the Arrange window, within which you deal with sequences as individual objects, or grouped into folders. These two types of entities are placed on tracks. You can nest sequences and folders within folders to any depth, the third dimension of *Notator Logic*'s 3-D approach. At certain zoom levels, the Arrange window can display playback parameters associated with the objects it contains, or a bird's eye view of standard music notation.

Doubling-clicking on a folder object reveals any nested folders or sequence objects it contains, and double-clicking on a sequence object opens either a music-notation window, or an event-list view of its contents. Additional windows include Hyper Edit (a bar-graph, histogram-style display of any type of data) and Matrix Edit (*Notator Logic*'s term for the obligatory piano-roll display).

Notator Logic's Score windows are powerful and, in some instances, rival the features found in dedicated notation packages. Current versions of the program (1.1 and 1.2) lack some of the system and page-formatting features found in notation software, but version

1.5 is expected to address these concerns with global layout functions. Unfortunately, the program doesn't have a PostScript or TrueType music font, so printouts are bit-mapped, and slurs and ties are ugly. These shortcomings aside, *Notator Logic* employs a number of "intelligent" algorithms that usually display your MIDI data closer to way you want it than any dedicated notation program.

Notator Logic offers the highest resolution of any sequencer at 960 ppqn (version 1.1 of *Ballade* is also supposed to have this) and supports an unlimited number of tracks. Another powerful feature of the program is the ability to memorize up to 90 screen sets that you can instantly recall with the number keys. Screen sets contain the number, size, type, location, and zoom factor of each window; their horizontal and vertical scroll locations; the current top window; the object hierarchy level of each window; and whether the windows are linked to other windows and the current song position.

When a window is in Link mode, it instantly reflects changes made to the uppermost window, even in the background. A special Link mode, Show Same Level, assures that whatever data is being edited in the uppermost window will be displayed. For example, a single event-list window can switch its contents to any sequence object you click on in an Arrange window. Or you can have separate event-list windows auto-updating for each object. A Catch mode that you can toggle for individual windows keeps the specified windows at the current song position (similar to auto-scroll in other programs).

Notator Logic's Environment window gives credence to its claim to be an "object-oriented music environment." Here, you use virtual cables (as in *HookUp!*, *MAX*, and *Megalomania*) to interconnect processing modules, including channel splitters, arpeggiators, delay lines, voice limiters, chord memorizers, and data "transformers." You wire these together and to other objects, such as virtual instruments, mapped instruments, faders, click generators, and physical and virtual inputs and outputs. The Environment window lets you create sophisticated MIDI processors, mixers, virtual instruments, and environments optimized for live performance, as well as control over practically every aspect of MIDI data flow within the program and between the program and the outside world. Furthermore, it's easy and fun to operate.

PERFORMER

Mark of the Unicorn's *Performer* wins reader popularity polls in one publication or another year after year. The company has focused on elegance of user-interface, and the software's users have responded enthusiastically (see **Fig. 7**). Mark of the Unicorn also markets *Digital Performer*, a version that supports 16-bit digital audio recording.

Through *Performer*, Mark of the Unicorn has introduced a wide variety of features that other manufacturers have adopted, such as multitrack, multichannel recording; selection of discontiguous regions for editing; selection based on pitch range, durational range, and velocity range; options to affect incremental change from a percentage to a percentage over a specified time; chord quantization (Deflamming); Tap Tempo; and nested looping of any number of arbitrary regions per track, with boundaries assignable down to the tick level.

The scope of most *Performer* features is limited only by available RAM; the more RAM you have in your computer, the more tracks, sequences, songs, virtual instruments, and slider consoles you can define. Simultaneous display of multiple tracks in multiple edit views is also limited only by available RAM. All windows, or a specified subset, can synchronize their scrolling to playback.

A few of *Performer*'s features have yet to be adopted by their competitors, including Smart Quantize (optimized for converting data to notation) and curve-fitting options for changing data over a time-delineated region. To the linear and exponential curves found in other programs, *Performer* adds logarithmic and S-type curves.

The program lets you display data as an event list, piano-roll (including a graphic display of non-pitch data), and two notation windows, one that displays one editable track and another for printing any combination of tracks. If you have used Mark of the Unicorn's old *Professional Composer* notation software, you'll recognize the printout generated by the new score-printing options available in version 4.1. Like several other professional sequencers, *Performer* provides an Overview window along with its track list, but the *Cubase* and *Notator Logic* overviews are more powerful.

Sequence Chunking in *Performer* is intuitive. Unfortunately, many now-standard pattern-editing features are absent, including the ability to define individual playback settings for copies of the same Chunk, unlinking copies of Chunks for individual editing, and independent durations for duplicated Chunks. You can group Chunks into Songs that can be nested within other Songs.

Performer offers many other appealing features: online help, virtual instruments and patch lists, an extensive toolkit for virtual fader consoles, support for MOTU's Video Time Piece, and integration with the company's *Unisyn* universal patch editor/librarian.

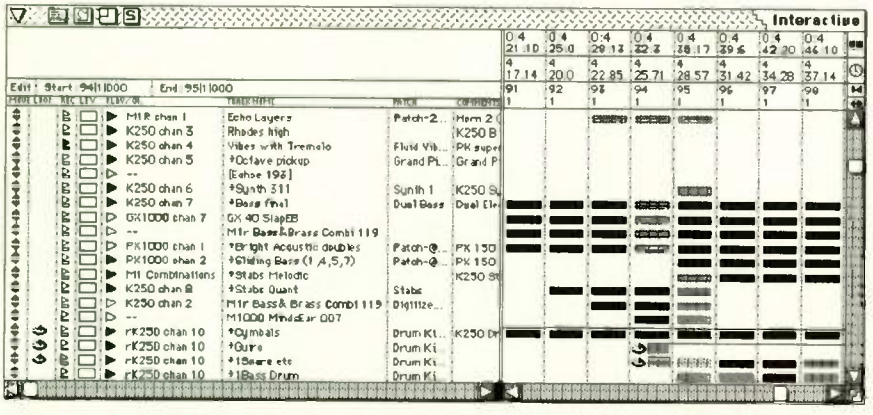

FIG. 7: The overview incorporated into the Track Window of Mark of the Unicorn's *Performer* shows off the program's unique interface.

PRO 5

Passport's *Pro 5* is the latest incarnation of the company's earlier *MasterTracks*, *MasterTracks Pro*, and *Pro 4*. Like its

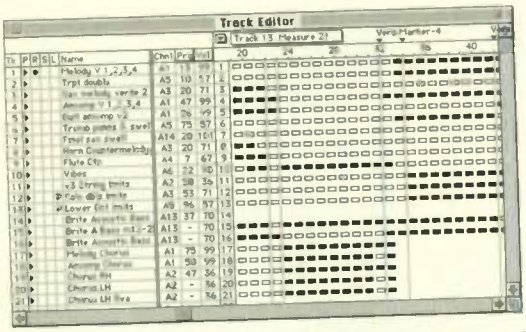

FIG. 8: Passport's *Pro 5* offers the most straightforward interface of any Mac sequencer.

junior sibling, *Trax*, *Pro 5* retains an ease-of-use that really suggests the term "user-friendly" (see Fig. 8).

Through *Pro 5* and its predecessors, Passport has continued to introduce ground-breaking features to the Macintosh music community. These include a track/measure-level overview, with some limited editing capabilities (the Track Editor, originally labeled the Song window); quantization on input; selection of regions based on meter; and keyboard remote-control functions that go beyond simple record, pause, rewind, and playback. Other helpful features include Velocity stems that graphically display the value of each note and an option to view a grayed-out display of note data behind its associated controller data.

In addition to the standard editing windows also found in *Trax* (*Trax*'s Track Sheet and Song Editor windows are combined into a single window in *Pro 5*), the program provides eight data displays for Pitch Bend, Channel Pressure, Key Pressure, Modulation, Continuous Controllers, Program Change, and Tempo. A Big Counter window is useful in studios where you have to view the Macintosh screen from a distance. A SysEx librarian window is also available. If you require notation, Passport markets *Encore* and *MusicTime* (a stripped-down version of *Encore*), both of which are based on the *Pro 5* sequencing engine.

Many of *Pro 5*'s dialog boxes include a Use Change Filter button. The Change Filter is a dialog box that lets you direct your editing to notes constrained by a user-definable range of pitch, duration, Velocity, MIDI channel, and rhythmic placement relative to the beat of the measure.

A few idiosyncrasies bear mentioning. When you cut or copy notes in the piano-roll display, notes whose endings cross bar lines that are not within the selected region are truncated; new notes are created from the portion that hung over the bar line.

The current version of *Pro 5* is limited with respect to song-chaining; it permits linear constructions only. When you create a Song Playlist, you give up synchronization options, and you cannot use the same sequence twice without saving two copies of it to disk. The only controls the Song Playlist offers are designed for live performance. You can initiate playback of the next song on the list after a specified number of seconds, when you press a key on your Macintosh keyboard, or upon receiving a specific MIDI note or controller.

VISION

Opcode's *Vision* has the longest history behind it (see Fig. 9). The program is the descendant of one of the first Macintosh sequencers, *MIDI Mac Sequencer* (1985).

The company's *Studio Vision*, which adds support for 16-bit digital audio tracks, was the first to incorporate MIDI sequencing with digital audio and is still the leading program in the category.

Like many of the sequencers mentioned, *Vision* has introduced many new ideas to the Macintosh music community, including transposition maps and virtual instruments that span multiple channels and cables. *Vision*'s virtual instruments can be set to silence other instruments, automatically reassign pitch according to a map you provide, ignore track or sequence transposition (very desirable for drum tracks), output to specified MIDI channels on a certain serial port or cable, scale velocity, and transpose. *Vision* is unique in letting you create Overflow instruments; when the polyphonic range of one device is exceeded, the additional notes "overflow" to a designated device.

Vision requires a system extension called *OMS* (the *Opcode MIDI System*), often erroneously thought to be a competitor or replacement for Apple's *MIDI Manager*. *OMS* handles program communication with the serial ports and also interfaces with the internal Macintosh timing clock. *OMS* can "learn" the names of all your devices, including their serial port and channel assignment, and "share" that information with *OMS*-compatible programs. If you are using a multi-cable interface, *OMS* manages your cable assignments. Compatible interfaces include Mark of the Unicorn's MIDI Time Piece, MIDI Time Piece II, or MIDI Express and Opcode's Studio 5 and Studio 4. The Opcode interfaces provide a wealth of additional features when used in conjunction with *OMS*.

Vision's main window displays up to 26 sequences. As with *EZ Vision*, each sequence is identified by a letter from A to Z and can have a unique name. The program offers two basic types of sequences, referred to as "normal" and "generated." (Generated sequences apply randomness to pitches, rhythms, or both.) You can create two other kinds of sequences. A Parts List consists of an ordered list of other sequences. A "captured" sequence contains a "recording" of the output of a Parts List, generated sequence, or sequences that you might trigger during a live performance.

Vision provides nine Players that you can think of as independent playback engines. By typing letters on the Macintosh keyboard, you can direct the associated sequences to any of these nine Players. Each Player has a sequence queue so if you continue typing sequence letters, you can end up with dozens of sequences playing simultaneously and others waiting in the wings. Two or more Players can play the same sequence starting at different times, so you can overlap playback of a sequence with itself. All of these functions can be triggered from a MIDI controller.

Editing *Vision*'s piano-roll display is straightforward, but there are some pleasant surprises. Foremost among these is the option to "stretch" selected regions by dragging the mouse. This either scales attacks and durations while retaining the existing tempo, or generates new tempo events to ensure that a region lasts a specific duration.

Like *EZ Vision*, *Vision* links to *Galaxy* or *Galaxy Plus Editors*. Once you have linked them, you can choose your patches by name from a pop-up menu, rather than having to remember program numbers. You can even edit patches while the sequence is playing.

Vision's Select by Rule is a powerful conditional-selection filter that lets you zoom in on data matching any combination of criteria you can imagine. You can include any editable parameter in your selection rule, as well as rhythmic placement relative to bar lines or beat lines. You can also designate that certain events appear before or after the events you want to select. You can use Boolean operators (AND, OR, NOT) in your selection rule, and these, in turn, can be "ANDed" together.

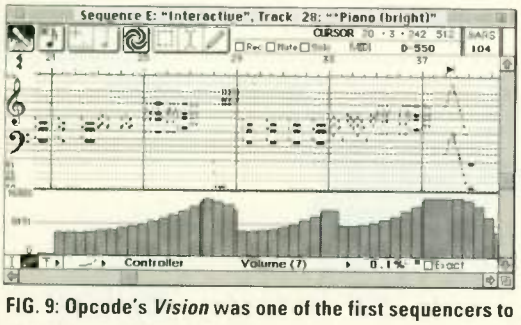

FIG. 9: Opcode's *Vision* was one of the first sequencers to include graphic note editing.

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CONCLUSIONS

Don't think you can simply count up the number of options offered by a sequencer and determine that one program is better than another. An informed judgment must be based on a variety of factors that are unique to each individual. Some musicians might base their decisions entirely upon copy-protection. None of the entry-level sequencers are copy-protected, but

continued on p. 130

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EM watches the production of a music video from behind the camera.

Illustration by Erik Adigard

AX ACCESS PASS

MAKING A MUSIC VIDEO

By Michael Molenda

So Disneyland is making a lot of noise about adding "Toon Town" to the Magic Kingdom. Big deal! Uncle Walt's ghost should visit a music video set. Now *that's* Toon Town.

Think about it. The average music-video production is a vortex of commerce and creativity swirling around a poor little song that was the product of some musician's inner demons. If that doesn't sound like the plot of a Tweety and Sylvester cartoon, I give up. And the keeper of order in this crazy fantasy world is the video director.

The director develops the treatment, or scenario, that translates a musical work into the visual montage you see on your favorite music video channel. It's no easy chore. The director's creative ideas are often funneled through a small army of creative and technical assistants, the musical artist, and the artist's record company

and management. A strong vision and careful diplomacy are essential to keeping the collaborators from turning into raging Tazmanian devils.

To give **EM** readers an insider's perspective on this roller coaster ride, we've researched the production of "She Got Me (when she got her dress on)." The band, Masters of Reality, is critically acclaimed, with a sound that evokes Cream for the 1990s. The director is Casey Niccoli, an award-winning video artist and self-described "risk" whose unique eye is not always suited to MTV fare. Can art and commerce co-exist in an industry dedicated to selling "units" (that's "records" to you and me)? Is it possible for musicians to maintain their dignity when employed as promotional tools? Can a serious visual artist remain uncompromised amidst the zipper cuts, big hair, and self-consciousness that defines current videology? All I can say is: Read on.

Niccoli's "Spanish soap opera" theme is amplified by her use of subtitles throughout the conceptual footage. The actors actually spoke their lines in Spanish.

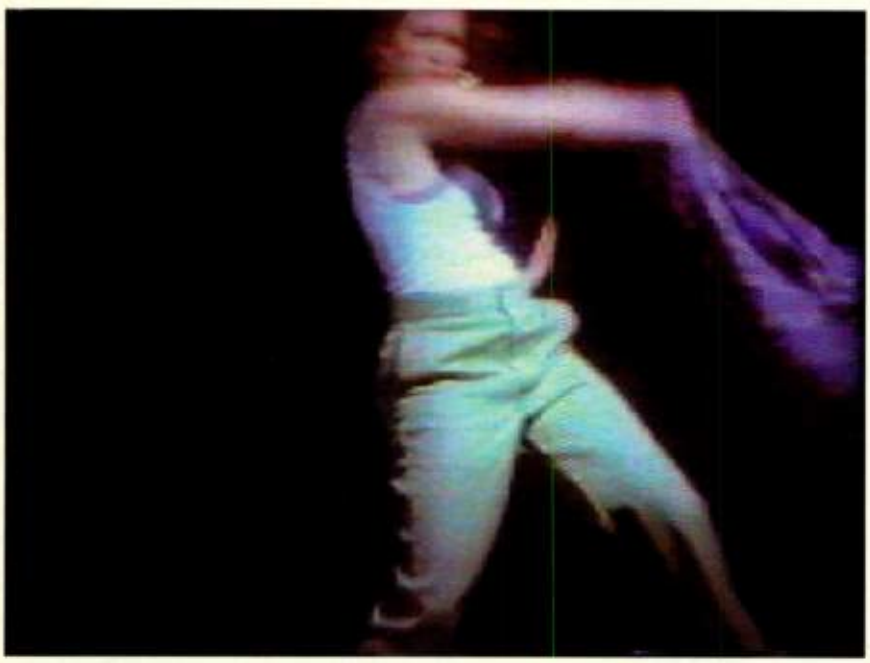
MEET THE DIRECTOR

Casey Niccoli is one of those lucky people who has found their personal Holy Grail. For her, the glittering chalice is the glow of a video monitor.

"I had never held a camera in my hands until I was asked to do a documentary for (ex-husband Perry Farrell's band) Jane's Addiction," says Niccoli. "It was basically a video record for the band's fans, so I rented a camcorder and did interviews with the musicians and shot some behind-the-scenes footage. The whole process really excited me. Before filmmaking, I have to admit I was never inspired to put 100 percent into anything I did. Video was a revelation. I had finally found something I was really good at. Now it's practically become my reason for being."

Niccoli's 28 minutes of documentary footage was included in a commercial video release for Jane's Addiction's "Mountain Song." (The original video production for the song contained nudity, which effectively scotched its airing on MTV.) Her actual debut as a music-video director was "Been Caught Stealing," which won Best Alternative Video for Jane's Addiction at the 1991 MTV awards. Since then, Niccoli has directed a feature film ("Gift" for Warner Brothers), a CBS television special on Yamaha's new music showcase, and a documentary on the 1991 Lollapalooza tour.

"I'm not a trained videomaker," she says. "I can't tell you how many times I've been told technical terms that I've just forgotten. However, I don't see my lack of technical knowledge as a limitation. The most important thing is a good idea. I have a vision, and the technical people are there to help me get that vision on film."



Niccoli's snap decision to costume the dancer (one of the "Fly Girls" from the television show *In Living Color*) in gang garb caused controversy on the set. She was supposed to wear a dress.

MEET THE BAND

Masters of Reality are not your typical video glamour pusses. They are three aging geezers with transcendent musical chops who write brilliant rock 'n' roll songs. The band features Chris Goss on vocals and guitar, Googe on bass, and the legendary Ginger Baker

on drums. (And yes, Goss is completely exhausted from telling unimaginative journalists what it's like to play with Baker.)

The album from which "She Got Me" hails, *Sunrise on the Sufferbus* (Chrysalis Records), is one of the most exciting productions I've heard this year. It's a wonderful potpourri of psychedelic lyricism, loud and nasty guitar licks, steamroller grooves, and humorous asides. But don't take my word for it. My neighbor Steffan Chirazi, who writes the "Raw Power" column for *BAM* magazine and freelances for the heavy metal rag *Kerrang*, called Masters of Reality "a god of music to be revered." Besides, you have to love a band that wrote the following message on its album's promotional copies: "To whom it may concern: We were asked by our record company to make a comment on this promo. Here it is: Listen."

THE TREATMENT

Just as most cinema productions are borne from screenplays, music videos use *treatments* as their foundations. When a record company decides to underwrite a promotional video for one of its releases, it sends a copy of the song to (hopefully) appropriate directors and solicits treatments. A treatment puts the visual concept of the proposed video into prose, so the band and record company can decide whether a director is right for their project. Unfortunately, the preliminary treatments received for "She Got Me" were pretty dismal.

▼

"She Got Me" was shot in one day with one 16 mm camera.

"Everything looked like 'Jeremy' (Pearl Jam's video about a disturbed and homicidal teen) with miniskirts," says Chris Goss. "The problem with people who do videos for a living is that you can't expect them to understand the band as well as the band understands itself. You just hope the director

has some empathy with the song and that the style matches the music. That's absolutely critical. We want to ensure that the public gets the vibe we want them to."

At this point, Niccoli was asked to develop a treatment, but it was an "11th hour" situation. She was given one day to deliver.

"Unfortunately, you don't get paid to write a treatment, so it kills you if you write a great story and don't get to film it," Niccoli says. "It's incredibly difficult to write something original and specific to a particular song, which is why I think there isn't much originality or heart in the video medium. When there's a chance your treatment might not get made, why bother pushing yourself so hard?"

Niccoli's concept revolves around what she calls a "Mexican soap opera." The opening scene shows an archetypal Latin lover flexing his muscles and basking in the glow of self-confidence. Then, a dancer (one of the "Fly Girls" from the hit show *In Living Color*) in tough, cholito garb appears. The conceptual footage revolves around the lover's attempts to seduce a woman who ultimately turns the tables on him, while subtitles display the verbal sparring.

When all hell breaks loose, even the band gets involved. A residency inside the television set offers no sanctuary from the flying objects tossed around the apartment during the lovers' spat.

Throughout the video, the band is seen in black and white performance footage and reaction shots. Niccoli adds a surreal quality by having the band pop up inside the apartment TV set.

"I was really inspired by the song," says Niccoli. "It's real short (2:48, to be exact), so I listened to it a few times and developed the first layer of the Mexican soap opera concept. The subtitle idea was something I had wanted to do for a long time, and because I had to finish the treatment overnight, I decided to use it. I also decided not to follow the lyrics of the song because I like to do things that are fresh and unique. Sometimes this is a problem. I naïvely think I'm being hired to be an artist, but most record companies could give a shit (about innovation); they just want the product out. So I was pretty scared when they actually hired me. I couldn't help thinking, 'Now that I have to do this, is it really going to work?'"

Fortunately, the band loved Niccoli's treatment. The humor seemed perfectly suited to "She Got Me," which Goss considers just a "quick, fun, rock 'n' roll song."

"After going through all these treatments, the only one that made me laugh was Casey's," he remembers. "So many bands take themselves too seriously these days. Everything is so self-important. For me, the video medium has dealt with every emotion, and the only one that holds up is humor. It kind of makes sense that if you're forced to do something for promotion, you might as well do it tongue-in-cheek."

Once Niccoli was hired on, she began revising the original treatment. She enjoyed the luxury of actually meeting the band—some record companies allegedly keep the band out of the loop—and getting their perspectives on her treatment. Because the initial deadline was so brutal, Niccoli also

Lover boy gets his bell rung, as Maria turns the tables and becomes the hunter instead of the hunted. The lips on the television screen were "keyed in" during post-production.

took some time to flesh out additional layers of plot and staging. The revisions were completed in one week.

PRE-PRODUCTION

The budget for "She Got Me" was set at $50,000. Similar to most recording budgets, this figure often denotes an "all-in" deal, for which the video producer pays all costs and is expected to deliver a completed master to the record company. Currently, a $50,000 budget is considered an industry average. Directors are usually paid ten percent of the total budget. (Despite the fact that Niccoli was brought on at the last minute, the record company asked her to cut her fee; she wisely refused.)

Before she was considered for the "She Got Me" project, Niccoli signed on with Madd Hatter Films, a Los Angeles video-production company. Madd Hatter's co-owner, Darren Lavett, agreed to produce "She Got Me" and worked with Niccoli to secure a crew. Twenty-one people (not including the food service staff) were required to complete the shoot. In addition to Niccoli and Lavett, the team was composed of a director of photography (Jim Gucciardo), production manager, production coordinator, assistant director, assistant cameraperson, film loader, art director (Claire Kauffman, who helped design the living room set on the day of the shoot), art assistant, gaffer (the chief electrician), best boy (the gaffer's assistant), key grip (prop person), best boy grip (the grip's assistant), video playback operator, stylist ("I had her running around buying things for the costumes up until the morning of the shoot," admits Niccoli), make-up artist (Jill Fink), and three production assistants.

Chrysalis Records provided Madd Hatter with a DAT copy of the "She Got Me" audio master. The DAT was simultaneously duplicated to ¼-inch analog tape for playback on a Nagra deck during the shoot, a ¾-inch video master for off-line editing (where the shot sequences are determined prior to the final "on-line" editing session), and a D2 digital master for the completed audio/video master. SMPTE time code is also striped simultaneously to each master. This one-step process ensures that on the day of the shoot, the time-code numbers displayed on the SMPTE slate—which are generated via a feed from the ¼-inch playback deck—always match the numbers on the off-line and on-line video masters. The SMPTE slate is the modern version of the classic clapboard and is filmed before each scene to provide a visual time-code reference.

"It's important to do a lot of preparation before the shoot," warns Niccoli. "I learned the hard way. I'm not very organized. I used to jot down notes and then lose them. I discovered that I had to type out a list of what I wanted to ensure people took me seriously. For 'She Got Me,' I didn't do a storyboard, I just made a shot list. However, a script was composed for the actors because they actually delivered their lines in Spanish. Details like that are usually difficult to pull off on the fly. I always make sure I have a clear vision of what I want before the cameras start rolling."

THE SHOOT

"She Got Me" was shot in one day with one 16 mm camera. (A video tap is run from the film camera to a video monitor so the director can immediately assess every shot.) Set-up commenced

at 8 a.m. on December 17, 1992, and actual filming began at 10 a.m. with Niccoli shooting performance footage. As with most video performance sequences, the band mimed to the pre-recorded audio master. Niccoli shot *50 takes* of the entire song from different perspectives before wrapping up the performance footage at 2 p.m. The dance sequence was completed in four takes after only 30 minutes. Then, all the conceptual footage was shot, and the production closed down at 1:30 a.m.

"I had two band managers and two record executives constantly looking over my shoulder because I'm not exactly a sure-bet video director; I'm a risk," admits Niccoli. "Luckily, the footage was beautiful. But it's a drag having to prove yourself on the set. For example, my treatment called for a dancing girl in a red dress. On the day of the shoot, I changed my mind; I just didn't want a 'chick' in a dress. So I put her in gang clothes. Everyone freaked out. It was like, 'What's going on here? She's supposed to be wearing a dress.' The record execs were so upset they walked out of the studio. Of course, when she started dancing, everyone forgot about the dress and started cheering because she really kicked ass."

One other notable change involved the lighting design for the band performance shots. Originally, Niccoli planned to bathe the musicians in colorful "candy cane" lighting. But after meeting the band she opted for a darker, moodier atmosphere. In addition, a single spotlight was employed to sweep across the musicians faces and a lightning strobe was flashed across some shots to provide a visual climax for the scenes used at the end of the video.

"Because the band is older, I really wanted them to look cool," says Niccoli. "The lighting change really helped, and ultimately we washed the color out (in post-production) so the performance shots are all black and white. Also, I didn't direct the band, I just filmed them doing what they did. They looked more natural, which is great because I didn't want a bunch of guys trying hard to look younger."

The personality of "She Got Me" lies mostly in its concept and camerawork. The video was never conceived as a special effects extravaganza. However, a few subtle tricks were snuck in to keep things interesting.

"We shot some performance tracks that were lip-synched at double speed," says producer Darren Lavett. "The playback sounded like Alvin and the Chipmunks, but when we start editing and the tape speed is back to normal, the singer's lips are still in synch. We also blue-screened the television during some of the conceptual shots so we could key-in some images at post-production. That was kind of tricky, because at the budget we were working with, we could only do this if the camera wasn't moving. So for the conceptual shots where the camera is moving around, such as the lover's fight sequence, we had to pre-shoot some Hi-8 (video) footage and actually have it playing on the television while we filmed."

POST-PRODUCTION

"On December 18, 1992, without any sleep, I went into telecine," says Niccoli. "This is where the 16 mm film is transferred to video tape."

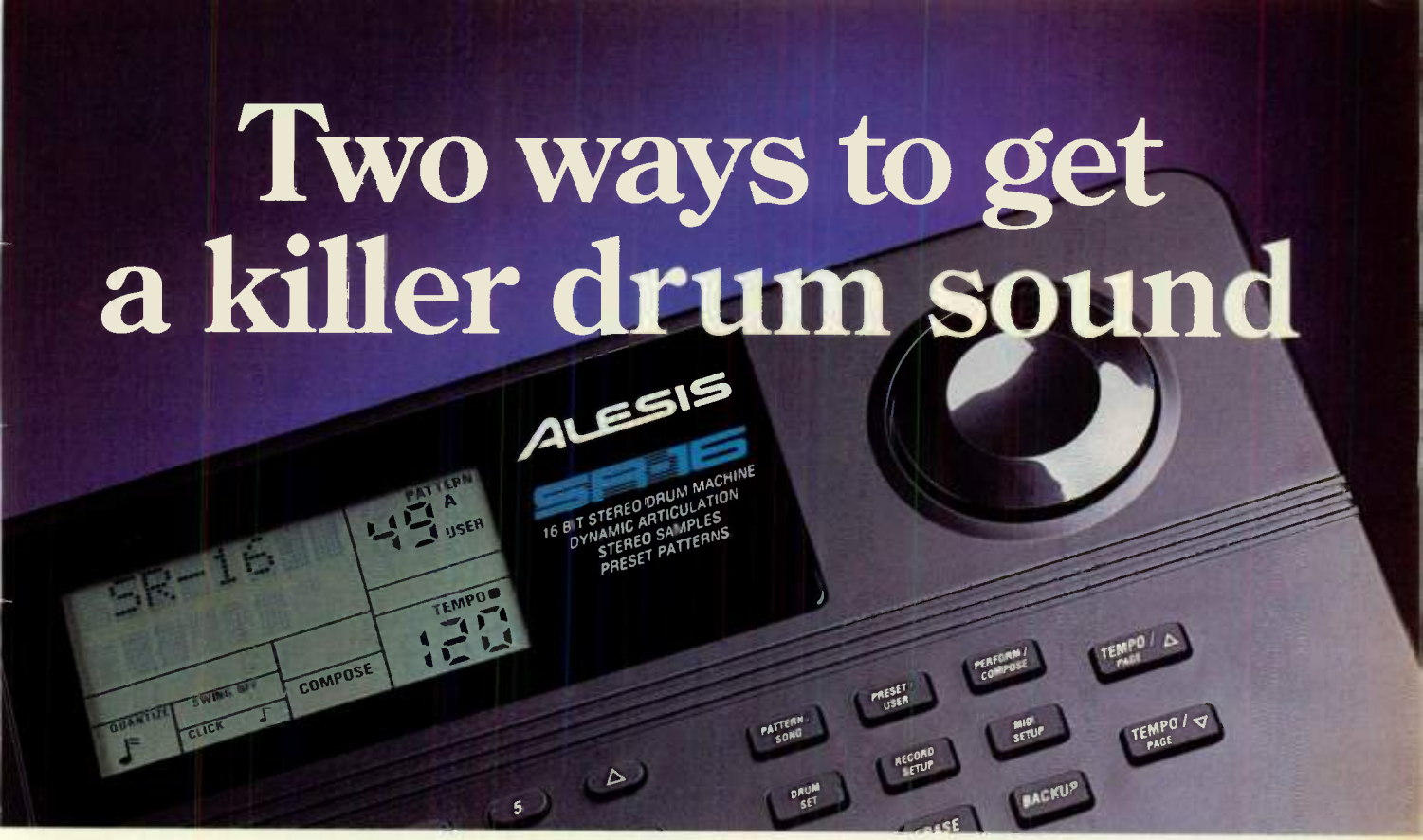
However, the telecine process is more than just a format transfer. Footage can be color-corrected, contrast-enhanced, or even completely drained of color (which was done for all the band performance shots). Niccoli had two video masters made simultaneously from the 16 mm color film: a ¾-inch copy with window dubs for off-line (preliminary) edits and a Beta SP copy for the master on-line edits (the final product). The trusty Nagra playback deck was brought into the telecine room so the audio and video could be synched together on all copies.

"I also made a ½-inch VHS copy so I could look at the footage and note which shots looked cool," says Niccoli. "Then I went directly into the off-line suite with my editor, Eric Zumbrunnen. Off-line editing is where the narrative flow of the piece is constructed, shot-by-shot. You usually have a couple of days before the record company starts asking to see how you're progressing. When the rough edit is completed, everybody gets to see it and put their two cents in. The record company wanted me to cut some of the subtitled (conceptual) shots and replace them with performance shots. There was no room for negotiation, so I threw in more performance shots to keep the label happy. However, I also managed to sneak in one more subtitled scene."

The on-line edit, or "final mix," was scheduled January 4, 1993. Niccoli was given just five hours to edit a complete master. Such tight deadlines are why a well-focused and productive off-line session is so important. In the off-line suite, the shots the director selects are entered into a computer

Stark lighting and black-and-white footage illuminated the Masters of Reality in an aura of coolness. Niccoli did not direct the band, opting instead for a natural performance vibe.

Two ways to get a killer drum sound



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editing system that lists the time-code numbers and chronological sequence of every shot. This *edit list* is saved on disk. In the on-line suite, the editor merely pops the disk into the editing system and puts the computer into auto-assemble mode. Once the video footage is in a playback machine (or machines, if multiple video masters exist), the computer searches for the pre-selected shots and edits them, in order, onto the final master tape. After the shots are recorded onto the master tape, visual effects and graphics can be added. Then, voila: It's a wrap!

"Even at this point, a record company executive came down to make sure I used a nice typeface for the subtitles," says Niccoli.

FINAL CUTS

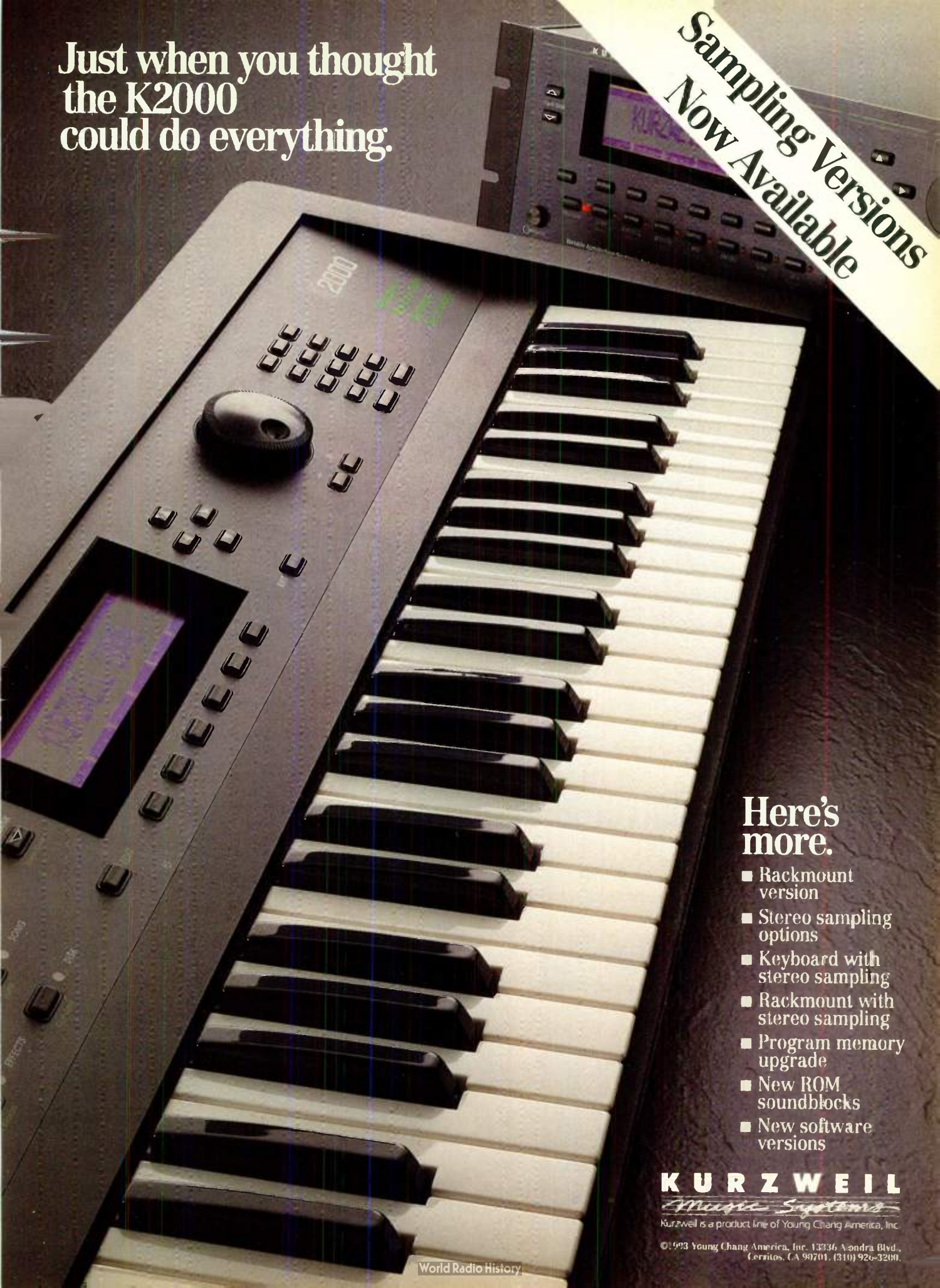
At press time, it was too early to assess the impact of Niccoli's work. Whether "She Got Me" becomes a buzz clip on MTV or not, the video is a rollicking party of images and humor that deserves recognition.

"Casey's ideas are really fresh and original," says Lavett. "She hasn't seen a lot of music videos, which is good. I look at videomaking as an extension of school; it's an ideal outlet for experimentation. Unfortunately, this business is basically a very tight circle of people that know what everybody else is doing. That's why the videos on MTV and other music video channels seem to repeat the same moods and shots. Casey's strength is in her ideas and style. And, to me, the great thing is there's not any other Casey Niccolis out there."

But how does a band composed of talented, passionate players view the current promotional climate that demands musicians become minute movie stars?

"Well, a Masters of Reality video will never compete with a Bugle Boy (jeans) ad," admits Goss. "And that's just fine. Ultimately, it's the music that does the talking."

EM *managing editor* **Michael Molenda**'s *obsession with film directors such as Jean Cocteau and Orson Welles hasn't stopped him (unfortunately) from enjoying old Cheap Trick videos.*



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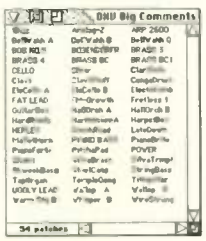

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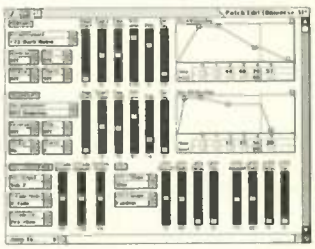

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Spectral Enhancers

By Scott Wilkinson

Transform listless audio spectra into sparkling sonic jewels.

When people discuss signal processing, they're usually referring to effects such as reverb, delay, and flanging. But there is another, less well-known type of signal processing that can enhance audio signals just as dramatically. These processors are generically known as *spectral enhancers.*

The primary purpose of spectral enhancers is to add more "presence" to a sound. Sometimes, they are used to "brighten" a dull stereo mix, or add a sense of transparency to a sonic environment. The process can compensate for subtle—and sometimes not so subtle—losses in clarity when analog masters are duplicated onto cassette. In some instances, the sonic quality of older recordings (we're talking 1930s, '40s, and '50s) can be partially restored to their original luster. However, the use of spectral enhancers is not limited to stereo sound sources. They can process individual instruments or vocals to improve clarity and definition.

BASIC CONCEPTS

All sounds can be broken into a set of simple sine waves composed of different frequencies and amplitudes. These simple waves are called the harmonic content (or spectrum) of the original sound. To work their magic, spectral enhancers alter the amplitude and relative phase of the various frequencies within the spectrum of the signal being processed. (For more on harmonic spectra and other aspects of basic sound theory, see "From the Top: Making Waves" in the January 1992 **EM**.)

The amplitude of a frequency component corresponds to its "loudness," but the concept of relative phase is less intuitive. Simply stated, the relative phase of an audio signal is the position of the crests and troughs in its waveform with respect to another identical waveform of the same frequency (see **Fig. 1**). Shifting the phase displaces the crests and troughs of one signal with respect to another. The process of filtering or equalization often induces phase shifts as a side effect, which can affect the quality of the sound.

Conventional graphic and parametric equalizers alter the amplitude and phase of the frequency spectrum in a static fashion. For example, if you boost 1 kHz by 3 dB, any frequency components at or near 1 kHz are boosted by the same amount. However, spectral enhancers are generally *dynamic;* they do their thing based on the amplitudes and frequencies in the spectrum of the input signal as it changes over time.

Most enhancers are based on a *sidechain* design (see **Fig. 2**) that splits the input signal into two copies; one goes to a summing amp and then to the output, while the other is diverted through the enhancement circuitry. (Most spectral enhancers have two channels so they can process stereo signals.) Then, the direct and processed signals are combined before being sent to the outputs. This internal mixing often increases the level of the output signal, particularly on short peaks such as snare cracks. Because "surprise" hot levels can cause distortion on tape (or through a sound system), most enhancers are designed to maintain an even (1:1) input/output amplitude ratio.

HARMONIC GENERATION

There are three basic types of spectral enhancers. The first type employs *harmonic generation* or *harmonic synthesis.* This process generates harmonics not present in the input signal and adds them to the original sound. Traditionally, mid and high harmonics are

added to brighten the sound.

As with most enhancement methods, harmonic synthesis splits the input signal into two copies, one of which is directed to the sidechain. The processed signal first passes through a level control and variable highpass filter, which allows frequencies above a user-specified threshold to pass through unaffected while frequencies under the threshold are diminished. The signal then enters the harmonics generator, which creates harmonics at frequencies determined by the input spectrum. Finally, the processed and unprocessed signals are mixed and sent to the output.

The Aphex Aural Exciter, which was the first harmonic synthesis processor, has undergone several evolutions. The current model is designated Type C^2. The Aural Exciter Type C^2 includes a second sidechain called "Big Bottom" (see Fig. 3). This sidechain, which is parallel to the Exciter circuitry, enhances bass frequencies by employing a low-pass filter to remove high harmonics from the input signal. The effect is more pronounced at low input levels and diminishes as the input level increases. Most importantly, the peak level of the signal is not increased by the process.

Some spectral enhancers are designed expressly to give signals a bigger boom. The dbx 120XP Subharmonic Synthesizer and Furman PUNCH-10 both create a "subharmonic" one octave below the fundamental note of the input signal.

DYNAMIC EQ

The second type of enhancement is called *dynamic EQ*. In this process, the audio spectrum is divided into a number of bands, each of which is boosted or cut dynamically. Or, as the spectral content of the input signal changes, the amount of the specific boost or cut changes, as well. This treatment can be used to affect the entire spectrum, rather than just highs or lows.

For example, the Dolby Model 740 Spectral Processor is a 2-channel dynamic EQ that divides the audio spectrum into three bands. It then boosts only the low-amplitude signals in each band (by as much as 20 dB) without affecting the high-amplitude signals or changing the overall dynamic range. As you might expect from Dolby, the Model 740 also includes a noise-reduction circuit on each channel.

Another spectral enhancer based on dynamic EQ is the Vitalizer from SPL.

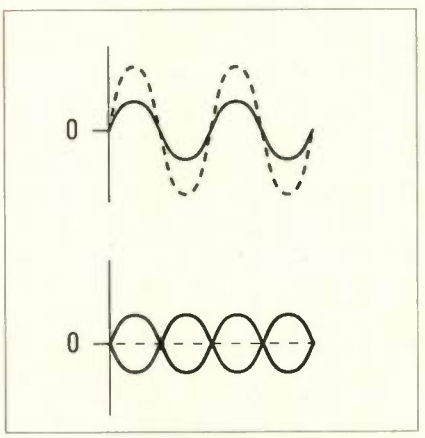

FIG. 1: Complex waveform interactions are nothing more than constantly changing reinforcements and cancellations. In the first diagram, two waveforms are "in phase," so they reinforce each other additively, resulting in a higher amplitude, as depicted by the dotted waveform. In the second diagram, the two waveforms are 180° out of phase and cancel each other out, resulting in no sound (as depicted by the dotted line).

The Vitalizer analyzes the input signal for its spectral content and amplitude, then sends it through a sidechain of five filters that are interactively linked to each other; the action of each filter affects the others.

The 296 Spectral Enhancer from dbx's new Project 1 signal processing series also uses dynamic EQ. Unlike some enhancers, the sidechain signal passes through a hiss reduction circuit *before* the EQ section. This signal-routing design prevents audible hiss (or other noises) from being enhanced along with the original sound.

DYNAMIC PHASE SHIFTING

The remaining type of spectral enhancement is called *dynamic phase-shifting*. In this process, it is the phase of each harmonic—not the amplitude or frequency—that is shifted dynamically.

This approach is used by BBE in their Sonic Maximizer products. The Sonic Maximizers are based on the principle that any sound played by a loudspeaker is delayed—and therefore phase-shifted—by different amounts, depending on the frequencies present. As a rule, high frequencies are delayed more than low frequencies. The resulting distortion often makes sharp transients, such as drum hits, sound "mushy."

The Sonic Maximizer compensates by adding more delay time to the low frequencies of an input signal and less delay time to the high frequencies. This action/reaction delay allows the different frequencies of the audio spectrum to reach your ears at the time nature (and acoustics) intended. After the dynamic phase-shifting is complete, the unit analyzes the spectrum of the input signal and applies dynamic EQ without inducing additional phase shifting. Unlike other enhancers, the Sonic Maximizer uses no sidechain; the entire signal is affected by the process.

Other products combine several types of enhancement. The Orban 290RX Adaptive Enhancement Processor's sidechain includes two types of processing: harmonic and spectral restoration. Harmonic restoration generates new harmonics down to 1 kHz, depending on the control setting. Spectral restoration is a form of dynamic EQ and phase shifting that is particularly useful for enhancing vocals without increasing sibilance. A noise-reduction circuit is located after the restoration section.

Behringer makes two enhancers: the DUALFEX EX 802 and the ULTRAFEX EX 2200. According to Behringer, recordings of acoustic instruments in a so-called classical setting require enhancement that produces a "softer" transparency, while pop recordings

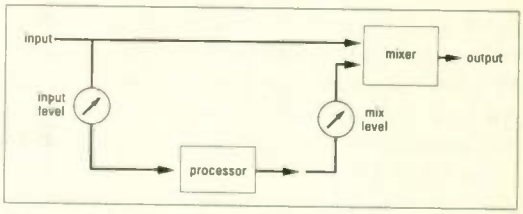

FIG. 2: In a "sidechain" design, the input signal is split into two copies; one proceeds to a summing amp and then to the output, while the other is diverted through the processor. In the sidechain, an input level control determines how much of the signal is processed. The processed signal is then mixed with the original sound and sent to the output.

need more "bite." A Variable Sound Processing (VSP) circuit in the DUALFEX lets users fade between these two types of enhancement. The process uses dynamic EQ and phase shifting.

The ULTRAFEX has a "Natural Sonic" processor that also uses dynamic EQ and phase shifting and a separate bass processor that enhances low frequencies with dynamic phase-shifting and bass boost.

The BOSS EH-50 Stereo Enhancer from Roland combines dynamic EQ and phase-shifting in five preset modes with almost no user control other than enhancement level. The first mode enhances high frequencies, while the second mode enhances the mids and highs for vocals; neither of these modes responds to the input level. The other three modes are level-sensitive, and each enhances a different part of the spectrum.

APPLICATIONS

Enhancers are normally used in the recording studio during the final mix. Most mixdown effects are patched into the aux sends and returns to facilitate a user-determined balance between the "wet" and "dry" signals. But enhancers are often patched into a mixer's *insert points* so that the entire signal passes through the device. Patching into the insert points also maintains the phase relationship between the original and processed signals.

In general, use as little of the effect as possible. Don't forget that the process enhances the intended sound *and* any noise present in the input signal.

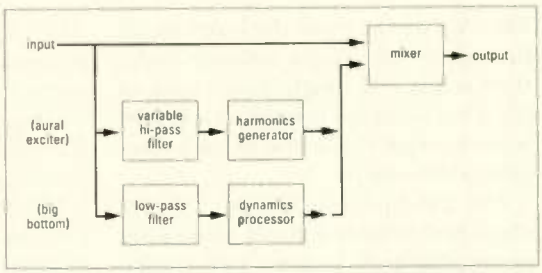

FIG. 3: The Aphex Aural Exciter Type C² with Big Bottom includes two sidechains. The Exciter itself includes a high-pass filter and harmonics generator, while Big Bottom enhances the bass frequencies that make it through a low-pass filter.

You may be clarifying a bad sound along with the good. Although several devices include noise reduction to minimize enhanced noise, it's always a good idea to use just enough level to get the job done and no more.

Enhancing individual sounds can be very effective in helping certain instruments stand out in the mix. Vocals are a good place to start. Enhancement not only improves overall sound quality, but also intelligibility. However, be careful enhancing overly sibilant voices; an enhanced high-frequency "s" sound often drowns out everything else.

Enhancers can also be patched into a mixer's stereo bus to process an entire mix. But beware of employing enhancers during a marathon mix session. The impact of the effect diminishes as your ears become accustomed to it, which may lead you to wonder why you used the effect in the first place. Also, the high-end shimmer of dull master tapes can be revitalized by patching an enhancer between two mastering decks. One deck plays your original master, while the second records the processed signal from the enhancer. Hopefully, your mixes are good enough that they need little enhancement.

Used with care, a spectral enhancer can add a professional edge to home recordings. However, it's easy to overdo it; as the commercial says, "a little dab'll do ya." With the proper restraint, enhancers can become an indispensable tool in any studio's arsenal.

(If you wish to build your own high harmonic-generating spectral enhancer, check out "The $10 Harmonic Sweetener" in the September 1987 EM.)

EM *technical editor* **Scott Wilkinson** *enjoys enhancement whenever he can find it.*

SPECTRAL ENHANCER MANUFACTURERS

Aural Exciter Type C²
Aphex Systems, Ltd.
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Sun Valley, CA 91352
tel. (818) 767-2929
fax (818) 767-2641

Behringer DUALFEX EX 802
Behringer ULTRAFEX EX 2200
Samson Technologies
262 Duffy Ave.
Hicksville, NY 11801
tel. (516) 932-3810
fax (516) 932-3815

Boss EH-50 Stereo Enhancer
Roland Corporation
7200 Dominion Circle
Los Angeles, CA 90040
tel. (213) 685-5141
fax (213) 726-8665

dbx 120XP Subharmonic Synthesizer
dbx 296 Spectral Enhancer
AKG Acoustics
1525 Alvarado St.
San Leandro, CA 94577
tel. (510) 351-3500
fax (510) 351-0500

Model 740 Spectral Processor
Dolby Laboratories, Inc.
100 Potrero Ave.
San Francisco, CA 94103
tel. (415) 558-0200
fax (415) 863-1373

Orban 290RX Adaptive Enhancement Processor
AKG Acoustics
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San Leandro, CA 94577
tel. (510) 351-3500
fax (510) 351-0500

Punch-10
Furman Sound, Inc.
30 Rich St.
Greenbrae, CA 94904
tel. (415) 927-1225
fax (415) 927-4548

Sonic Maximizer
BBE Sound, Inc.
5500 Bolsa Ave., Suite 245
Huntington Beach, CA 92649
tel. (714) 897-6766
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Authoring Systems

By Jeff Burger

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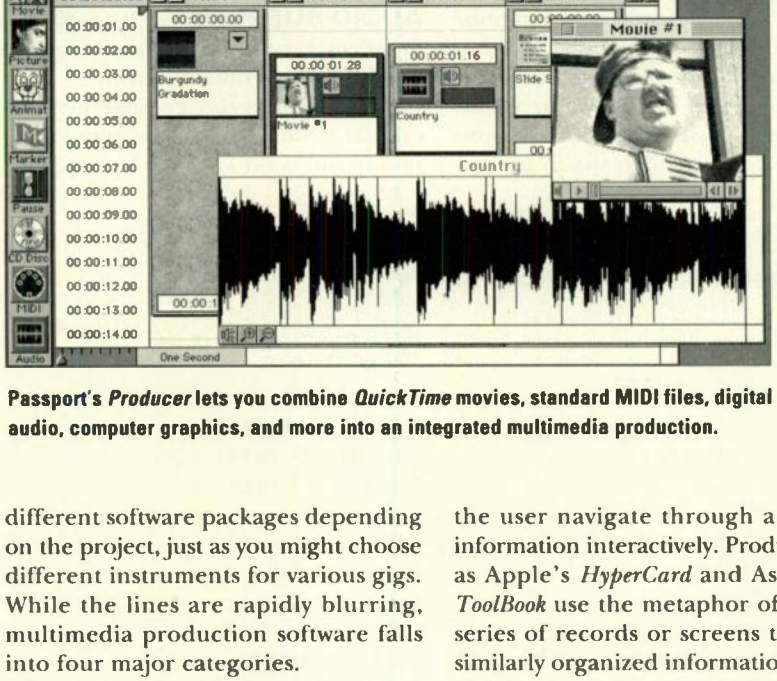

Passport's *Producer* lets you combine *QuickTime* movies, standard MIDI files, digital audio, computer graphics, and more into an integrated multimedia production.

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BASIC CATEGORIES

Most multimedia productions are developed by integrating a variety of different media—audio, graphics, text, video—using off-the-shelf software. These integrating applications comprise perhaps the fastest-moving and most highly competitive software category in the market today.

When you start to work on a project, the first step is selecting the right tool for the job. Music videos, boardroom presentations, trade-show productions, interactive kiosks, computer-based training, and entertainment titles all have unique considerations and requirements. Professional producers employ different software packages depending on the project, just as you might choose different instruments for various gigs. While the lines are rapidly blurring, multimedia production software falls into four major categories.

Presentation software is designed primarily for passive presentations that follow the metaphor of the slide show: linear productions that require no interaction other than pressing a key or mouse button to advance. The emphasis of products such as Aldus *Persuasion* and Microsoft *Power Point* is on simple production values and ease-of-use in the fast-paced business world.

The main text that appears on the "slides" is derived from a text outline either created in the program, or imported from a word processor. Templates for slides can be designed to provide backgrounds, graphic elements, and transitions. In addition, predefined text styles can convert hierarchical outline levels to titles, bullet points, body text, printed speaker notes, and the like. This approach, combined with a storyboard mode for slide sorting, allows a presentation to be altered right up to the last minute with minimal effort.

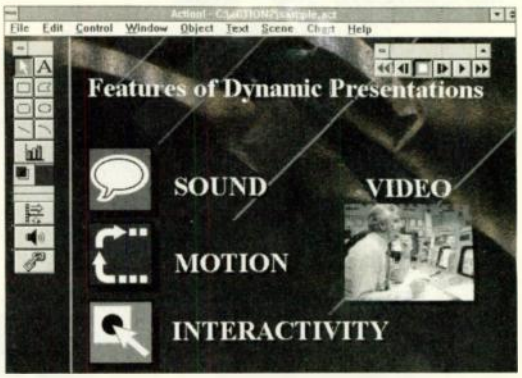
Authoring systems are designed to let the user navigate through a body of information interactively. Products such as Apple's *HyperCard* and Asymetrix' *ToolBook* use the metaphor of *stacks*, a series of records or screens that hold similarly organized information. At the simplest level, the user can browse the stack or conduct an electronic search for specific information. You can also program "hyperlinks" that allow the user to call up related information automatically. (A simple example is automatic definition look-up when the user clicks on an unknown word.) The most advanced products offer database support, which allow information to be searched and retrieved from a master set of records, rather than manually tying information to specific actions.

Multimedia production or media-integration software typically allows more ambitious integration of various media, often with more advanced user-interactivity. Products such as Macromedia's *Director* and *Action!* (see **Fig. 1**), Passport's *Producer*, and Commodore's *AmigaVision Professional* (see **Fig. 2**) provide the ability to combine media such as graphics, animations, digital video, and music along a timeline. The metaphor is typically that of a stage,

often complete with "actors" in the form of miniature, animated objects. This genre of software is not only a good bet as a creative vehicle, but typically offers the greatest support for external devices, such as CD-ROM drives and video transports.

Digital-movie editors represent the latest wave of authoring software, thanks to the pervasiveness of compressed digital video and animation technology such as Apple's *QuickTime* and Microsoft's *Video for Windows*. Packages such as Adobe *Premiere* and VideoFusion's *VideoFusion* use the metaphor of a non-linear, multi-source, video editing environment. Segments of digitized video are isolated, imported into a timeline or storyboard, and combined using various transitions and special effects.

While this genre is perhaps the best choice for music video-style productions, it comes with some caveats: hefty processing time, large storage requirements, and a significant trade-off between image size, quality, and frame rate without expensive hardware. Some packages export edit decision lists, making them useful for inexpensive off-line editing.



Macromedia's *Action!* for *Windows* (also available for the Mac) is one of the newer entrants into the field of multimedia authoring systems.

AUDIO SUPPORT

Features vary radically from product to product within these main categories. Perhaps the most critical criterion from a musician's standpoint is the way in which a given package allows audio to be integrated. Eight-bit, RAM-based sounds aren't good for much more than sound effects. Eight-bit or 16-bit sound spooling from a hard disk is the minimum requirement for anything resembling a soundtrack. (The audio channels of digital movie formats such as *QuickTime* and *Video for Windows* provide one method of integrating this level of audio.)

Support for better audio quality is often harder to find. Sixteen-bit sound from dedicated hardware companies such as Digidesign and Turtle Beach is supported only by a handful of multimedia packages. MIDI is gaining increased support, owing partially to its inclusion in the MPC (Multimedia Personal Computer) specification in the *Windows* world.

The issue of audio goes well beyond integrating various formats, however. All but a few archaic programs allow music and visual media to play simultaneously. Most programs only offer the equivalent of wild sync, though: Start playback of the soundtrack and visuals, and cross your fingers. Worse, you can tweak the animation speed and audio tempo to perfection, only to find the whole thing is out of sync when played on another computer. Only those packages built from the ground up on a processor-dependent standard, such as *QuickTime*, will retain their synchronization across different machines.

It's not uncommon to have two or more independent sound sources and related media tracks when producing interactive content. Unlike a standard musical composition or movie, interactivity places the evolution of the audio-visual content in the hands of the user.

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interactive production complete with soundtrack, sound effects, and narration. Ideally, the soundtrack music will continue playing seamlessly regardless of when the user makes various navigational choices. When a choice is made, a sound effect might immediately confirm the selection. The next segment might then provide a voice-over while the soundtrack continues. Independent audio tracks—such as MIDI for the soundtrack and digital audio for the effects and speech—provide the only solution in such a scenario. With a few exceptions, goodies like interactive control over looping and fades on demand are still just items on the wish list.

SYSTEM-LEVEL ISSUES

If you plan to distribute your production to other users, you'll either need a package that most people have (such as *HyperCard*), or one that offers a run-time or player module. This is a play-only utility that can be distributed with your final production. Be sure to check the licensing agreement from the specific manufacturer for legal details.

With sizable market shares going to both Mac and PC environments these days, the ability to play your production on different computer platforms is increasingly important. Macromedia's *Windows Player* and CoSa's *PACo Producer* are two products that address this issue. Also, if you have a minimal machine and/or high aspirations, check out the recommended RAM, hard disk, and system software requirements before purchasing production software.

ROUNDING IT OUT

Most software categories mentioned so far integrate media from various sources. Most also provide some tools for creating and editing media. While these products give you everything under one roof at one price, few media integration packages offer the power of software dedicated to individual tasks such as animation, digital audio editing, or MIDI sequencing exclusively. When budgeting for multimedia tools, evaluate the strengths and weaknesses of the centerpiece packages you are considering compared to your level of expectations. If you want killer animation, for example, you'll probably want to create it in a dedicated package and import it into the media-integration software.

One of the major trends in desktop media of all kinds is clip media: libraries of scanned photos, clip art, canned animations, needle-drop music, and digital video footage. While you can purchase these libraries separately, the costs quickly add up. Many manufacturers include clip media collections with their media integration packages. If you're a novice in any of these areas, such bundles can be a distinct advantage when purchasing your software hub.

Obviously, price is also a factor, and you generally get what you pay for. Assembling a multimedia production environment is like putting together a recording studio. Don't forget to budget for hardware tools that help create the various media components of your productions. VCRs, cameras, video digitizers, scanners, graphic tablets, display adapters, NTSC converters, CD-ROM drives, processor accelerators, and hefty storage and backup devices are just some of the products you'll find handy.

Once you have all the pieces in place, it's just a matter of creating and refining, creating and refining, and creating and refining. It's challenging work, but the results are amazing. Good luck!

Jeff Burger *is author of* The Desktop Multimedia Bible *(Addison-Wesley, 1993). This new book, which covers all aspects of multimedia technology, tools, and techniques, is available from Mix Bookshelf.*

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Virtual Music

By David Cope

Computer-generated composition comes of age.

These days, musicians and composers of all stripes use computers as tools for musical creation. In most cases, they use MIDI sequencing programs to perform their music on samplers or synthesizers. Some also edit the timbral quality of sounds to create unique sonorities for their music.

Others, including myself, work with computer music in a different way. We program computers to compose music without regard to the method of its performance. This approach is called "algorithmic composition," "machine composition," "computer-aided composition," or "virtual music." It involves conceptualizing the compositional process and then coding that conceptualization into a program using a language such as C, Pascal, or the language I use, LISP. The results are computer programs that create imaginative and unpredictable new compositions.

BACKGROUND

The idea of virtual music is not new, even though computers are a relatively recent invention. In essence, virtual music has existed ever since the first wind chimes were built in ancient China. While the pitches of wind chimes are fixed, the rhythm and order of those pitches are completely at the whim of the wind. The same is true of ancient Greek Aeolian harps, whose strings vibrate randomly in the wind without human performers. Today, computers offer an extraordinary opportunity to utilize digital speed and memory to produce complex and diverse new compositions.

Several individuals pioneered the use of computers for composition, rather than sequencing music or editing timbres. Lejaren Hiller, Leonard Isaacson, and Iannis Xenakis, among others, have created computer-composition programs for decades. (See Hiller and Isaacson's *Experimental Music;* New York: McGraw Hill, 1959; and Xenakis' *Formalized Music;* Bloomington: Indiana University Press, 1971.) However, few of these pioneers have developed programs to compose new works in discernible musical styles. My initial attempts at computer composition were aimed at creating new works in my own style. More recently, I have created programs that compose works in the styles of known classical and popular composers.

One program I've created is called *Experiments in Musical Intelligence*, or *EMI*, which consists of several parts designed to create machine-composed music in recognizable musical styles. The *EMI* program described here is loosely based on the concept of the *ars combinatoria*, Latin for the "art of combining," used by classical composers such as Wolfgang Amadeus Mozart, Johann Kirnberger, and Joseph Haydn.

ARS COMBINATORIA

The idea of *ars combinatoria* is to compose a series of fragments that can be combined in different ways while remaining stylistically acceptable. Even a simple set of fragments can produce numerous new works that fit a recognizable style while varying in aesthetic quality.

This process is based on a concept called *triads*. Triads are 3-note chords that retain their identity in a given key, regardless of the order of the notes. For example, we identify a measure of music with lots of C's, E's, and G's as C major, regardless of the order or octave of those C's, E's, and G's. This is true even when other pitches are present in the measure. In fact, the sense of

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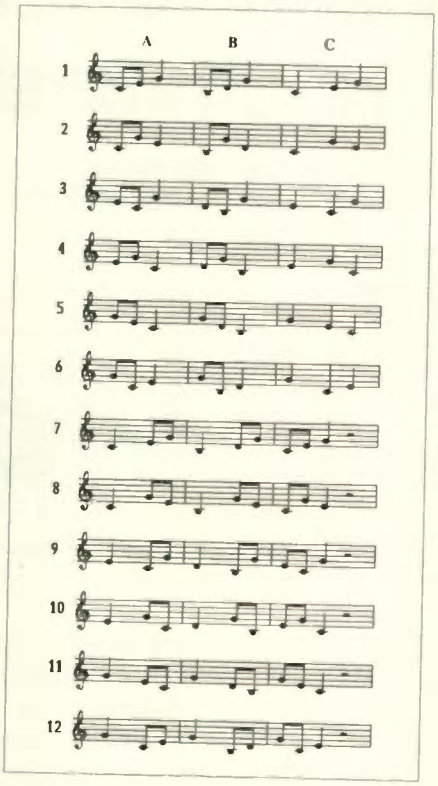


FIG. 1a: A 12 x 3 matrix consisting of variations that use the notes C-E-G (column A), G-B-D (column B), and C-E-G (column C).

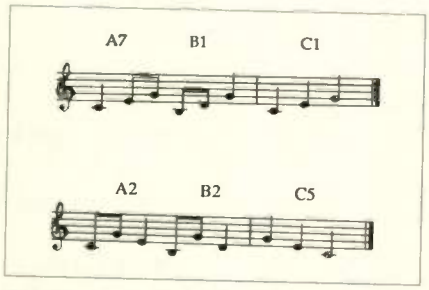


FIG. 1b: Two examples of music drawn from Fig. 1a, with sources identified by column letter and row number.

triads can be so strong that we sometimes perceive certain notes when they are not present. For example, a measure of just C's and E's can lead us to perceive the implied G's.

One way to create an *ars combinatoria* is to construct a matrix. For example, **Fig. 1a** shows a three-across and twelve-down matrix that produces an *ars combinatoria*. The measures are alternately filled with a C-E-G fragment, G-B-D fragment, and C-E-G fragment across each row. Randomly selecting one measure from the first vertical column, one measure from the second vertical column, and one measure from the third vertical column creates new patterns of C-E-G, G-B-D, and C-E-G, as shown in **Fig. 1b**. If all the elements are in the same general range, the new sequences, of which 1,728 are mathematically possible here, will be musically viable. Mozart's typical matrix was 16 × 1.1, resulting in 45,950 trillion possibilities.

CHOPIN

In *EMI*, new works are created by applying the principles of *ars combinatoria* to fragments that are *not* designed to be so easily disassembled and reassembled. This process is accomplished by analyzing a style of music to determine its triads and then recombining these triads in an order comparable to one of the works being used as a seed.

Two brief phrases from different mazurkas by Frederic Chopin, a noted Nineteenth century composer who was not particularly interested in *ars combinatoria*, are shown **Figs. 2a** and **2b**. Using *ars combinatoria* methods, however, a computer program can disassemble and recombine similar triads to create a completely new mazurka phrase.

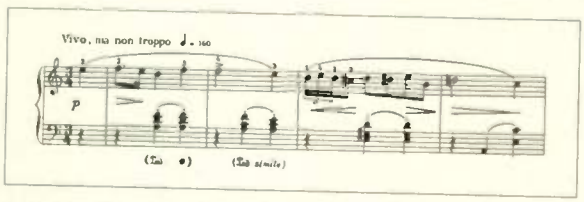


FIG. 2a: The first phrase of Chopin's Mazurka op. 7, No 2.

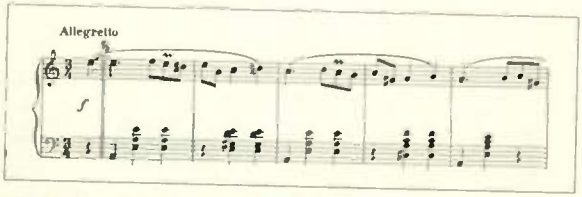


FIG. 2b: The first phrase of Chopin's Mazurka op. 67, No 4.

Fig. 3 is a simple analysis of the music in **Fig. 2b**. This analysis assumes that each measure of music in **Fig. 2b** is of one triad or 4-note chord (not always true, but true in this case) and identifies each chord using the associated pitch names. Note that tonal knowledge is used to count duplicate pitches in various octaves as a single pitch, discount pitches not actually part of the

A-C-E E-G#-B-D A-C-E D#-F-A-C A-C-E

FIG. 3: A template based on the music in Fig. 2b, showing the predominant triads and 4-note chords in each measure by note name.

chord, and include implied pitches that are not actually present.

A new mazurka phrase recombined from the originals is illustrated **Fig. 4**. I have indicated the source of each measure with the figure number and measure number. Playing this phrase on a keyboard gives you the opportunity to judge the success of this simple *ars combinatoria* process.

MOZART

Recombining measures of music with like triads can result in musical failures, as well as successes. This occurs because certain elements of a composer's style cross bar lines or extend beyond one measure in length. These elements should remain intact if the composer's style is to survive the recombination process.

In order to keep these elements intact, I developed a pattern matcher. Pattern matching is a traditional technique in artificial intelligence that allows more satisfying compositions

THE EMI DISK

The best way to appreciate these musical experiments is to hear them for yourself. To facilitate this, David Cope has produced an EMI disk that includes example source code (in Common LISP), additional articles, and many musical examples in the form of Standard MIDI Files. To receive a copy of the disk, send $5 (to cover costs) to: Glen Spencer, MuSIG, 1120 College Ave., Palo Alto, CA 94306. If you're a member of PAN, you can download the material from the EM SIG on PAN. Call (215) 584-0300 for more information on how to join PAN.—*Bob O'Donnell*

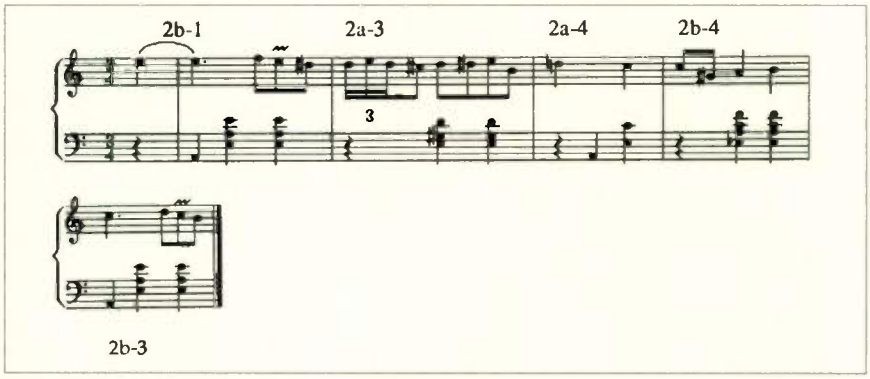


FIG. 4: A recombinant phrase made from various measures of Figs. 2a and 2b, with sources indicated by figure and measure number.

from the process of *ars combinatoria*. Using pattern matching, *EMI* collects patterns, or "signatures," that are common to more than one work, which are then protected from recombination.

Note the two phrases from Mozart piano sonatas shown in **Fig. 5a** and **5b**. If you carefully inspect the ends of each phrase, you'll find a melodic line that varies in rhythm and harmony, but is similar enough to satisfy the *EMI* pattern matcher. This signature (see **Fig. 6**) is common in Mozart's piano works. If it were recomposed, the resulting piece would lack the indelible qualities that help us recognize his musical style. Notice that in both of the original phrases, Mozart's use of this signature falls across a measure line. It's only one note, but fragmenting the music at these measure points would significantly alter the style-identifying signature.

Fig. 7 illustrates an *EMI*-composed Mozartean phrase that includes the signature located near the end of the phrase as in **Figs. 5a** and **5b**. The exact locations of the rest of the fragments cannot be as easily detected because this music was derived from a very large *ars combinatoria* set: the entire collection of Mozart sonatas.

It is important to understand that *EMI* is constructed from two contrary subprograms: one trying to recompose everything as much as possible (*ars combinatoria*), and one trying to protect the original music from being recomposed (pattern matching). The balance between these two elements is quite complex and contributes to the enormous computing time necessary for this program to compose original pieces.

EMI goes much deeper than this brief, superficial description permits (See sidebar "The EMI Disk"); the actual program requires hundreds of pages of programmer's code. Included in the code, for example, is a natural-language, augmented-transition network (ATN) program, which helps make logical choices of new measures instead of random choices.

THE OUTCOME

Regardless of whether one considers this music a success or failure, virtual music is a compelling notion. There are those who wonder about the legality of the music. To whom does the copyright belong? Who gets the royalties, if any? Some, like those who thought samplers and synthesizers would put performers out of business, now claim these new programs are a similar threat to composers.

I believe virtual music may pose a threat to bad composers, but good

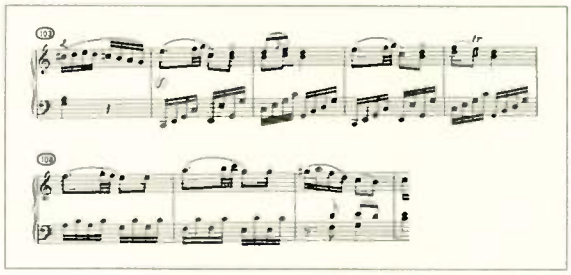


FIG. 5a: A phrase from the third movement of Mozart's K. 330, piano sonata 10, measures 103-111.

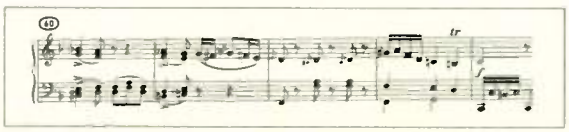


FIG. 5b: A phrase from the first movement of Mozart's K. 547a, piano sonata 17, measures 60-64.

composers have nothing to fear. In fact, if good composers experience a composer's block, they might find programs such as *EMI* to be of real assistance in composing *more* music in their own style, not less. Interestingly enough, just such a block led me to invent *EMI*.

In addition, such programs can help musicians better understand musical style and possibly enable non-composers to feel the thrill of "authoring" a new composition. For me, the best part is the thought that my own composing could extend beyond my lifetime. Assuming that anyone wants to hear my next work at that point, they could have *EMI* compose it from my own music. It's possible that future composers might never compose complete works, but rather create a database of their musical style that would then act as a seed for an endless number of original, machine-composed works.

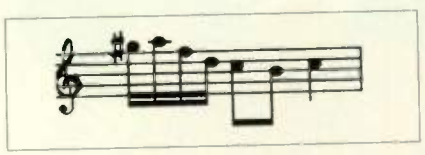


FIG. 6: A Mozartean signature found near the end of each example in Figs. 5a and 5b, beginning on a melodic G#.

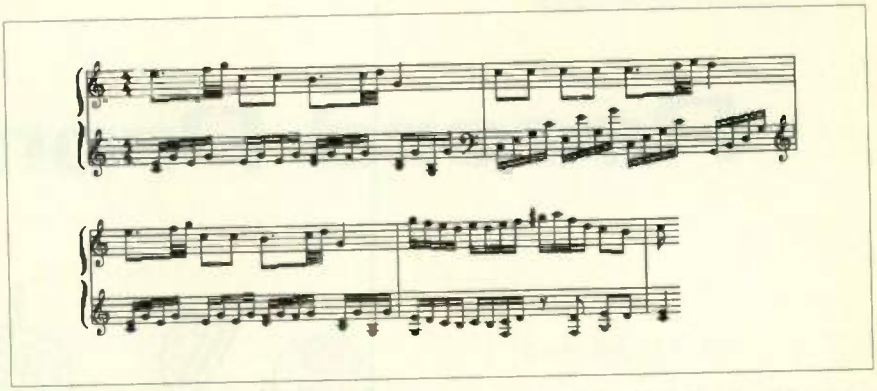


FIG. 7: A new phrase showing Mozart's signature (at the end of this phrase). The rest of the phrase is the result of recombination from the entirety of Mozart's piano sonatas.

I believe that the positive implications of virtual music far outweigh the negative ones. Imagine a future where you can go to a concert and hear the premiere of a new work in the style of Bach, or a work in the styles of Bach and Mozart fused together, or one that begins in one style and ends in another, or even a new work by *EMI* based entirely on new works composed by *EMI* after Mozart. These are all extraordinary possibilities for an extraordinary time.

(If you're interested in learning more about *EMI*, the author's *Computers and Musical Style* [Madison: A-R Editions, 1991] discusses its underlying concepts in greater detail and provides more extensive examples of *EMI*'s musical output.)

David Cope *is a professor of music at the University of California, Santa Cruz.*

Record Promotion

By Nadine Condon

Hard work and friendly persuasion keep records from getting lost between radiowaves.

One of the most misunderstood aspects of the music business is record promotion. A mysterious aura has always surrounded record promoters. If you believe the muckrakers, independent promoters are nothing more than criminals who trade money and drugs for radio airplay. While the music business *does* have its share of borderline characters, the majority of record promoters are far from purveyors of payola.

Basically, record promoters are hard-working people immersed in the responsibility of getting an artist's work out to the public. How they work is up to each promotion person, but *what* they do is simple: They get records played on the radio.

RADIO, RADIO

Radio stations are divided into different stylistic formats. The current major categories are contemporary hit radio (CHR), album-oriented radio (AOR), urban, country, adult contemporary (AC), alternative/college, metal, jazz, rap, and new age/adult alternative. Each week, trade publications track stations in every category and compile information for the powerful and influential charts that list records receiving the most national airplay.

These charts are vital to a record's success because radio stations are blatant copy cats. When a station sees a record is "hot" on similarly formatted stations, it often adds the record to its playlist. Then, as more stations add the record, its chart position increases, and the hopeful journey to the top of the charts begins.

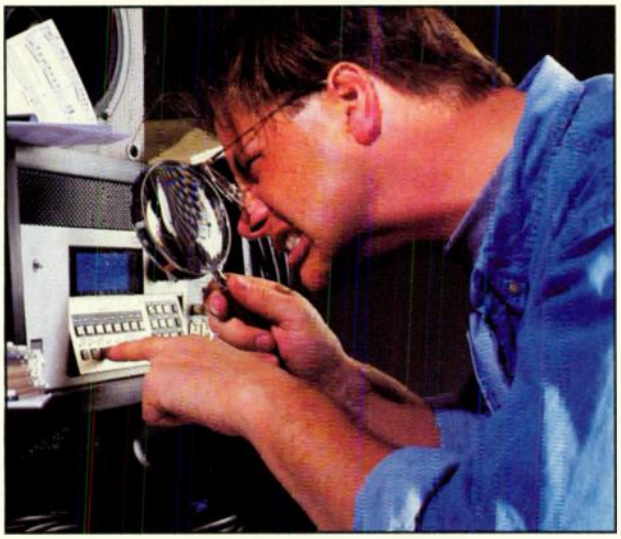
Traditionally, the charts also help record labels determine marketing strategies for a particular release. The amount of money a label spends on advertising, sales, and promotion for a record is often directly related to how high the record charts. Records that don't generate chart action are usually ignored by the major labels and often die a dismal death in a record shop's bargain bins.

PROMOTING SUCCESS

Unfortunately, shaking some action on the charts is not an easy gig. Because of the overwhelming number of current releases, merely sending a record to a radio station won't get it played, even if you're Sony Music. Station program directors (PDs) and music directors (MDs) usually receive 50 new records a week. The competition for airtime is brutal. Major labels attack the competition with in-house promotion departments whose sole responsibility is to personally deliver records to the radio stations. Promotion staffs also place initial introductory calls to the station describing the current release, make follow-up calls informing the station of the release's current success on other stations, wine and dine PDs and MDs, and develop promotional giveaways and contest trips that enhance the record's appeal to radio personnel and consumers.

However, in-house promotional staffs are often overwhelmed by the sheer number of their label's releases. To effectively work the overflow, labels hire independent record promoters, or *indies*. Indies are specialists who have nurtured close personal and professional relationships with the PDs and MDs of important radio stations. Because the key to good promotion is personal contacts, these people are incredibly valuable. They act as a conduit between a label and a station and can get through to a PD or MD when

MARK MATCHO



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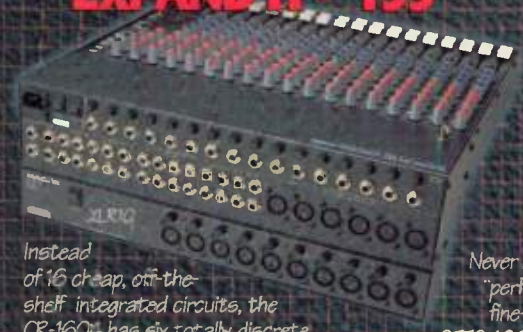

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ROTATE IT • $19

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others can't. For example, if 50 promotion reps are calling a station, the PD is most likely to return the calls of people he or she knows, likes, and trusts.

The price for an indie's contacts and persuasive talents varies according to his or her industry standing, success record, the format being promoted, and the type of project. Costs range from $400 to $1,000 per week for a specified number of weeks, or a flat fee of $5,000 to $20,000 for the "life of the project" (generally considered to be ten weeks).

Savvy artist managers often negotiate with the labels to hire indies for their clients. This is smart business as it ensures that the artist won't get lost in the shuffle of releases promoted by the label. The fee for independent promotion is paid by the artist's promotional budget—which may or may not be recoupable by the label—and the label writes the checks.

PROMOTING SMALL LABELS

Smaller, independent labels perceive chart action differently than the majors. The life of an independent record is not greatly influenced by chart numbers, as the company may only have a regional emphasis or a cult (niche) market. However, if a small label does chart a record, it greatly increases industry status, credibility, and visibility. Self-released records that chart usually make a big splash at major-label A&R departments.

However, the promotional options facing an independent or self-released record are limited. Frankly speaking, most CHR stations only play major-label releases, so it's a waste of time badgering them. It's better to first get a record happening in a more receptive arena. College, alternative, and other more-specialized stations (rap, new age, etc.) usually accept records from smaller independent labels.

Exploiting this specific market are

KIDS, DON'T TRY THIS AT HOME!

Back in the early 1980s, I released a solo album on Amorous Records, a small San Francisco label run by artist-manager Stephen M.H. Braitman. The deal was typical of most independent label contracts: I paid my own recording costs, and the label manufactured the record and secured an independent distribution deal.

It was soon apparent that we weren't selling any records by wishing and hoping. A meeting between Braitman and the label's three artists (myself, Times Beach, and House of Pants) produced the bold plan to bankroll an outreach program to college radio and major-market FM stations. The concept of professional record promoters servicing small independent labels was underdeveloped at this time, so the do-it-yourself approach seemed the best way to fight anonymity (and the dire equation of "no airplay and no sales equals a bankrupt label").

Amorous Records installed a "cut rate" long distance carrier on the office phone and paid for national college and major market radio lists. The bands agreed to reimburse Amorous for phone calls in our behalf (a more immediate twist on the "recoupable" promotional budget) and instituted a program of telephone warfare where each band spent a specified amount of time harassing PDs and MDs, logging responses, and mailing records to interested stations.

The initial response was quite impressive. The stations started mailing their playlists (see **Fig. 1**) to the Amorous office, and within two months my record was being played nationally on more than 55 radio stations. (The eventual final tally was 92 stations, of which 67 were college and 25 were AOR.)

Unfortunately, our naivete and lack of experience started to kill us. We didn't think to recommend a song as a "single," so each station picked a favorite cut. It was interesting to see the diversity of songs played, but the lack of a cut on which to target serious promotional efforts stalled successful marketing. Also, the telephone bills and mailing costs were sinking the bands and the label. No one was sufficiently capitalized to handle monthly costs averaging $300 for phone bills, $125 for postage, and $75 for mailing, printing, and packaging. In addition, our distributor was being rather sluggish at moving our records, so actual sales remained slow.

All the time and expense provided the bands tons of ego gratification and enough playlists to wallpaper a kitchen, but the eternal bottom line—revenue—wasn't justifying the operation. Within eight months, the bands and label agreed to abort the promotional push. Without sustained airplay my record died like a self-fulfilling prophecy. The distributors returned boxes of unsold goods (many of which still reside in my parent's attic; sorry, Mom and Dad), and Amorous Records faded into history as just another seminal—albeit unsuccessful—new wave label.

A few years later, when my band The Wobblies was courted by the (then) West German label Marimba, I had no reservations about agreeing to a substantial recoupable budget for independent promotion. I'd learned my lesson.—*Michael Molenda.*


PD MIKE TURNER
MD DEBORAH ROSNER
HOWARD SCHLOSSBERG
PERIOD ENDING [illegible] 1984
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[redacted] PLAYLIST
KCSN 88.5 FM

LW	TW	ARTIST	ALBUM	LABEL
6	1	Katrina & the Waves	Katrina & the Waves 2	Attic
[illegible]	2	[illegible]	[illegible] States Live	Warner [illegible]
1	3	[illegible]	Too Tough To Die	Sire
2	4	Del [illegible]	[illegible] Day	Slash
24	5	The [illegible]	Stone Cold World	[illegible]
[illegible]	6	Let's Active	[illegible]	[illegible]
[illegible]	7	[illegible]	[illegible]	[illegible]
[illegible]	8	[illegible]	Family Man	[illegible]
[illegible]	9	[illegible]	Passion [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Steppes	[illegible]
[illegible]	[illegible]	[illegible]	"The [illegible]"	[illegible]
14	[illegible]	The [illegible]placements	Let It Be	[illegible]
[illegible]	14	[illegible]	Joe's Second Record	Subterranean
4	[illegible]	[illegible] Mink	"Devil's Devil"	(local tape)
[illegible]	[illegible]	[illegible] Zappa	Thing Fish	[illegible]
[illegible]	[illegible]	[illegible]	"Locusts"	(local tape)
[illegible]	[illegible]	[illegible]	Ride the Lightning	Elektra
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	"Biko" - [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] of Children	[illegible]
[illegible]	[illegible]	[illegible]	Temple Fire	[illegible]
[illegible]	24	[illegible]	Popular History of [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Native [illegible]	Fever
[illegible]	[illegible]	[illegible]	Two [illegible] From the Move	[illegible]
[illegible]	[illegible]	[illegible]	Glorious [illegible] of a Misspent...	[illegible]
[illegible]	[illegible]	The [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Belfegore	Elektra
[illegible]	[illegible]	[illegible] Flag	Slip It In	[illegible]
[illegible]	[illegible]	[illegible]	How Will the Wolf Survive?	[illegible]
[illegible]	[illegible]	This [illegible]	This Mortal Coil	4AD
[illegible]	[illegible]	[illegible]	The Pla[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	A&M
[illegible]	[illegible]	The [illegible]	Hateful of the Hollow	[illegible]

FIG. 1: One of the actual playlists sent to Amorous Records showing the progress of my album. Not a bad week!

a growing number of small indie promoters who work small-label and self-released records. Their radio lists are compiled from similarly specialized trade publications such as *College Music Journal* (*CMJ*), *The Gavin Report*, and *Rockpool*. Fees paid to the small indie promoter are more in line with independent label budgets, averaging $200-$250 per week, with a four-week minimum. The smaller indies usually commit to calling each station once every two weeks and provide other services, such as promotional mailings.

Obviously, there is no large record label underwriting the promotional costs for self-released or independent projects (unless the label has cut a distribution deal with a major). This means *you* are paying the bills, so be sure to target your radio audience and hire an indie who specializes in your field. A well-targeted indie is especially important if you're seeking college radio airplay, as there can be a yearly turnover of the students who run the stations. Because of this rapid turnover, it's nearly impossible to form close bonds with PDs and MDs, so the value of a smaller indie lies in his or her knowledge of the station's overall programming. A college station's format usually doesn't change, even if the staff does. However, it's essential that the indie understand the history of what works–and what *doesn't* work–for a college station's musical format.

A good, reputable indie promoter should give you a client history that details past successes and a list of stations they service. If you hire them, make sure you receive a detailed breakout every week of your record's activity on each station. This report should include whether the station listened to the record or not, any comments from the PD or MD, and whether the record was tested or added. If the station plays your record, the activity must be reported to the trades and the indie should concentrate on stimulating upward chart movement.

Also, certain professionals within the independent promotion community specialize in niche marketing and other specialized tasks. These include co-ordinating promotional activities while a band is on tour, contests, and target mailings to special "fan lists."

THE ROAD TO THE CHARTS

The important considerations to remember in record promotion are a band's marketing budget, its short- and long-term career goals, and maintaining professional working relationships with the industry.

Independent promoters are an essential part of a record's equation for success. Any band releasing an independent project should make room in its budget for a promoter. You'll have a tough time getting your music heard without one.

Nadine Condon *is a music business consultant specializing in promotional strategies. Her clients include BMI, The Polygram Label Group, MCA Records, Island Records, and Grammy Award winner Melissa Etheridge.*

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Electronic Musician
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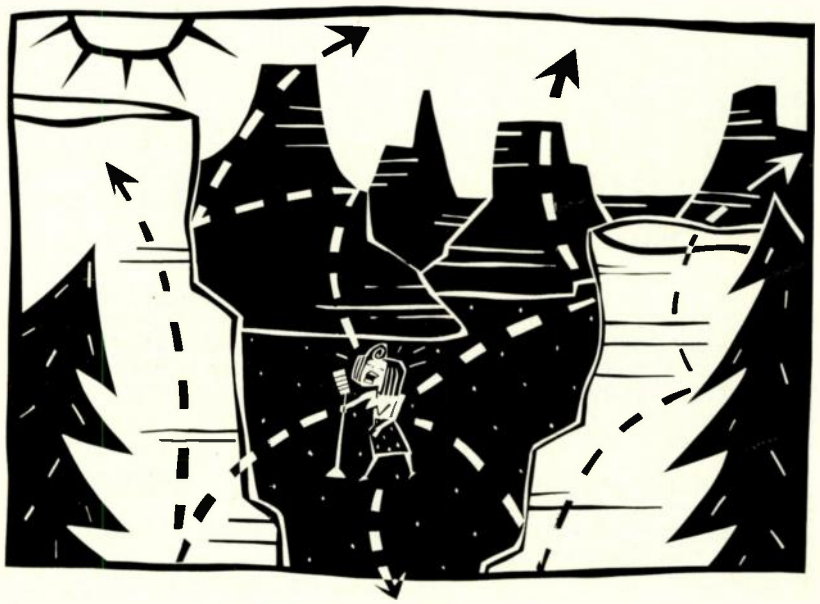
Mixing with Reverb

By Neal Brighton

A little restraint prevents your mix from getting lost in the wash.



Back when Phil Spector invented the "wall of sound," outboard reverb units consisted of long springs, heavy plates, and specially designed acoustic chambers. Obviously, few of today's personal recording studios have the space to accommodate these signal-processing monsters from the past. But unlike recording engineers (who are still debating analog vs. digital audio), reverb lovers can embrace the digital age without reservation. Thanks to the microchip, a smorgasbord of acoustic environments can fit into a 19-inch rack space.

Effectively using this bounty of easily accessible acoustical environments is another matter. Heavy-handed application of reverb can turn a well-recorded track into runny lasagna.

It helps to understand a bit about how reverbs emulate acoustical environments. The basics of reverb were explored in "Sing a Song of Reverb, Part 1" in the February 1986 **EM**, and "From the Top: Solving the Mysteries of Reverb" in the June 1991 issue, so if you don't understand the difference between early reflections and pre-delay, dig out those back-issues. (**EM** back issues and reprints of out-of-print articles are available from Mix Bookshelf; tel. [800] 233-9604, or [510] 653-3307.) If you've done your homework, you're ready to examine some applications.

WE ARE FAMILY

One of the major mixing applications for reverb is putting diverse elements into a common acoustical environment. An engineer often designates a particular unit—whether it's a personal favorite, the best box available, or a device noted for sonic excellence—as the "master" reverb. This overall reverb, which is often set to a medium or large room (or plate) with a decay time somewhere between 1.5 to 2.5 seconds, is used to process, in varying amounts, each instrument in the mix.

In effect, the master reverb gives the track an illusion of cohesiveness. A synthesizer without a natural (or internally processed) environment can sound like it was recorded in the same room as an electric guitar. The master reverb can bestow identical acoustic qualities upon every instrument, fooling the ear into believing the "band" played together. Multitrack sessions often record instruments at different times and in diverse acoustical environments, so employing a master reverb can make a track sound more organic.

HITTING THE TRACKS

While developing a master reverb is the most *organic* method of environmental control, it isn't the only way to spice up tracks, or even the most appropriate. Some engineers match individual reverb programs to specific instruments, then mix the processed tracks in a common "room" created with a master reverb. Other engineers couldn't care less about a cohesive environment and purposefully create diverse programs that highlight particular sounds and instruments. If you want to break up the band (sonically speaking), here are some specific reverb applications and ideas.

Drums. Although less fashionable today, gated reverb has been a popular percussion enhancement for years. In the past, a gated reverb sound was produced by sending the reverb returns (or outputs) into a noise gate and setting the threshold and release parameters to abruptly snap off the reverb decay. Now, almost every multi-effects device offers this sound as a factory

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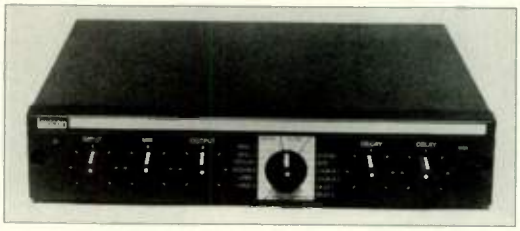
Ensoniq's DP/4 is a complicated multi-effects processor capable of constructing extremely detailed acoustic environments.

preset. A short decay "tail" can add more punch to snare tracks, although the resulting effect is considered by some to be rather clichéd. Playing with the gated reverb's room size and decay time can produce anything from pistol-shot slapbacks (cool on snares) to bizarre "percussive" reverb tails (very tricky on toms).

If you want punchy tracks, but can't stomach gated-reverb effects, try a short decay on a moderately large room or plate program. This big/short combo maximizes the impact of the drum without allowing a long decay to obscure other instruments. On a recent remix project, the drums (kick, snare, hi-hat, three toms, and four cymbals) were submixed to two tracks by the original engineer to free up space for more instrumental parts. It was obvious at the mixdown that the stereo drum tracks were pretty limp compared to the rest of the mix. Employing the big/short reverb energized the drum tracks without adding an obnoxious reverb decay to the hi-hat and cymbals. Minimal effort rendered the drum sound "naturally" punchy and saved the mix.

When constructing reverb environments, keep in mind that plate programs often accentuate the highs, while rooms tend to exhibit warmer timbres. Also, take care with the amount and time of early reflections, diffusion, and predelay. These parameters provide aural clues that help indicate not only room size, but where the listener is sitting relative to the sound source and reflective surfaces. If preliminary reflections or reverberation anticipate the direct percussion sound, you may end up with some weird, disorienting timing anomalies.

Guitars. When it comes to putting reverb on guitars, almost anything goes. Just be careful the decay time isn't so long that it washes out the track, a common mixing problem. If you really want ripping guitar tracks, critically assess if reverb treatment is necessary. A typical miked amplifier usually produces suitable ambience (depending on the room in which the guitar was recorded); if further treated with a guitarist's favorite effects processor, the guitar signal may already be over-processed. Depending on the mix and performance style, adding more reverb can actually *diminish* the power of the guitar.



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My rule of thumb is to start with a completely dry track. If the guitars burn, leave them alone. If not, sneak some reverb in until you're happy, then quit while you're ahead. It's always better to use less reverb than you think you need.

Keyboards. Except for lush string programs, few synths and sampler tracks survive being washed in large reverbs. The overwhelming ambience reduces most sounds to audio mush. But electronic instruments often benefit from a little extra substance. One of my tricks for fattening up synth tracks involves running the signal into a reverb unit that has a large room setting with a short decay time. Then, I route the output of this reverb into *another* reverb unit set with a medium plate and a long decay. The first reverb setting emulates the acoustics that would have existed if the sound source were miked, and the second reverb blends the synth into the overall mix. Be sure to adjust the wet/dry mix of the second reverb (or the effects-return levels, if you're routing the outputs of both units into your mixer) to prevent the long decay from compromising overall clarity.

Vocals. The lead vocal track often screams for reverb. Actually, the lead *vocalist* often screams for reverb. And he or she always demands tons more than is appropriate. Unfortunately, a voice submerged under a sea of reverb only serves to sink your mix. Because the vocal is often the prime element of a track, you must stop reverb overkill by any means necessary. A subtly processed voice punches out of a track; a reverb-doused mess usually gets lost in the wash.

If you insist on using a reverb with a long decay, try holding back on the effects-return level. A barely audible reverb wash provides a nice background ambience without overwhelming the track. And don't forget that adjusting a short reverb's pre-delay can make a relatively dry vocal treatment sound "wet." You simply move the onset of reverb closer to the direct signal (voice). In addition, keep in mind that every voice has a different quality and timbre, so audition plate and room reverbs until you find a program that works best.

CLEANING HOUSE

There are other ways to keep your mixes punchy besides backing off the reverb

(see "Recording Musician: Transparent Mixing," in the April 1993 EM). One of the major causes of compromised sound in effects devices is not maximizing the signal input. If you want to get more reverb out of your box, don't instantly crank up the output. Such a maneuver only increases your chances of dumping hiss into your clean mix. First, make sure the signal input level of the unit is as hot as it can get without distorting, *then* boost your output to the desired level. This simple technique maximizes your signal-to-noise ceiling.

It also pays to solo your reverb returns to check noise levels. Many low- and mid-priced processors exhibit some level of audible hiss, so I always put a noise gate on the effect returns. The gate ensures that residual noise is silenced when no signal is running through the reverb unit. Take care to set the gate's threshold and release parameters so that the reverb can decay completely. Some processors have internal EQ, and you can always run your effects returns into a mixer channel for equalization purposes, so there is almost no excuse for muddy reverb. I usually cut some bass frequencies to enhance clarity.

Some guitar processors, such as the Alesis QuadraVerb GT, offer flexible reverb parameters and can do double duty in the home studio.

A little-known problem is that using two or more models of the same reverb unit can cause signal-phasing. Try reversing the left and right outputs of each unit if you notice that your mids and highs are compromised.

QUICK DECAY

Well, there you have it. Reverb can make your mix sound larger than life, or it can flush clarity down the audio drain. If you employ reverb in a mix, don't forget that the effect plays as much a part in the overall sound as the instrument you are processing.

Ultimately, all the elements of a track influence the final sonic mix. So don't let that paranoid vocalist talk you into decorating his or her voice with the "Grand Canyon" reverb program. (This warning goes double if *you* are the vocalist.) And remember, keeping your tracks clean doesn't mean you can't have fun. Once I've maximized my signal levels, I toss the manuals into a drawer and start goofing with every reverb parameter I can get my hands on.

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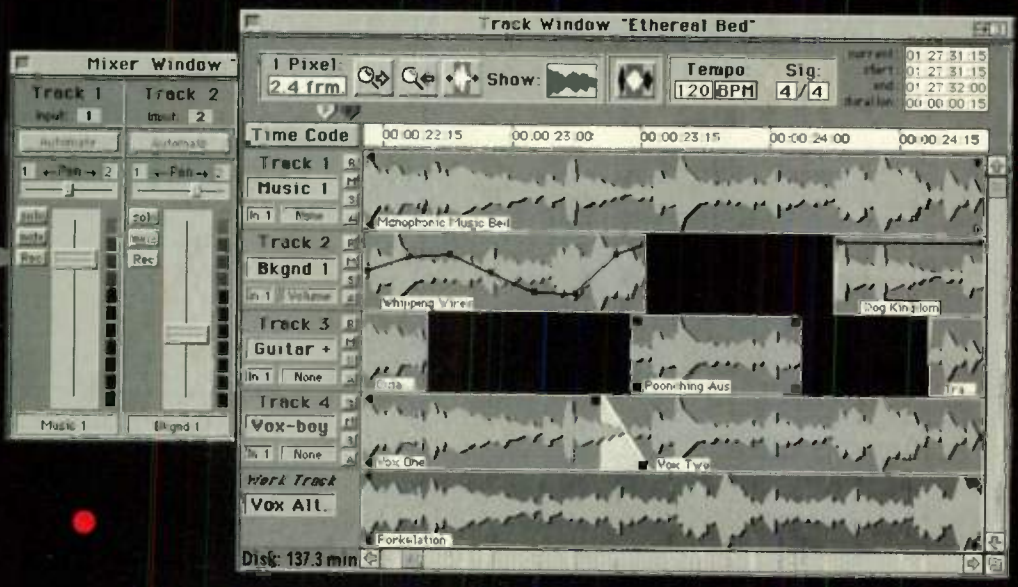

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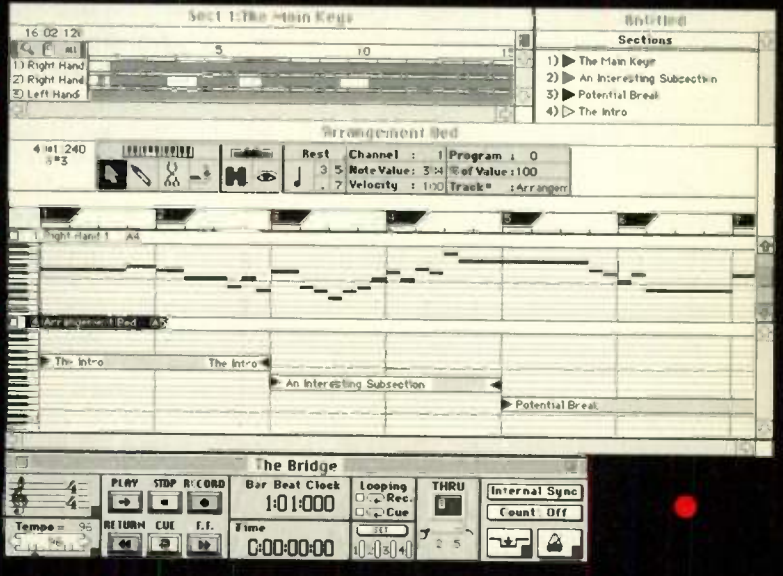

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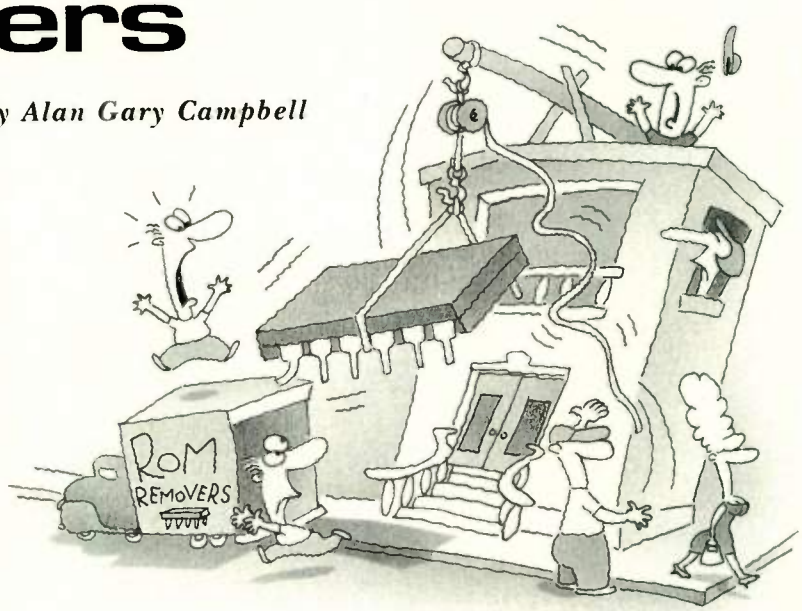
Questions & Answers

By Alan Gary Campbell

Our intrepid techno-journalist investigates suburban ROM-swapping and more



Q. What is the proper procedure for removing and installing ROMs? Do I need to purchase a commercial IC-removal tool?

A. Changing ROMs is a fundamental do-it-yourself skill that can be performed with common and inexpensive tools. It's easy, but you have to get it right, or you'll destroy the ROMs. ROMs can be irreparably damaged by static electricity, or by incorrect installation. A commercial IC-insertion and removal tool is a convenient accessory and a necessary aid for swapping multiple ICs in production work; but for ROM upgrades and other occasional do-it-yourself tasks, a miniature screwdriver is an adequate substitute, if used carefully.

ROMs are large, multi-pin ICs. The ones you can readily change fit into receptacles, called "sockets." You have to remove the old ROM from the socket and insert the new one without bending or breaking any pins. Make sure that the new one is not installed backward, as powering up with the chip in backward will destroy it. Before removing the old ROM, sketch a diagram showing the correct direction of installation. Most ROMs have an orientation notch on one end, and pin 1 (which is usually keyed on the circuit board) is often indicated by an indentation or a dot.

To protect against static electricity, a properly grounded conductive wrist strap (Radio Shack 276-2397, or equivalent) should be worn. Use a nonconductive tweezer or a miniature needlenose plier with insulated grips to handle the ROMs. (For more on the dangers of static electricity, see the January 1993 "Service Clinic.") Excessive handling should be avoided; keep the ROMs in their protective packaging until needed.

With your wrist strap on and grounded, use a miniature flat-blade screwdriver and pry up each corner *gently*, a little at a time, until the old ROM is free. Work slowly and carefully; if you pry up too much on one corner, you'll bend the pins on the opposite side. Don't try to pull the ROM out with your fingers; the socket will "let go" all at once, and you'll bend or break a lot of pins, probably sticking some in your finger.

Lift the old ROM out with the nonconductive tweezer or plier. Before you install the new chip, you'll probably have to "form" the leads slightly. Get an IC pin-aligner (Radio Shack 276-1594, or equivalent); this inexpensive, static-safe device will form the leads in seconds. Note that the body of the pin-aligner must be properly grounded.

Using the tweezer or plier, carefully place the properly oriented ROM in the socket. Check visually to verify that all the pins mate properly with the respective socket holes. Gently push the ROM into place until it "seats." Take care not to apply excess, or off-center, force; you might break a pin or fold it under IC, causing permanent damage. Double-check each ROM for proper installation before power-up.

Similar procedures apply to smaller ICs. While it is true that many analog ICs and most TTL digital ICs are not especially static-sensitive, it is wise to follow static-safe procedures, just in case.

Q. Is there any way to easily check the phase of audio inputs and outputs? I've read that phase inversion can degrade the sound, and I'd like to maintain phase continuity throughout the signal chain. Is this possible?

A. There is considerable controversy with regard to whether or not absolute

continued on p. 130

JACK DESROCHER

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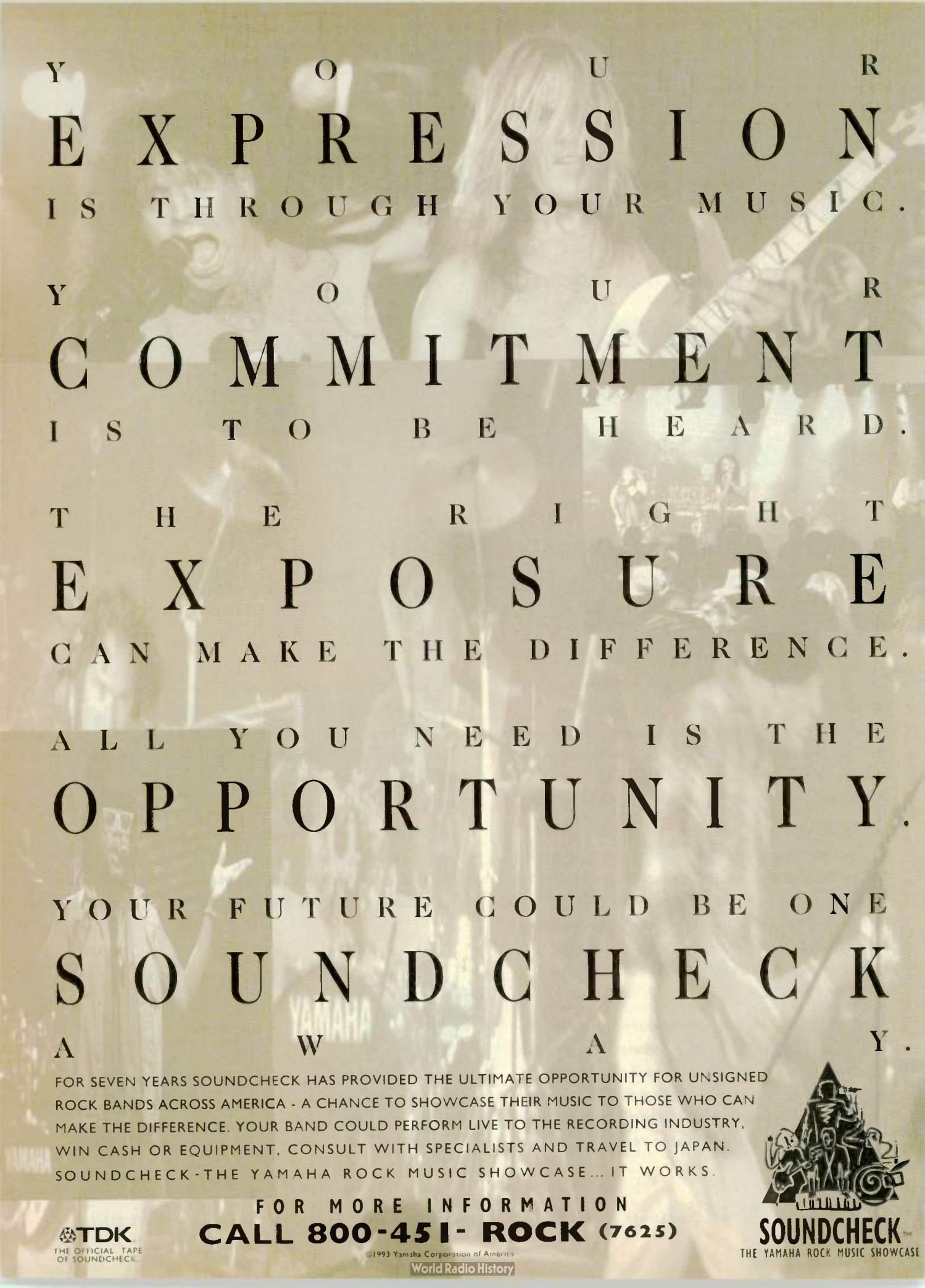

found in many instruments. Of course, you sacrifice the advantages of having everything in one package.

However, the Vintage Keys has several new tricks that push its synthesis resources to a much higher level than the Proteus sound engine. First and foremost are high-quality, digital, resonant, lowpass filters (one per Instrument) that, combined with the unit's versatile, easy-to-use modulation-routing scheme, help make the Vintage far more than a mere sample player. While they're not actually analog filters, they sound extremely good by any standard and offer a choice of 2- and 4-pole response (providing 12 and 24 dB/octave response curves).

The digital filters give the Vintage the ability to generate complex, expressive sounds. (I'll be the first one in line if E-mu adds these filters to the original Proteus.) Synthesizer purists would probably dispute the idea that a single digital filter can reproduce the variety of subtle characteristics exhibited by different filter designs. There's no mistaking the timbre of an Oberheim SEM or Minimoog filter, and if you're familiar with analog synthesizers, you'll probably agree with the purists. But for practical purposes, who cares? Some might wish for multimode operation and other options, but I'll take these excellent-sounding filters, thanks.

Another important Vintage feature is polyphonic portamento, which helps the unit re-create many of the sounds associated with analog synthesis. The glide is remarkably smooth and realistic, an accomplishment for which tech heads should be grateful; this effect is not trivial on sample-based sound modules. The portamento time can be modulated by a number of controllers, but, unfortunately, it can't be turned on and off using one of the three available MIDI footswitch messages.

Finally, the Vintage is equipped with 8 MB of sample ROM, twice that of a stock Proteus. Better yet, the ROM can be upgraded by the user to 16 MB.

THE GOOD NEWS

After only a few days, I discovered the Vintage Keys' alter ego. It is a powerful, extremely versatile synthesizer with a huge variety of modulation routings.

After a short warm-up, I was able to navigate around the various parts of the Vintage voice engine without problems. Several days and three dozen original sounds later, I had barely scratched the surface. This instrument is definitely for the serious sound programmer. Between the internal modulators and the large number of MIDI controllers, the Vintage provides almost as much raw horsepower as a small modular system. Surprisingly, some of the looped and layered samples provide timbres that my Oberheim Xpander can't touch.

Although the Vintage Keys has a lot of potential for those willing to invest the programming time, most modern synths succeed or fail in the market based on their factory presets. E-mu's recent Vintage Keys advertisement urges us to "think of it as the world's largest collection of classic analog keyboards," and that's how we should evaluate it. This brings us back to the questions posed earlier about whether the Vintage Keys really sounds like the classic synths, or at least sounds close enough.

First, here's the good news. The Rhodes and

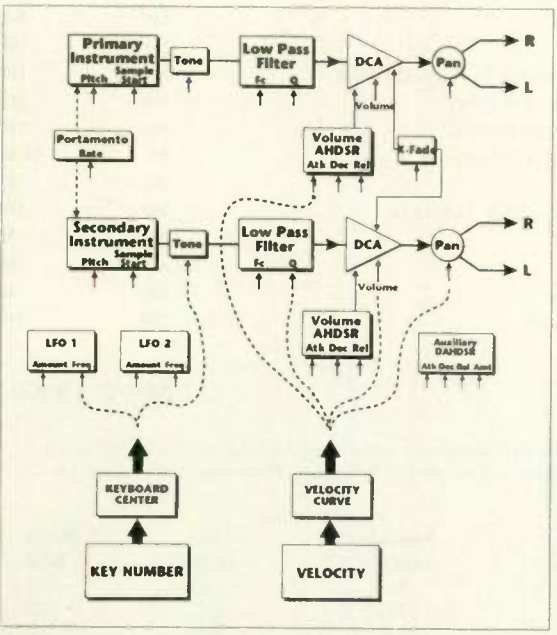

FIG. 1: The Vintage Keys' architecture, including its keyboard and Velocity modulation routings, are very Proteus-like. The biggest differences are the resonant lowpass filters and portamento. (Courtesy E-mu Systems.)

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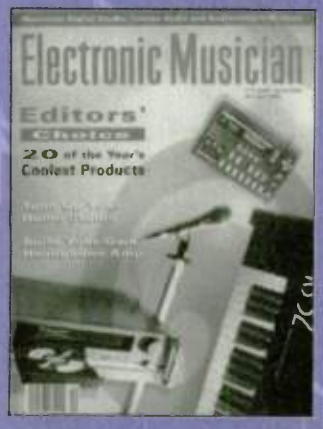

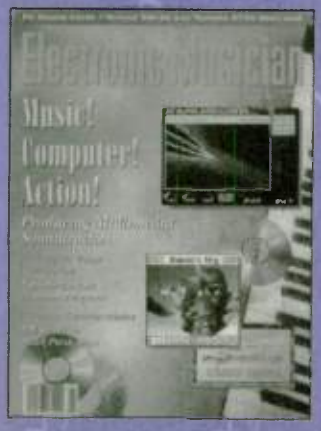

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B30505

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B30505

Wurlitzer electric piano patches are gorgeous. They're clean, crisp, warm, and funky, and the source samples appear to have been prepared with loving care. There are two variations of each, played with hard and soft attacks. If you prefer authentic electric pianos to FM or other synth substitutes, I recommend that you check out the Vintage right away.

As anticipated, it has some fantastic synth samples. The fat, gutsy Moog 55 Rez offers lots of motion, and the Memorymoog is among my favorites. There are also a large number of sampled waveforms from additive, analog, and digital sources; these are excellent for beefing up lackluster sounds without heavy editing. For example, the slightly detuned Oberheim OBx sawtooth waveforms can be used to assemble huge bass and pad patches.

My main gripe regards a few short loops on the Minimoog samples. While the Clavinets were wimpy, I found it fairly easy to edit them into something better. Overall, most of the synth samples sound great, even when they don't sound just like the original instrument.

THE BAD NEWS

Now, the bad news. It's just too much to ask of any reasonably priced, contemporary sound module to duplicate the timbres from dozens of legendary instruments that had little in common, sonically speaking. While some emulations are excellent, many just aren't convincing, and there are a number of out-and-out disappointments.

The Vintage proved to be especially weak at reproducing the Leslie effect on its Hammond organ samples. It features a wide variety of B3 samples with various drawbar and other settings, but I found virtually all the Hammond-with-Leslie patches surprisingly unrealistic. A little listening revealed that the problem isn't poor-quality Hammond samples; the samples (of Keith Emerson's B3, incidentally) are extremely well-recorded.

Instead, E-mu's approach to the Leslie effect is unsound. The Vintage simply crossfades between two multisamples of the Hammond with the Leslie speaker rotating at its fast and slow rates. There is a sudden, jarring transition between rotation speeds, instead of continuous acceleration and deceleration. There's no Doppler effect and no emulation of the Leslie's complex acoustics when the speaker baffle changes speeds. It simply doesn't sound like a real Leslie. The first preset in the unit uses some LFO tricks to achieve a better Leslie-like effect, but it's still not convincing. However, I played the Hammond patch that includes a slowly rotating Leslie speaker through an external signal processor with a superior rotary-speaker simulation. This made all the difference between "lame" and "killer."

After comparing the Vintage Keys with my Minimoog, Oberheim Xpander, and Oberheim 2-Voice, I give the Vintage a B-minus. While the new synth has plenty of pads, leads, and basses that sound analog-like, the patches lack subtle details that play a big part in a real analog synth sound.

For example, many analog synths, such as the Minimoog and Oberheim Two-Voice, produce noticeable intermodulation distortion, which often enhances their sound. The Vintage Keys always puts out a clean, crisp sound across the entire dynamic range, which simply isn't the same. Perhaps a subtle analog overdrive or distortion effect would partially make up for this deficiency, but it probably wouldn't sound quite right. In addition, there's no pulse-width modulation or phase-sync, two popular analog techniques for generating aggressive, gutsy sounds, although there are a couple of samples of phase-synched tones. What a pity.

Of course, the Vintage is far more stable than an analog synth. Its presets remain set exactly as you leave them; even the filters stay perfectly calibrated. Besides, the resemblance is close enough that you could use the Vintage Keys in place of some dinosaurs onstage; most audiences don't care where the sounds originated anyway, as long as they're good. I doubt the Vintage would fool critical listeners as an emulation device, but it might please them on its own merits.

PROTEUS REVISITED

As I went through the entire sample ROM, I was struck by the fact that several Vintage samples—notably the trumpet, sax, and trombone—also are in the Proteus/1 sample set. According to E-mu, this was done to complete the demo sequence. Similarly, the onboard drum kit uses exactly the same samples as those in the ProCussion. The sounds are somewhat enhanced by sampled room ambience, which can be layered with the drums.

I would prefer to see E-mu use this ROM space—approximately four percent of the Vintage's memory—for something more suited to the vintage theme. For instance, they could have completed the demo sequence with classic synth brass and kits of Roland, Linn, and Simmons electronic drums. Fortunately, E-mu advised us that some of the classic drums are high on the list for the next upgrade.

Product Summary

PRODUCT:
Vintage Keys
PRICE:
$1,099
MANUFACTURER:
E-mu Systems
1600 Green Hills Rd.
Scotts Valley, CA 95066
tel. (408) 438-1921
fax (408) 438-8612

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

EM MEETS E-MU

Electronic Musician has examined the Vintage Keys' ancestral Proteus sample-player modules in four reviews and one applications-oriented feature article. For more on this popular family of products, see the following articles:

REVIEWS

Proteus/1	October 1989
Proteus/2	December 1990
Proteus/3 World	August 1992
Proteus MPS	April 1992

APPLICATIONS

"The Art and Craft of Using E-mu's Proteus"	March 1990

Back issues of EM are available from Mix Bookshelf; tel. (800) 233-9604 or (510) 653-3307; fax (510) 653-5142.

CONCLUSION

I am of two minds concerning this product. On one hand, there's the synth that E-mu claims will re-create the sounds of well-known classic keyboards. On the other, you have an expressive, powerful, sound module that provides plenty of explosive sounds, many of which bear a close resemblance to the sounds of classic instruments.

In the end, the question of how well the Vintage pulls off the sound of classic keyboards boils down to how close you need to come to the real thing. (Of course, we're talking about sampling, not physical modeling; E-mu can supply "snapshot" examples of specific analog patches, not the awesome variety an analog synth can produce.)

Having put up with the limitations of analog synths for nearly twenty years, I have no problem settling for an imitation in certain situations, as long as I have the original instruments on hand for certain projects. And if you're mostly looking for a synthesizer that combines powerful programming features with old, yet fresh-sounding waveforms, the Vintage could be just what you need. But don't sell your Minimoog, ARP 2600, and Oberheim Xpander quite yet.

(Special thanks to Frank Stratton at Studio Resource Centers in El Cerrito, California.)

Charles R. Fischer *is a test technician for AKG Acoustics, Inc. He also writes for several magazines, designs MIDI controllers, and is planning to record a new album of his compositions later this year.*

Kurzweil K2000RS Synthesizer/Sampler

By Scott Wilkinson

What do you get when you cross a sampler with a synthesizer?

Since its introduction, the K2000 has become one of the most popular synthesizers available. And no wonder; its large sample ROM, optional sample RAM, and flexible synthesis architecture make it a mighty instrument. In addition, there is plenty of third-party support, including editor/librarians and lots of sounds.

As soon as the keyboard appeared, many people—myself included—immediately asked about a rack-mount version. Kurzweil neatly avoided the issue and reminded us that a sampling option was on the horizon. That sounded interesting, so we waited with baited breath.

Well, the wait is finally over: The sampling option *and* rack-mount version are available. The family tree now includes the K2000 and K2000S keyboards, as well as the K2000R and K2000RS rack units; "S" denotes the presence of the sampling option. Not only that, the internal software has undergone two major updates since the original K2000. Version 1.3 is standard on non-sampling instruments, while version 2.0 includes all sampling functions and other enhancements.

I'll concentrate on the sampling capabilities and version 2.0 software, but will also cover the major changes found in version 1.3. If you are not familiar with the basic structure of the K2000 or VAST (Variable Architecture Synthesis Technology), refer to the original review in the March 1992 **EM**.

FIRST GLANCE

The K2000RS is a 3U rack-mount module with the same graphic LCD and associated soft buttons as the keyboard version. The rest of the buttons and the data wheel are essentially the same, although their arrangement is somewhat different as dictated by the rack-mount design. I like the layout; it's logical and easy to get around. Some of the multifunction Mode buttons have even more functions with the sampling option installed, but I didn't find this a problem, as the labels are nicely color-coded.

With the sampling option, the front panel also sports several input connectors. Along with an optical input for digital signals, the analog inputs include two low-impedance, balanced XLRs (rack version only) and one high-impedance, ¼-inch stereo TRS (two separate, unbalanced signals).

The rear panel includes MIDI In/Out/Thru, eight individual audio outputs arranged in four stereo pairs, two main stereo audio outputs, and two

25-pin SCSI ports. The sampling option adds two XLR jacks, one each for digital input and output. The digital input can accept AES/EBU or S/PDIF signals under software control; all you need is a cable adapter to receive data from an RCA S/PDIF source. (For more on digital audio formats, see "The Digital Puzzle" on p. 24)

The digital output is always live, sending anything generated by the K2000 in real time (except when sampling from the digital input). During analog sampling, the input signal is sent to the digital output, which provides analog-to-digital conversion as a bonus.

The K2000RS includes powerful sampling and synthesis capabilities in a 3U rack-mount design.

ARCHITECTURE

Although the K2000 architecture was described in the original review, I'll summarize it here, including some of the changes in version 1.3. The maximum polyphony of all K2000 models is 24 notes, with 16-part multitimbral operation. A single, MIDI-controllable, DigiTech effects processor offers 27 mono, stereo, and multi-effect algorithms. The sequencer is rudimentary, with a maximum capacity of 7,500 notes per Song (15,000 notes total). Rumor has it that the next major software revision will include more comprehensive sequencing capabilities.

Individual samples form the foundation of the sound architecture. Version 1.3 supports stereo samples, which are indicated with an "S" in their name. Stereo samples can also be split into two mono samples. All K2000 models include 8 MB of sample ROM, and Kurzweil will offer two additional 8 MB ROMs for $459 each.

All K2000 models can be loaded with up to 64 MB of sample RAM in the form of standard SIMMs. This lets you import your own samples from floppy disk, SCSI, or MIDI. Of course, sample RAM is essential for the sampling option. The K2000S and K2000RS come with 2 MB of RAM.

To form a multisample, up to 384 samples are assigned to a Keymap. One or two Keymaps are then assigned to a Layer, in which the samples are processed through one of the 31 real-time DSP algorithms that comprise VAST. Up to three Layers are combined to

form a Program; special Drum Programs can include up to 32 Layers (which don't have to be drum sounds). Up to three Programs can be combined in a Setup, which lets the instrument transmit on up to three MIDI channels.

Apparently, many people were dissatisfied with the original factory sounds. Version 1.3 includes a new set of factory sounds, which most people like better, according to dealer feedback. However, I don't like them as well as the original sounds; many have excessive top-end emphasis. This is a trend in pop music, and I seem to be in the minority on this point. Fortunately, all K2000s come with a disk that includes the original sounds.

Except for samples, all objects (Keymaps, Layers, Programs, Setups, Effects presets, Songs, etc.) are stored in battery-backed Program RAM (P-RAM). The standard configuration is 120 KB, but version 1.3 includes support for an optional expansion to 760 KB ($395).

Many types of internal (up to 760 MB) and external SCSI drives are supported, and version 1.3 includes support for SMDI (SCSI Musical Data Interchange). I tested the K2000RS at one end of a SCSI chain that included a SyQuest 44 MB removable cartridge drive; a 600 MB, magneto-optical (MO), removable-cartridge drive; and an Akai S1000 at the other end, making sure there were no SCSI ID conflicts or unnecessary termination. In this configuration, both the K2000RS and S1000 experienced problems; removing either instrument from the chain and applying the proper termination eliminated the problems. (There are no problems in the system's normal configuration: S1000 to SyQuest to MO to S1000.) Unfortunately, the ways of SCSI are mysterious, and I never managed to track down the cause of the trouble.

VERSION 2.0

The K2000S and K2000RS come with version 2.0 software, which is required for sampling; the K2000 and K2000R come with version 1.3. Even if you don't have the sampling option, you can install version 2.0 firmware ($150) in order to take advantage of its other enhancements.

Aside from sampling and editing (more on that in a moment), the major features of version 2.0 include backup and copy functions in Disk mode. These features let you copy files directly from one disk to another without having to load everything into the instrument as an intermediate step. The instrument will even copy a large, fragmented file that was saved on several floppies and combine them into one file on a hard disk, which is very cool.

SMDI dumps are up to twice as fast as with version 1.3, depending on the other device or program. In addition, support for other formats is now expanded to include the following instruments: Akai S900/S950 (floppy only); Akai S1000/S1100, Ensoniq EPS/EPS-16+/ASR-10 (floppy and SCSI); and Roland S750/S770 (SCSI only). Obviously, this is of great benefit to owners of these instruments who have collected large libraries of samples.

I tried importing samples and programs from an Akai S1000 hard disk into the K2000RS. As you might imagine, files in a non-native format take much longer to load than those in K2000 format. Stereo Akai programs and samples are imported as 2-Layer K2000 Programs because the S1000 saves stereo samples as two separate files. Unfortunately, the Layers are not completely synchronized, resulting in an unintentional flanging effect. In addition, the two sides are not linked; editing one side doesn't affect the other. This can be fixed by rearranging the samples as two Keymaps in one Layer. Nevertheless, I would like to see a function that lets you tell the K2000 what to do with incoming samples: arrange them as a stereo sample, two Keymaps in a stereo Layer, or two separate Layers.

SAMPLING

The sampling option can be added to a K2000 or K2000R by installing the SMP-K ($595) or SMP-R ($645), respectively. It operates with 16-bit resolution, using 18-bit analog-to-digital converters. Available analog sampling rates are 29.4, 32, 44.1, and 48 kHz.

I performed some informal, subjective comparisons of sound quality between the K2000RS and the S1000, using the same sample in both units, with maximum output levels, no EQ, and equal input levels on the mixer. I heard virtually no difference in the quality of sample playback between the units, although the K2000RS had a noticeably higher noise floor when no

FIG. 1: In this example, the Sampling page is set for digital sampling. For analog sampling, the digital-specific parameters are replaced by sample rate and gain.

sound was being played. This was undoubtedly due to the effects processor; the noise floor dropped significantly when the effects wet/dry mix was set to 100% dry, or the output was taken from the individual outs instead of the mix outs. (In Program mode, the noise floor from the mix outs sometimes changes noticeably as Programs with different effects are selected.)

The process of sampling is straightforward. All sampling parameters are set on the Sampling page (see Fig. 1), and a stereo level meter in the display helps you set gain levels for analog sampling. If the threshold parameter is turned off, sampling begins immediately after you start the process; if not, sampling begins after the input signal exceeds the threshold level.

Sampling is initiated by pressing one of three soft buttons. Record simply begins sampling according to the threshold setting. Auto works like Record, but the sample is automatically saved with the lowest available ID number above 199 and assigned the root key C4; this feature is convenient for taking several samples in quick succession. The Timer soft button counts down ten seconds before starting to sample.

After sampling is complete, you are asked to strike the root key (assuming you didn't use the Auto button), followed by the opportunity to save the sample. If the signal clips during analog sampling, the word "Clip" appears in the display along with the number of clips; if no clipping occurs, the maximum level is displayed in dB.

The new sample (or any sample selected on the Sample page) can be played immediately from the keyboard or front-panel buttons. The K2000 automatically assigns it to a temporary Keymap, Layer, and Program. This didn't work initially; playing the keyboard triggered the Program on that channel. As it turns out, the Transmit Program Change parameter on the MIDI Transmit page had been turned off somehow, possibly when loading a file with this setting. Turning on this parameter solved the problem. Kurzweil admits this is a bug that will be fixed in a future version.

EDITING

After selecting a sample (including any ROM samples) in the Keymap editor or Sampling page, it can be edited in a

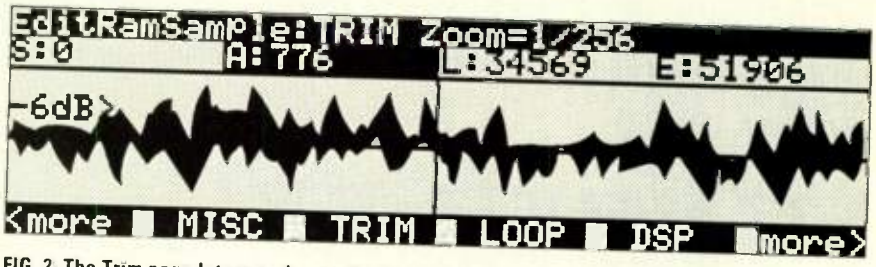


FIG. 2. The Trim page lets you change the Start, Alternate Start, Loop, and End points.

variety of ways, in one of four pages: Trim, Loop, DSP, and Misc. All modifications can be heard by playing the keyboard in the specified key range, and nothing is permanent until you make it so. Zoom In/Out and Gain +/- are available as soft buttons in the Trim and Loop pages and affect the waveform display only. Zoom provides horizontal magnification, adjusting the displayed distance between individual sample points, while Gain +/- offers vertical magnification. The two features are also implemented in the multifunction Mode buttons.

The Trim page (see **Fig. 2**) lets you move the Start, Alternate Start, Loop, and End points of the sample. You can cause the sample to start playing from the Alternate Start point under user-specified conditions, such as moving the mod wheel more than halfway through its travel. This is an either/or switch; I wish the software included the ability to continuously vary the Start point according to Velocity.

Initially, the Start and Alternate Start points are coincident, as are the Loop and End points. (Loops are defined between the Loop and End points.) The positions of these points can be specified in milliseconds, or number of individual samples. The selected point always appears in the center of the waveform display, shifting the relative position of the waveform. An Audible Sample Cueing feature lets you hear the appropriate portion of the sample as you move a point. The Link function allows you to associate two or more of these points; as you move one point, any linked points move accordingly.

Adjusting the Start and End points in the Trim page doesn't truncate immediately; it merely moves pointers around so you can hear the results of your edits. If you save the sample, the new points become permanent, although the entire waveform continues to appear in the display if you leave the Alternate Start point at the beginning of the original sample.

In the Loop page, the waveform area is divided into two parts. On the left is a shortened waveform display, while the right half contains a loop display similar to those found in sample-editing programs (see **Fig. 3**). The looped segment (as defined by the Loop and End points) begins in the center of the loop display and proceeds to the right. It wraps around to the left side of the loop display, ending at the center. This lets you match the beginning and end of the looped segment. Pressing + and - together advances the selected point to the next zero crossing in either direction, a valuable shortcut.

Because the looped segment is defined by the Loop and End points, it might seem the end of the loop is always the end of the entire sample. But you can circumvent this by moving the End point forward and placing the Alternate Start point at the end of the sample, where it acts as the new End point. In this case, the order of

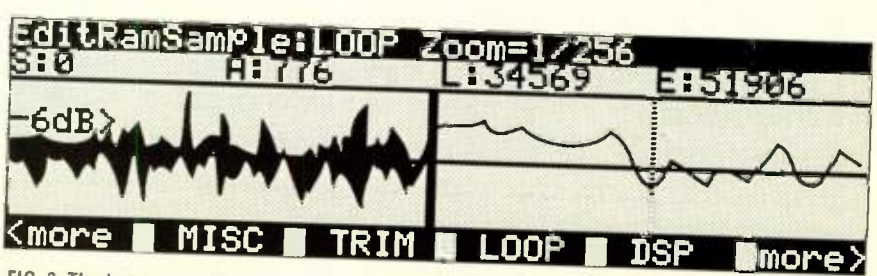


FIG. 3. The Loop page shows the waveform in the left half of the display and the loop transition point in the right half.

points is: Start, Loop, (Loop) End, and Alternate Start. Thus, the sample starts playing and proceeds into the loop, which continues until key-up, after which the sample plays to the end. (The Release Rate parameter in the Misc. page must be slow enough to hear the end of the sample after key-up.)

The DSP page is available for RAM samples only. Non-real-time DSP functions are applied to any segment of the sample as defined by separate Start and End points. Again, no operation is irreversible until you consciously replace a sample. However, there is no way to stop a DSP process before it's finished, and some functions take quite a long time to complete. I wish the instrument provided an abort button to stop the process at any time.

The "slice-and-dice" functions include crossfade curves to smooth out the transitions between the affected sample segments. These curves include linear, exponential, cosine, equal (same at both ends of the crossfade), and mix (a combination of linear and exponential). The cut, copy, and paste functions work just like their computer counterparts: The cut or copied segment remains in a clipboard until it is replaced by another segment, or the power is turned off.

Although I can't describe every DSP function in the allotted space, they are comprehensive. Basic functions include normalization, truncation, overall volume adjust, and two types of volume ramping. The selected segment can be cleared (replaced by silence), deleted, reversed, or inverted, which flips the entire segment over the zero line.

Crossfade looping is performed in the DSP page. I might have preferred to see it in the Loop page, but after debating the issue, the Kurzweil engineers decided it was a DSP function. This function includes all of the crossfade curves mentioned earlier.

The DSP functions also include pitch shifting, time expansion/compression, and sample-rate conversion. All these functions include a "Quick" parameter that determines the quality of the end result; higher quality takes longer to complete. Pitch shifting works well, with few or no audible artifacts at the highest-quality setting.

Unfortunately, time expansion has some problems, even at the highest-quality setting. In one test, I stretched

the duration of a single-pitch sample by a factor of two in the S1000 and K2000RS. The S1000 sounded quite good, while the K2000RS induced many gurgling artifacts. I also stretched a rhythm loop of 9.3 seconds to 11 seconds; although there were still a few artifacts, the overall result was much better.

Several DSP functions let you replace or mix the selected segment with a segment from a second RAM sample. You can also insert the second segment at any point in the primary segment. In addition, four "beat" functions replace or mix the second segment into the primary segment at regular intervals. These intervals are determined by tempo, starting beat number, and offset (how many beats between occurrences) parameters. You can even cause the second segment to come from different areas of the second sample for each repetition, and the volume of each repetition can be progressively adjusted. These unique functions are designed to create and modify rhythmic loops, which is a very clever idea.

The Misc. page include a number of parameters that apply to the entire sample. These include root key, pitch adjust, volume adjust, alternate start volume adjust, decay rate during sustain, release rate after key-up, loop on/off, loop playback (forward, backward, bidirectional), alternate start sensing (norm/reverse), and ignore release (which should be turned on only for samples that inherently decay to silence).

Product Summary

PRODUCT:
K2000RS
Synthesizer/Sampler
PRICE:
$3,595
MANUFACTURER:
Kurzweil Music Systems
Young Chang America
13336 Alondra Blvd.
Cerritos, CA 90701-2205
tel. (310) 926-3200
fax (310) 404-0748

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

CONCLUSIONS

The K2000RS is one deep machine. New users can expect a substantial learning curve, but the documentation is excellent, so you should be able to find your way without too much trouble. Version 1.3 fixed some bugs and added many new features. Version 2.0 adds sampling functions and quite a bit more. In particular, the ability to read more sample formats and the disk backup/copy functions are greatly appreciated.

The sampling option includes a full complement of input and editing features comparable to any high-end sampler. The sound quality is excellent, the DSP functions work well (except for time stretching), and the ability to send signals from the analog input directly to the digital output in real time is a great touch. The ability to easily audition samples and edits without commitment is also a big plus.

Aside from a few quibbles, I am quite impressed with the K2000RS. By crossing this much sampler with a powerful synthesizer, Kurzweil has created a new breed of electronic musical instrument; perhaps we should call it a "samplesizer." And as a firmware-based device, its descendants will keep getting better without making orphans of previous owners.

(Special thanks to Brett Rosenberg and Jeff Rona for their help with this review.)

Barefoot Software SMPTE Track Platinum

By Mike Rosen

New life for a classic Atari sequencer.

The collapse of Hybrid Arts rendered two distinct product lines homeless. Digital F/X purchased the defunct firm's hard-disk recording hardware (Digital Master EX, reviewed in the April 1993 EM). But Hybrid Arts was best known for its Atari software, especially its *SMPTE Track Gold* sequencer, and aficionados have awaited a champion who was prepared to support and develop the software line.

Now, out of the West strides a barefoot newcomer—Barefoot Software, that is—founded by ex-Hybrid Arts staff members. Barefoot's first step is the release of *SMPTE Track Platinum*, the latest version of *SMPTE Track* for the Atari 1040ST/STE, Mega ST, TT 030, and Falcon030 computers. I ran *STP* on an Atari Mega 4 ST with monochrome and color monitors. Although it runs well in monochrome, running *STP* in color makes the program look far better, despite the lower screen resolution (320 × 200 in color, as opposed to 640 × 400 in monochrome).

The main screen is broken down into tiles (sections) so the user can choose between three different preset configurations. The default Tile configuration consists of the Track Tile, which lets you see twelve of your 60 tracks at a time; a Transport Tile with typical Play, Record, Rewind, and Fast Forward buttons; a Group Mute Tile that lets you mute tracks according to MIDI channel; and a Control Tile that allows you to manipulate MIDI Control Change events (see **Fig. 1**). *SMPTE Track Platinum* also gives you a Tile that shows 24 tracks onscreen; *SMPTE Track Gold* users will appreciate this improvement over the twenty tracks visible in *Gold*.

RECORDING

The clock resolution in *STP* is selectable between 96 and 192 ppqn. While that's low in comparison to professional sequencers today, the feel of *STP* was pretty good, and the overall timing of the program was solid.

According to the folks at Barefoot, *SMPTE Track Platinum* can be used as a linear sequencer, pattern-based, or both. I quickly found the program's weak point when I used it as a linear sequencer, however. Simple things such as recording four measures of drums and copying it three times to quickly create a 16-bar phrase should be easy in any sequencer. It's not simple in this one. For example, after recording the four measures, you click on the Cash Register icon to get to Section mode. In Section mode, you select the track with the 4-bar drum groove and change the start- and end-time counter to select the pattern length. Then you must select the Repeat Bar icon to get back into Register mode and change the Counter to select the

● SMPTE TRACK

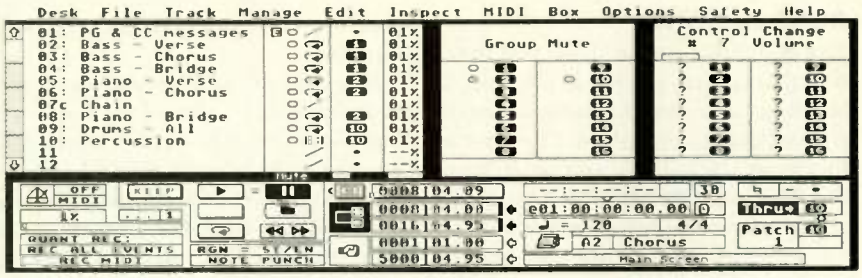


FIG. 1: *SMPTE Track Platinum*'s main screen comprises several sections, or Tiles. The default configuration consists of (from left to right) the Track Tile, a Group Mute Tile that lets you mute tracks according to MIDI channel, a Control Tile that allows you to manipulate MIDI Control Change events, and the Transport Tile (bottom center).

destination where you want the new phrase to start. Finally, you select Glue In Section from the Edit menu and tell the dialog box how many times you want to copy the section. Holy convoluted groove-buster, Batman! Having to do those same steps every time you need to copy-and-paste a small phrase gets tiring.

I really like the Punch In and Out counter, which lets you play along with the track, automatically punching in and out at a selected time. *STP* then puts the new version on a different track, preserving the original recording.

LOOP RECORDING

Like most sequencers, *STP* allows you to loop-record. Every time *STP* completes the selected loop length, it automatically puts the new pass on a different track. For example, if you have a 4-bar loop and recorded a clave for four bars, then a cowbell for four bars, the clave and cowbell will automatically be put on separate tracks.

After recording, you have three track-assignment options: Clean takes every instrument on each track and combines them onto one track; Semi combines only selected tracks; and Rename (which doesn't rename anything) leaves all the tracks intact so every pass stays on its respective track. With Rename, you could easily delete the clave or cowbell without having to go into one of your editors. The only drawback to these options is you are constantly naming and renaming tracks.

EDITING

The program offers a Text Editor that shows all MIDI events numerically (in hexadecimal and decimal) and a Graphic Editor that shows MIDI events in "piano-roll" form.

The Text Editor provides an overview of what is happening in any one track and is useful for adding and deleting events such as Control Changes and Program Changes. On the other hand, editing the flood of separate Note On and Note Off messages in a list gets very confusing. It doesn't help that the Text Editor won't let you audition the track you are editing in real time; instead, to hear Note On information you have to manually select the Quarter Note Play icon located next to each Note On message.

The "piano roll" Graphic Editor is more intuitive. Notes are displayed graphically in relationship to the piano keyboard (see **Fig. 2**). In the upper part of the screen, events such as Velocity

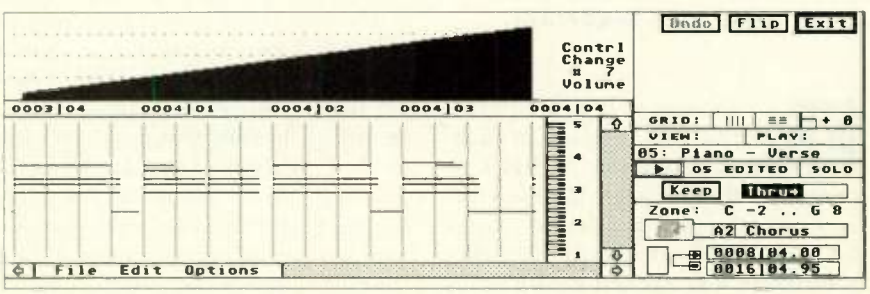


FIG. 2: The Graphic Editor offers graphic representations of Velocity, Control Changes, and other MIDI events and lets you edit them by drawing in curves with the mouse. A "piano roll" display (bottom) shows notes graphically in relationship to the piano keyboard.

(for each note event), Pitch Bend, Channel Pressure, and Control Changes are graphically displayed. You can zoom in to display a single measure, or zoom out to see the whole track.

Making notes shorter and longer can be accomplished by simply selecting the note and using your left or right mouse button to "drag" the start or end of the note to its new duration. Selecting both mouse buttons allows you to move the entire note to a new location. Unfortunately, the Graphic Editor can't automatically move ("snap") the note to a quantized increment on the screen when you release the mouse button. It has a Vertical Grid that helps guide you when editing note values (from a quarter-note to sixteenth-note triplets), but you must be precise when moving notes on the screen.

The graphic representations of Velocity, Control Changes, and other MIDI data at the top of the Graphic Editor page let you edit events by simply drawing in curves with the mouse. This function works well, especially if you need to increase or decrease Velocity for one or two notes, or fade MIDI Volume up or down for a specific track. The Graphic Editor also provides functions such as Zap (erase), Exchange Channel, Weed Duplicates, Velocity Adjust, Alter Timespan (changes sequence duration to fit a specified time), and Quantize, which lets you manipulate data in a whole region, or just one note.

STP gives you three quantization choices. Move Note moves the entire note to the nearest selected quantize value. Shift Attack keeps the original Note Off event where it is and only moves the Note On to the nearest selected quantize value. Finally, the Swing option lets you choose the amount of swing by preset percentages. Swing Quantize did a good job of tightening up phrases that were recorded with a swing feel, while still maintaining a good groove. It also was great for turning straight feels into a shuffle. I would like to see more quantization options, but the program's few settings work well. Fortunately, additional quantization options are promised for the next version.

Unlike the Text Editor, the Graphic Editor allows you to listen to the track in real time, while a scroll bar moves across the screen. After you are

finished making changes, you can save the edited version of your track onto a different track, preserving the original version.

A few other editing features deserve mention. Unmix Channel allows you to take a track containing multiple MIDI channels, extract the data on each channel, and place each channel on its own track. This comes in handy when you're loading a Type 0 Standard MIDI File and want to see each track separately.

The Key Split Track function separates the notes in a track and puts each note on its own track. This function is handy if you are using one track to play all your percussion parts and later decide you want the percussion parts on separate tracks.

FADERS AND JOYSTICK

SMPTE Track provides faders with which you can automate Control Change messages one track at a time, or all at once. However, you can't realistically fade out all your tracks simultaneously with MIDI Volume. When multiple tracks are controlled by one "master" fader, all track levels jump to the master fader's level setting, regardless of their previous settings. I would prefer to maintain the relationships between slave faders while controlling them with a master fader. The folks at Barefoot are aware of this and are researching the best way to use the faders for master volume control.

The Joystick Tile (see **Fig. 3**) has a position indicator that acts like a joystick you would use in an arcade game. The Joystick simultaneously controls two Control Change or Pitch Bend messages, assigned to the horizontal and vertical axes. I had fun with this feature, controlling Pitch Bend with Panning, Volume with Panning, and Volume with Reverb (Control Change 91). It's not every day you find something you have never seen before; I give this feature an "A" for originality.

SMPTE SYNC

SMPTE Track Platinum is an appropriate name for a program that comes with its own synchronization box. The SMPTE Mate Plus allows you to read and write SMPTE time code in 24 fps, 25 fps, 30 fps, and 30 drop-frame formats. *SMPTE Track Platinum* even comes with a *SMPTE Mate* desk accessory that lets you print SMPTE code

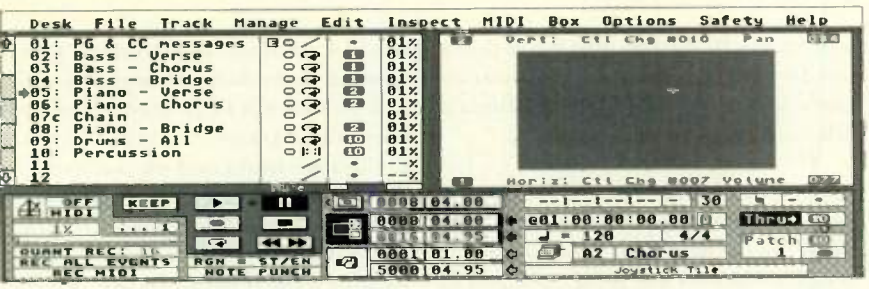


FIG. 3: The Joystick Tile has a position indicator (upper right) that acts like a joystick controller in an arcade game.

without leaving the program. In case you don't have enough memory to run *Platinum* and *SMPTE Mate* together in RAM, *SMPTE Mate* also comes as a stand-alone program. (According to a Barefoot Software representative, *SMPTE Mate* will be built into the next version of *Platinum*, eliminating the need for a desk accessory.)

I tested the synching capabilities of *STP* by printing code with the SMPTE Mate Plus to my multitrack tape deck and locking it to my Atari. It never skipped a beat through the whole session. Even when I fast-forwarded or rewound the tape to different parts of the song, my analog tracks stayed in sync with the computer, and *STP* caught up with the time code quite quickly.

DOCUMENTATION

I was disappointed in the documentation that came with *SMPTE Track Platinum*. I was given a *SMPTE Track Gold* owners manual and an 11-page addendum with an explanation of the new *Platinum* features, but Barefoot expects to have a new *Platinum* manual that includes the latest features by the time you read this.

I hope they improve the overall documentation, because *STP* isn't extremely intuitive. There are many unclear definitions and poor examples, and features often are mentioned in the midst of other discussions. Although I was able to get by, I learned many important functions by experimentation, rather than from documented examples. However, the support staff at Barefoot Software was helpful and knowledgeable.

CONCLUSIONS

SMPTE Track Platinum's best selling point is its price: I know of no other under-$500 program that includes a SMPTE sync box. However, the software needs significant improvement, especially in its linear sequencing functions. I was astounded to discover that *Platinum* lacks a clipboard function for executing simple cut-and-paste edits. Until I learned *STP*, I had never seen a sequencer that didn't allow simple cut-and-paste functions from the main screen. I also would like to see more editors, such as a Notation Editor and a Drum Editor. At present, the Graphic Editor is the only decent editor in the entire program; the Text editor is pretty lame.

I like a flexible sequencer that permits both linear and pattern-based recording. *SMPTE Track Platinum* would be good for those who prefer drum machine-style recording where the song is recorded section by section and pieced together. But if you like recording in a steady flow, from beginning to end, cutting and pasting a bit as you go along, *STP* doesn't cut it.

Because of its price point, *SMPTE Track Platinum* is still a contender, though it falls significantly short of its main competitors (Steinberg's *Cubase*

Product Summary

PRODUCT:
SMPTE Track Platinum 7.01
PRICE:
$499
SYSTEM REQUIREMENTS:
Atari 1040ST/STE, Mega ST, TT 030, or Falcon030 with 1 MB RAM
MANUFACTURER:
Barefoot Software
19865 Covello St.
Canoga Park, CA 01306
tel. (818) 727-7143
fax (818) 727-0632

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

and Emagic's *Notator*). But if you don't need bells and whistles and want to save a few bucks, *SMPTE Track Platinum* will more than get you by.

Mike Rosen *is a former product specialist for Steinberg/Jones and Roland. When he's not writing for* **EM** *he works as a musician/composer and MIDI consultant in the Los Angeles area.*

Rane MAP 33 Preamp

By Larry "the O" Oppenheimer

Forget the rain in Spain; the hippest preamp comes from the Rane in Washington.

Rane's MAP 33 is the most ambitious preamplifier for acoustic instruments I've ever seen. In addition to addressing specialized concerns such as proper impedance matching for piezoelectric pickups, Rane has implemented standard preamp features such as equalization to meet the specific demands of acoustic instruments.

The MAP 33 offers an elaborate signal path that features multiple independent mix outputs, effects send/ receive loops, and insert points. Its many options have been harnessed by placing everything under microprocessor and MIDI control, as well as providing 64 user memories to store complete setups. Naturally, there is a price for all these bells and whistles, a rather substantial $1,995 to be exact. As we shall see, this is reasonable for what you get.

I evaluated the MAP 33 by myself, with members of two bands in which I perform, and with guitarist Alex de Grassi. This gave me an opportunity to try it on acoustic guitars employing several kinds of pickups, electric guitar, acoustic violin and mandolin (both with pickups), vocals, and bodhran (an Irish side drum, picked up with a miniature condenser mic in this case). Not only that, I tried it both in live performance and in the studio.

WHAT YOU SEE

If not for the three ¼-inch, Instrument input jacks, the MAP 33's front panel would look more like a digital reverb than an instrument preamplifier, with its 2-line backlit LCD, mode-select buttons, and parameter-adjust knob. On the left are input and output overload LEDs for the three primary signal paths and outputs. A "signal present" indicator would have been useful, but at least the input overload LEDs are post-EQ, alerting you when equalization settings push the signal past the clip point. Three more LEDs indicate which audio input is active, and a 2-character LED display shows the current Preset number. Rane has placed the crucial Store button in an obvious place, right next to the preset-number display.

An array of control buttons (Menu Select, Cursor Movement, etc.) covers a good-sized section of the front panel. The rear panel is similarly filled with jacks and switches. In addition to its many displays, control switches, and jacks, the MAP 33 has a signal ground-lift switch and voltage-select switch. Yet, with all this hardware, I was irked to discover there is no power switch.

INPUT PATHS

The primary focus of the box centers on the Instrument inputs. Each Instrument input jack offers two input channels in a TRS (tip-ring-sleeve) configuration with two independent signal paths that simultaneously accept a signal from a piezoelectric pickup and a magnetic or electret-condenser pickup or mic. A switch next to each jack allows the user to select whether the piezo signal is on the tip and the mic signal on the ring, or vice versa. The mic inputs have phantom power, switchable between 6 and 15 VDC. Input-gain trimpots for the piezo and mic inputs are next to the jacks. There was no problem getting enough gain for any of the instruments I put through the MAP 33.

Only one Instrument input can be active at any time; if you plug an acoustic guitar, a fiddle, and a mandolin into the three inputs, you will need one preset with the guitar selected, another for the fiddle, and the third for the mandolin. This makes sense because you will probably want to process each instrument differently.

The selected Instrument input feeds the piezo- and mic-processing circuits (see Fig. 1), which are identical. Almost all the controls shown are implemented in software. A notch filter helps

eliminate pesky resonances that cause feedback, and the highpass filter (labeled "Low Filter" on the diagram) corrects boominess. A 7-band, fixed-frequency EQ lets you tailor the sound for the specifics of the instrument/pickup combination. Also included are an Invert Switch, Tuner Output, mutes, and a Direct Out. The two signal paths are finally united in the Pan section. Farther down the line are L/R insert points and Instrument level and mute controls; then the signal progresses to the Master section.

Curiously, there is a Direct Output On/Off parameter. Although I can understand a toggle for the insert loops (which also is provided), I fail to see the circumstances under which one would want a Direct Output to be inactive.

A fourth, mono Aux Instrument input shares its signal path with a rear-panel XLR Vocal input, letting you switch between the two. The Aux Instrument/Vocal signal path includes gain control, 7-band EQ, a mono send and stereo insert return, pan, and mute. It lacks the notch and highpass filtering available on the regular Instrument inputs.

As you would expect, the XLR Vocal input (labeled "Vocal" to avoid confusion with the Instrument mic inputs) is intended for use with a vocal microphone. Although it uses the same signal path as the Aux Instrument input, the Vocal input also provides phase-invert and +48V phantom-power switches before reaching the Input Select switch.

The Aux Instrument/Vocal section is much simpler than the Instrument input, and the additional L/R Line inputs are the simplest of all, passing through level, balance, and mute controls. The Line input path offers a mono out in addition to feeding the Master and Monitor sections.

MASTER SECTION

The Master section mixes all signal paths and provides left and right, balanced, ¼-inch, line-level outputs; left and right, XLR (pin 2 hot!), mic-level outs; and left and right send and return jacks. The Main Send is always post-fader, which precludes getting a sound that is mostly effects, but a pre/post toggle in the software would have been good. The Map 33's lack of level control on the Main Returns

proved bothersome because it required readjusting all the other levels to get the desired wet/dry balance. In the end, the Line inputs were most effective for effects returns.

The stereo noise gate in the Master section can be used in several ways, such as preventing unattended instruments from feeding back and as an effect to kill undesired ringing strings.

MONITOR SECTION

All inputs (including your choice of the piezo or mic Instrument signal) feed the monitor section, with separate Instrument, Vocal, and Line level controls and mutes. The signal paths are then mixed and progress to an Invert switch, 7-band EQ, and output level control and mute. The monitor section's Invert switch and 7-band EQ are especially handy in fighting feedback problems.

A monaural Monitor Expand Input sums with the Monitor signal just before the Output Level control and mute. This lets you bring an external monitor submix into your monitor system. The Monitor Expand Output, located ahead of the Expand Input, lets you send your internal monitor mix to an outside system.

▼

In almost every case, the instruments sounded excellent as soon as they were plugged in.

The headphone output, with accompanying level knob, auditions either the Main or Monitor outputs. It is squeaky clean and can get quite loud.

OUTBOARD CONTROLS

The MAP 33 has several jacks for connecting external controllers. Unbalanced, ¼-inch jacks accept a footpedal, Mute switch, and Memory Step momentary switch; all are programmable.

Rane's MAP 33 programmable acoustic-instrument preamplifier boasts pristine audio quality and highly sophisticated features, including complete microprocessor control.

The footpedal can control up to three internal parameters and/or transmit MIDI controllers 0 to 127 on any MIDI channel, and you can limit the minimum and maximum values sent. The Mute Switch jack can be assigned to mute almost any combination of the signal paths.

Memory Step lets you increment through a user-selected Range within the 64 user memory locations (which Rane calls "Memories"). You can create up to three independent Ranges; for example, you could step from Memory 10 to Memory 15 in one Range, from Memory 1 to 12 in another, and Memory 10 to 64 in the third.

Of course, there are MIDI In, Out, and Thru jacks. The MAP 33 provides MIDI Program Change mapping and can dump and load its memory (including the Program Change map) using SysEx. Incoming MIDI data can be merged with data generated by the MAP, as well.

ROLL YOUR OWN MENU

The User menu is probably the most potent tool for customizing the MAP 33 to your own uses. Up to fifteen parameters, drawn from any menus, can be pasted here, providing immediate access to the adjustments you most commonly make. Any or all of these parameters can be adjusted by MIDI Control Change messages.

Furthermore, the first six User menu parameters can be controlled via MIDI System Exclusive commands, or by the optional RC 6 Remote Controller ($249). This handy unit mounts on a mic stand and provides six data-adjust pots, three Memory Range-select buttons, and a lockout switch to prevent you (or anyone else) from accidentally bumping a pot while you're playing. The RC 6 connects to the MAP with a standard TRS phone cable.

PUT YOUR MIND AT EASE

All these features may make the MAP

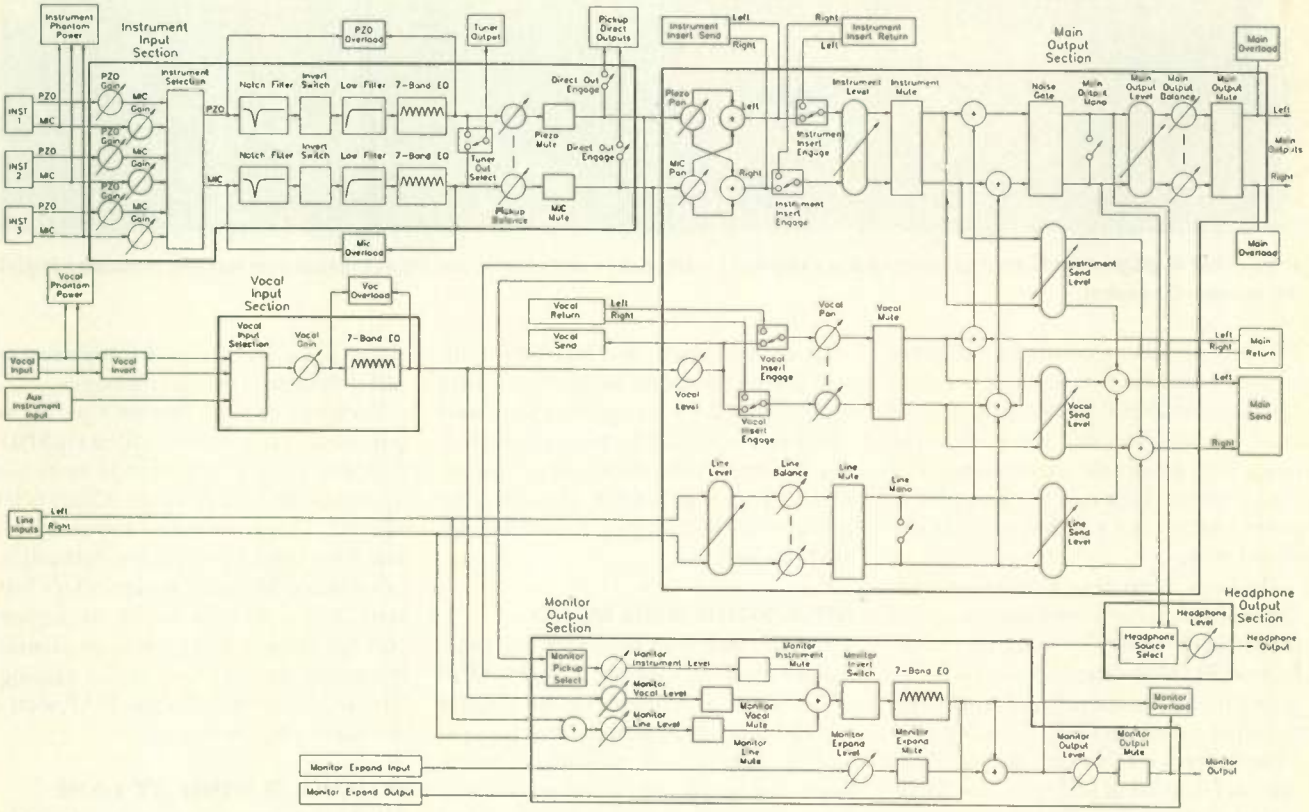


FIG. 1: The block diagram of the MAP 33's signal path illustrates its tremendous flexibility. Note that the selected input feeds the piezo and mic processing networks, which are identical. Almost all controls shown are implemented in software. (Courtesy Rane Corp.)

33 seem daunting to understand and operate, but it comes quickly if someone gives you a good tour first. (This sort of support is where buying from a local dealer beats mail order.) Despite my years of experience, it took me about half an hour to really get the picture. But after I gave Alex de Grassi about fifteen minutes of explanation, he started making tweaks without much trouble. Once you understand the menu structure, you're pretty much home free; the manual's block diagram is needed only to answer signal-flow questions.

Every parameter of every menu is pictured and described in the clear and well-organized manual, which even includes helpful details such as how to set the MAP up for common instrument pickups and microphones. If you get lost or confused, there is extensive online help available by pressing the Help button on the front panel. That's about as easy as it can get. Out of the box, the MAP 33 is set to power up in Help/Guided Setup mode, but a parameter in the Utilities menu disables this setting.

The Utilities menu also lets you choose a 3-digit security code, without which parameters cannot be modified from the front panel. You can take breaks with confidence that no one's going to mess with your settings.

SONIC NIRVANA

After all this yadda-yadda about the MAP 33's facilities, nothing has been said about the most important thing: its fabulous sound. In almost every case, the instruments sounded excellent as soon as they were plugged in. The violin required the most EQ, but this was the fault of the pickup and instrument, not the preamp, and the MAP's EQ was equal to the task.

In every case, the MAP sounded extremely clean and quiet, even the mic preamp in the Vocal section. Especially rewarding was the high end, which was smooth and open, not strident, as inexpensive preamps and amps can be. This is of particular importance for the delicate timbres of the mandolin and violin.

Rane was careful to provide the proper impedance-matching for piezo pickups and sufficient slew rate in the audio circuitry to get that wonderful airiness. And although the MAP would not be a good choice for getting a crunchy rock 'n' roll guitar sound, I got a beautiful, bright, bell-like rhythm sound from a stock Telecaster.

THE RIGHT TOOL

The MAP 33 provides a good toolbox for dealing with the problems most

Product Summary

PRODUCT:
MAP 33 Programmable Acoustic Instrument Preamp
PRICE:
$1,995
MANUFACTURER:
Rane Corporation
10802 47th Ave. West
Mukilteo, WA 98275-5098
tel. (206) 355-6000
fax (206) 347-7757

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

often encountered when amplifying acoustic instruments. In fact, it would be a gross understatement to say that the device is feature-laden. Only serious acoustic musicians such as de Grassi, or studios that record a lot of acoustic music, are likely to need this much from an instrument preamp (and be willing to pay for it). A stripped-down, programmable version of this box—perhaps selling for $500 to $800—would reach a much larger market. (Rane's lower-cost model, shown at the recent NAMM show, is not programmable.)

But the MAP 33 is clearly worth the money if you need that much preamp and can justify the expenditure. My quibbles with the MAP 33 are minor and my compliments are many. Rane has given us a sophisticated, superb-sounding way to amplify any acoustic instrument.

(Special thanks to Alex de Grassi.)

JLCooper MixMaster

By Peter Freeman

Volume and mute automation that won't empty your wallet.

Finally, high-quality compact mixers are affordable and readily available. Now all that home and project studios need are inexpensive automation methods to facilitate more elaborate, professional-sounding mixes. Products that answer this demand include Fostex's new DCM100/Mixtab combination, Mark of the Unicorn's MIDI Mixer 7s, and the Niche Audio Control Module. However, the first unit to address the lower-cost end of the spectrum is JLCooper's MixMaster, an 8-channel, 1U rack-mount, line mixer that features MIDI control of channel levels and mutes and costs just $499.

The MixMaster is intended to function as an automation retrofit for small mixers (with -10 dB signal levels), connecting through insert points, rather than as a stand-alone line mixer. The

PETER DIGGS

JLCooper's MixMaster adds eight channels of outboard automation to small mixers, connecting through insert points, but also offers 8 x 1 or 4 x 2 line mixing.

mixer can function as 8 × 1 or 4 × 2, switchable via MIDI Program Change messages. It is also possible to hardwire the unit permanently into the 4 × 2 (stereo) mode, using an internal jumper.

MAKING CONNECTIONS

All connections are made via ten ¼-inch, TRS stereo jacks on the rear panel. With this configuration, jacks 1 through 8 carry input (ring) and output (tip) signals for the eight MixMaster channels, while jacks 9 and 10 are Mix In and Mix Out connections. The tip of the Mix Out jack carries a mix of the signals at channel outputs 1 through 4, and the ring carries a mix of outputs 5 through 8, allowing the unit to be used without a mixing console. Mix In connects to the Mix Out of another MixMaster, cascading the two to create a larger mixer.

TRS connectors are probably the best choice for this box because it's designed to work primarily through the insert points of another mixer. Still, this precludes the use of the more readily available, mono ¼-inch connectors, which makes it less convenient should you want to use the MixMaster as a self-contained mixer.

To the right of the unit's audio connections are the ubiquitous MIDI In and Out ports (the unit has no MIDI Thru) and a power jack that accommodates the dreaded "wall-wart" AC adapter.

TAKING CONTROL

The only controls on the front panel are the Mode and Learn buttons and the power switch. The Mode button selects either of two possible modes of MIDI response: CC (Consecutive Channels) and CP (Consecutive Parameters). The latter mode is not applicable when using the unit in 4 × 2 stereo.

When the MixMaster is in CC mode, the unit responds to MIDI Volume messages on eight consecutive channels, one for each of its VCAs. In CP mode, the device responds to consecutively numbered MIDI Control Changes on a single channel. CP mode also lets you use MIDI note messages to mute and unmute MixMaster channels. Note Ons with Velocity values of less than 65 mute a channel, while Velocity values of 65 or higher unmute it. These two modes offer enough flexibility for most situations.

The Learn button tells the MixMaster which channels, notes, or MIDI controllers it should respond to. This is accomplished by pressing Learn, then sending the unit a sample of the MIDI message you want to control MixMaster channel 1. The box uses the next seven consecutive MIDI channels (CC mode) or Control Change messages (CP mode) to control the remaining VCAs. All VCA settings can be saved and loaded via MIDI System Exclusive.

EVALUATION

I tested the MixMaster primarily in my project studio, patched into the insert points of a Mackie CR-1604 mixer. A Lexicon MRC and Steinberg's *Cubase Audio* for the Macintosh controlled and recorded the automation moves for eight CR-1604 channels in the MixMaster's 8 × 1 mode.

Throughout the course of several mixes (both simple and complex), the box performed quite well. There was no perceptible "zipper" noise, and level changes were handled smoothly. Due to the limitations of MIDI's bandwidth, a small degree of sluggish response is unavoidable, especially when dealing with many channels of simultaneous control-change data. But most of the time this didn't bother me. The MixMaster's sound quality was quite good; I didn't notice that the unit added any distortion or changed the sound of the original signals.

However, I noticed a subtle quirk in the MixMaster's handling of Note On channel unmuting: Instead of instantly unmuting a channel upon reception of a Note On with the appropriate Velocity value, the unit does a rapid fade-in. These faded-in "unmutes" were consistently a bit lazy, which sometimes caused problems with precise rhythmic material. Perhaps this method was adopted to prevent pops or other noises from occurring when the VCAs snap open, but there should be some user control over the fade time so the unit's response can be tailored to different musical situations. The muting function was reasonably fast and caused no problems.

▼ The MixMaster exhibited no perceptible "zipper" noise, and level changes were handled smoothly.

While we are in the complaint department, I should mention that the first unit sent for review had a power switch that became stuck in the On position after one week's use. The

Product Summary

PRODUCT:
MixMaster
PRICE:
$499
MANUFACTURER:
JLCooper Electronics
12500 Beatrice St.
Los Angeles, CA 90066
tel. (310) 306-4131
fax (310) 822-2252

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

second unit I received was fine, but I was left with doubts about the MixMaster's roadworthiness.

CONCLUSIONS

The MixMaster sets out to do a simple but important task—automatic gain and mute control for mixers with insert points—and it unquestionably achieves its goal. I wish it were more physically robust, but ultimately you get what you pay for in that department. However, the MixMaster's sound quality, simplicity, and $499 price tag makes the unit a major contender in the home/project studio market.

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.*

AKG Blue Line Microphones

By Michael Molenda

These "pop heads" offer a wealth of miking options.

One of life's major drags for the home recordist is assembling a good microphone collection. Decent dynamic mics are pretty affordable, but professional-quality condensers can trample a budget without pity. Wouldn't it be nice (to evoke Brian Wilson) if a reasonably priced condenser mic existed that could be upgraded according to a home studio's expanding needs and cash flow?

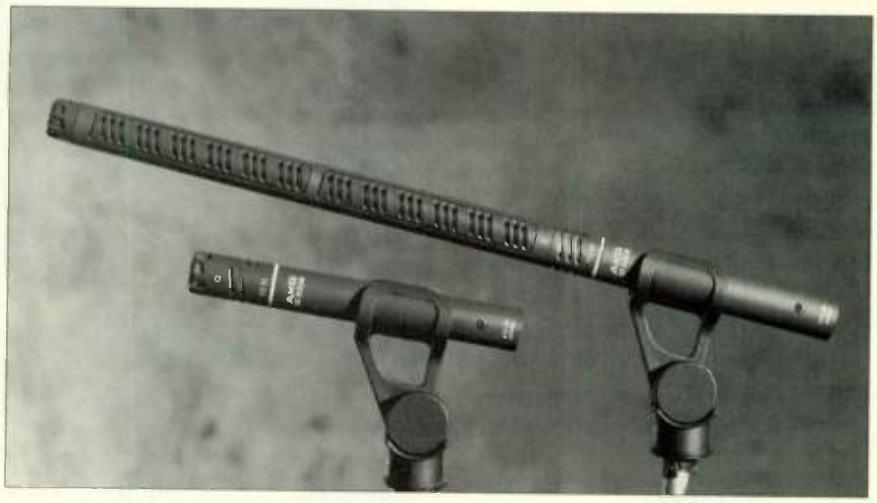
Well, stop dreaming. AKG's new Blue Line Series offers a good selection of affordable ($179 to $359) mic capsules based around a $259 Powering/Output module. The budget recordist can start with an all-purpose cardioid system and add other capsules without incurring the expense of additional master modules.

ALL IN THE FAMILY

The Blue Line Series is a modular condenser-microphone system consisting

of the SE 300 B Powering/Output module and eight diverse mic capsules. A wide selection of extension tubes and cables, swivel-joint mounts, windscreens, and adapters are offered as accessories. The slim, blue-gray (matte finish) output module utilitizes a bayonet coupling to attach the various capsules. The unit operates from any phantom power supply (there is no battery option); has a low-impedance, transformerless output stage; and includes a switchable, 10 dB output-level pad and a switchable, 75 Hz bass-cut filter. (The slope is 12 dB/ octave with a -3 dB cut at the 75 Hz corner frequency.)

An excellent selection of mic capsules are offered: cardioid, omnidirectional, hypercardioid, figure-8, shotgun, mini-cardioid, and mini-lavalier (omnidirectional). All except the miniature capsules offer a frequency response from 20 Hz to 20 kHz at ±2 dB. The mini lavalier offers a 20 Hz to 18 kHz range (±3 dB), and the mini cardioid delivers 150 Hz to 18 kHz (±3 dB). The maximum sound pressure levels (for 1% total harmonic distortion) vary from 132 dB without pre-attenuation to 142 dB with 10 dB pre-attentuation.



PETER DIGGS

The modular design of AKG's Blue Line Series microphones allows a single Powering/Output module to wear many hats. Eight different microphone capsules are available.

TESTING, TESTING

Maybe it was my childhood obsession with Lego blocks sneaking up on me, but I couldn't suppress the awe as I opened the handsome AKG case that contained almost the entire Blue Line modular system. I immediately had to snap every mic capsule and attachment onto the SE 300 B output module. The bayonet coupling always locked with a reassuring click, and even frantic, Roger Daltrey-inspired mic-swinging couldn't dislodge the capsule from its base. I tried grabbing the mic roughly from the top, emulating a fatigued (and grumpy) engineer during a 2 a.m. session breakdown, and the mic didn't flinch; the capsule remained firmly in place. Later on, I dropped the mic from atop a 7-foot boom stand—this wasn't a premeditated test, I just got clumsy—and it *still* didn't snap apart. These are rugged mics!

When I finally tired of clicking the capsules on and off, I actually used the mics on some production projects. The first test was an overdub session for San Francisco Bay Area solo artist Dave Crimmen, who has a beautiful Gibson J200 acoustic guitar. I snapped on the CK 93 hypercardioid capsule to minimize room reflections and pointed the mic directly at the sound hole. The timbre was a harmonious blend of warmth and sparkle. The mic accentuated some highs, but not so much that string noise and fret buzz dominated the sound. I also tried positioning the CK 91 cardioid capsule (padded down 10 dB) dead-on a Marshall speaker cabinet to record some guitar solos. This isn't the mic for metal mayhem; it doesn't collaborate well with heavy distortion. A better sound was achieved by using the capsule as a secondary off-axis or room microphone.

The propensity towards articulated highs was more evident on aggressive, high-frequency material. I used two CK 91 cardioid capsules as overhead drum mics. (Thanks to *Mix* magazine's products editor, George Petersen, for lending me his set of review mics.) Ride-cymbal performances were clear and bright, but anytime the drummer dug into the crash cymbals, I had to slam down the input mute. Ouch! A 10 dB cut at 10 kHz, mixed with subtle compression, tamed the bite. By comparison, AKG's C 451 and C 460 mics record smoother highs because they don't have the superior transient response of the CK91s. (They're also $90 to $140 more expensive.)

I was pleasantly surprised when I used the same configuration for room miking. When the cardioid capsules were moved ten feet in front of the drum kit, the stereo imaging and sonic quality was amazing. The cymbals calmed down, the toms sounded incredibly robust, and even the kick and snare cut through with power and snap. I tracked drums on a pro session using just the two Blue Line mics for room left/room right, a Shure SM57 on the snare, and a Sennheiser MD421 on the kick. The drummer just couldn't believe his kit sounded so huge with-

Product Summary

PRODUCT:
Blue Line Series Microphones

PRICE:
SE 300 B powering/output module $259;
CK 91 (cardioid), CK 92 (omni), CK 93 (hypercardioid) $179 ea.;
CK 94 (figure 8) $359;
CK 98 (10-inch shotgun) $279;
CK 97 C (mini cardioid) and CK 97 O (mini lavalier/omni) $199 ea.

MANUFACTURER:
AKG Acoustics, Inc.
1525 Alvarado St.
San Leandro, CA 94577
tel. (510) 351-3500
fax (510) 351-0500

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

out close-miking the toms and using overhead mics.

For background vocals, both the CK 92 omni capsule and the CK 94 figure-8 capsule recorded suitably bright timbres that enhanced the articulation of voice blends. I tried several positions with three to five singers at each mic, and the sound was always full and evenly balanced. On lead vocals, the mic tended to reproduce a sharp, almost steely timbre. This characteristic actually worked great when recording falsetto vocals, but I wouldn't automatically throw up a Blue Line mic to track a chest voice at full throttle.

Most EM readers are probably not interested in the shotgun and lavalier capsules, but I tried them anyway. Used conventionally, the CK 98 shotgun capsule has excellent off-axis rejection and clarity. I also used it, somewhat unconventionally, to record an acoustic guitar from outside of a room (about twenty feet from the source). The shotgun sound alone was exceptionally bright, which isn't surprising, as shotgun mics boost the high end to enhance speech articulation. But when mixed with a close-mic, the combination produced a crystalline, almost other-worldly timbre. It was a nice discovery. (An independent engineer used the shotgun to mic a snare drum from fifteen feet above a drummer's head and admitted he shouldn't have wasted the client's time with crazy ideas. I guess that means the sound was less than wonderful.) The C 97 lavalier capsule exhibited good clarity and definition. However, I declined a dare to mic a snare drum with it.

SERIES EVALUATION

The Blue Line Series is a well-designed, cost-effective system for the home or project studio. The modular concept can be a life-saver for small-budget operations, and, for the most part, the mics sound amazing. I would employ the Blue Lines for miking acoustic instruments and background vocals and as a room mic for recording drums. No microphone can be all things to all people, so I wasn't bummed out that the Blue Lines missed the mark on lead vocals and electric guitars. The bottom line is, these are excellent mics that should upgrade the recording quality of any project.

phase integrity must be maintained from the mic, through all intermediate stages of recording and mixdown, to the final reproducing amp and speakers. This is rather esoteric (and subjective); simply reinverting a phase-inverted signal is frowned upon due to the inherent non-linearities added when using an additional processing stage. Obviously, combining signals at different phase offsets will affect the sound, and phase continuity for signals that are to be split, separately processed, and recombined is very important. But the matter of whether the ear can detect absolute phase is still being argued. Subtle differences that many listeners report may be due to equipment limitations.

Nonetheless, phase continuity is worth investigating, since a few simple measurements can disclose hidden "gotchas" in submixers, external processors, etc. Moreover, for a home-studio installation, the measurements are necessary only when new gear is added.

It's simple to compare the phase of inputs and outputs by connecting a signal generator to the device under test and viewing the generator output and circuit output simultaneously on a dual-trace oscilloscope. (Use "chop" mode to avoid timing errors.) To facilitate this, you can construct an audio-to-oscilloscope adapter cable by cutting off the plug on one end of a UHF patch cord and installing a ¼-inch phone plug. (For more on this, see the September 1992 "Service Clinic.") For field evaluations, an LCD mini-scope with a built-in signal generator, such as the Fluke model 97 Scopemeter (see **Fig. 1**), is ideal.

FIG. 1: The Fluke 97 Scopemeter, an LCD mini-scope with a built-in signal generator, is convenient for testing the phase of audio inputs and outputs.

Phase inversion at equipment outputs can be corrected with a simple unity-gain inverter circuit (see **Fig. 2**), which can be retrofitted inside the affected gear by a service technician. A low-noise op amp, such as a TLO72 or NE5532, and metal-film resistors are advisable.

Q. I hear a funny mechanical sound, like running a piece of stiff paper along the edge of a comb, when I use the modulation wheel on my Ensoniq KS-32. What causes this?

A. The ribbon cables that connect the aftertouch mechanism to the performance-control PC board are slightly longer than needed. This simplifies service and allows the use of the same mechanism in several instruments. The

among the professional sequencers, only *Pro 5* is unprotected. *Cubase*, *Performer*, and *Vision* use the familiar key-disk/install copy-protection scheme, while *Cubase Score* and *Notator Logic* use hardware-key protection.

If you are shopping for an entry-level sequencer, you may want to keep in mind the upgrade paths offer by *EZ Vision* and *Trax*. If you are heavily into General MIDI or Roland GS Standard instruments, consider *Ballade*. *One-Step* offers certain "tinkering" options that will appeal to the avid hobbyist, while providing special JamBox support. However, for sheer power, ease of use, editing options, and a comprehensive feature set with an elegant interface to chunk manipulation, *EZ Vision* wins the entry-level shootout hands down.

It's difficult to designate a clear winner in the pro-level category. The developers at this end of the spectrum have each extended extra effort in a unique area and have done so without neglecting a well-rounded implementation of standard features. If you want a top-down approach to sequencing, your choices are *Notator Logic* and *Cubase* (or *Cubase Score*). *Cubase Score* is the clear winner if you require notation, integrated MIDI-processing, virtual console construction, or any of the advanced algorithmic options of this sequencer on steroids. Nonetheless, *Notator Logic*'s unique graphic object-oriented programming environment could be the deciding factor if you gravitate toward programs such as *Max*, *HookUp!*, or *Megalomania*.

If you are more comfortable with the traditional American bottom-up approach to sequencing, look at *Performer* and *Vision* first. Tangential issues may dictate one or the other. For example, which patch editor-librarian do you like? You'll be forced to use Unisyn with *Performer* and *Galaxy* with *Vision*. Do you have a MIDI-Time Piece or Video-Time Piece (optimized for *Performer*) or a Studio 4 or Studio 5 (optimized for *Vision*)? Do you need the notation that *Performer* provides or the extensive *OMS* support that *Vision* offers? You begin to see the trade-offs you'll have to make. Although *Vision* is the winner in overall power, editing options and speed, many *Performer* users choose the program on the basis of its elegant user-interface alone. My informal survey indicates that classically-trained musicians favor *Performer*, while those who are into pop, jazz, and the like prefer *Vision*.

So how do you choose between *Vision* and *Cubase*? This is where issues of taste enter and no one call tell you what tastes good. Of course, you might also want to consider what all your friends and colleagues are using because you'll probably be swapping files, tips, transposition maps, and virtual instrument libraries with them.

When you purchase a sequencer, keep in mind that you'll be staring at its screens for hours at a time and manipulating the same controls over and over to accomplish the type of editing that defines your personal musical language. Unless you're the type that buys clothes without trying them on, you should make every effort to find some time to experiment with these programs at a store, trade show, or friend's studio before you dip into your pockets.

Christopher Yavelow *is a composer, performer, multimedia producer, consultant, and professor of composition at Claremont Graduate School.*

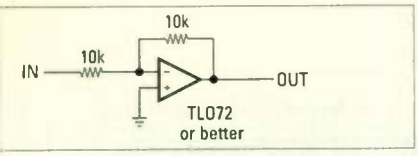


FIG. 2: Phase inversion at equipment outputs can be corrected with this simple unity-gain inverter circuit. Use a low-noise op amp, such as a TL072 or NE5532, and metal-film resistors.

cables may become misrouted and rub against the wheels, making the "comb-and-paper" sound. This effect appears harmless and can be corrected by disconnecting the cables (if needed), rerouting them away from the wheels, and plugging them back in. The front cable should be routed downward and to the front, beneath the headphone jack leads. The rear cable should form a loop to the left, then down and around. Although it is a simple repair, you should refer the unit to an Ensoniq authorized repair center if the synth is under warranty.

Service note: The Phillips screws that secure the top panel of the KS-32 are slightly undersized for the torque required. Take care not to damage the screw heads when opening the unit.

Q. The outputs of my Yamaha DX7 are considerably noisier than my other gear, and this shows up on recordings. In the October 1992 "Service Clinic," you wrote about replacing noisy op amps in mixers; would replacing the output op amps in the DX7 reduce the noise?

A. Most of the noise in the output of the original DX7 is inherent in the 12-bit design. (This applies to the DX9, TX7, and TX816, as well.) Replacing the output op amps would make little difference in the overall signal-to-noise ratio and is not really worth the trouble. One solution is to borrow or rent a DX7II, DX7S, or TX802 for recording important tracks. Sounds developed on the DX7 can be sent via MIDI to these more recent units to take advantage of their much-improved output stages. I've tried this with a DX7 and DX7IIFD, and it should work equally well with the other DX/TX-series gear, although some minor parameter tweaks are required after downloading.

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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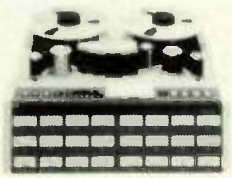

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PRO FILE

Radical Lead Guitar

Vernon Reid pushes the techno-tonal envelope.

By Michael Molenda

I thought I was unshockable. Well, at least as far as musical gear is concerned. I have succumbed to personal equipment lust, witnessed myriad stacks and racks from the backstages of countless rock concerts, and drifted blissfully in the gadget universe that is the domain of the **EM** editor. But I wasn't prepared for the diagram that Sean Beresford, guitar tech for Living Colour's Vernon Reid, faxed me to illustrate the incendiary guitarist's rig.

The schematic is two pages long and about as far away from a simple "plug guitar into amp" set-up as a Tonka truck is from the Space Shuttle. An effect as elementary as a Crybaby wah-wah co-exists with MIDI patch bays, MIDI preamps, two guitar synths, assorted sound modules and samplers, digital signal processors, custom amp heads, and a vocoder. This ain't rock 'n' roll; this is "Johnny B. Goode" in the 25th century.

"Living Colour is a funny hybrid," admits Reid. "Because we're a rock band, it's important that we physically play our instruments. On the other hand, we have a wide-open attitude toward technology. Electronics are a huge part of my sound, and I hope I've proven that there's no reason music can't be electronic *and* physical."

Some examples of Reid's marriage of technology and sensuality are the undulating symphonic lines underscoring the ethereal ballad "Nothingness" from Living Colour's recent album, *Stain*.

"Lately I've been influenced by ambient, droning bands, such as the Cocteau Twins and My Bloody Valentine," explains Reid. "So on 'Nothingness' I wanted a heavy, expansive ambience. And instead of having the guitar play clustered chords, I wanted to use cello-inspired melodic lines that would be thick enough to imply chords without actually playing them."

To attain the appropriate sonic density, Reid integrated the worlds of guitar and keyboard. His custom Hamer guitar (a sustain feature is built into the neck) is outfitted with conventional guitar pick-ups and a hex pick-up. The straight guitar signal was routed into a TriAxis preamp processed through an Eventide H3000. A "glassy" effect was achieved by using a harmonizing program—one unison part was mixed with a part one octave higher—with regeneration and delay. Amplification was handled via Mesa Boogie Rectifier and 2/90 power amps output to Mesa Boogie and VHT 4 x 12 speaker cabinets.

The hex pick-up was connected to a Gibson MAX guitar synth (for pitch-to-MIDI conversion) controlling a Korg Wavestation A/D with a custom "Nothingness" patch that layered string and pad voices together. In addition, the Hall Strings program on an E-mu Proteus 1 was added to the aural stew. The synth voices roared through a VHT Red power amp and two Bag End 15-inch speaker cabinets.

"Pretty much what I gave the (recording) engineers is what's on the record," says Reid. "They just put a few mics around my speaker cabinet and tweaked the console EQ."

But, as the title of another song on *Stain* exclaims, the visionary Reid is "Never Satisfied."

"Do you ever wonder if technology is moving fast enough?" he asks. "I mean, even though the capabilities of the machines are more advanced than most people use, some things are still lagging. Believe me, as soon as they can get pitch-to-MIDI (conversion) working so you can really sweat on the guitar, I have plans."

Living Colour (Reid is second from right).

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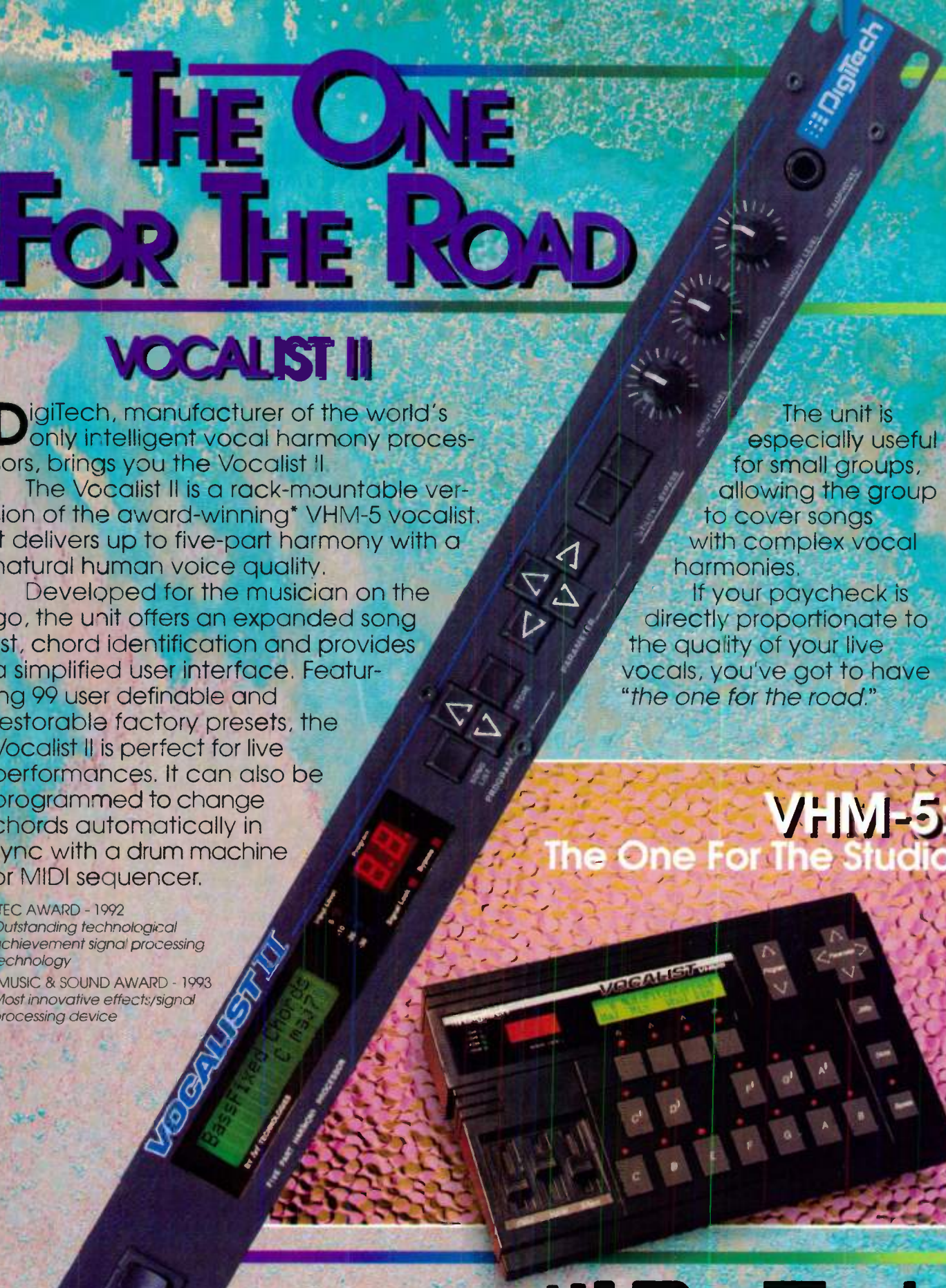

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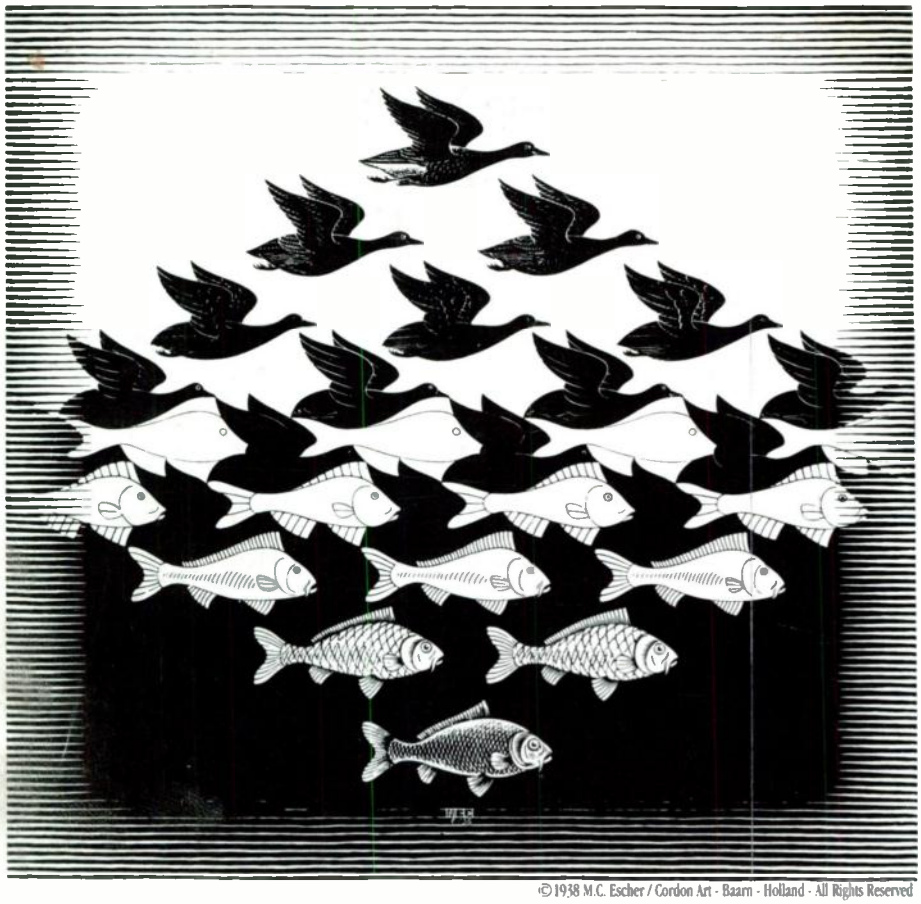

Study the illustration. Are the geese becoming fish, the fish becoming geese, or perhaps both? Seasoned recording engineers will agree that your eyes *and* your ears can play tricks on you. In the studio, sometimes what you think you hear isn't there. Other times, things you don't hear at all end up on tape. And the longer you spend listening, the more likely these aural illusions will occur.

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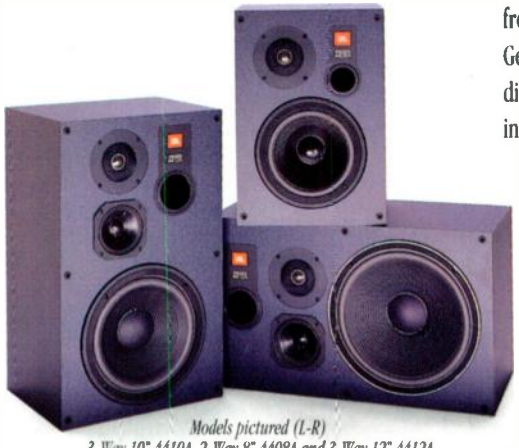

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