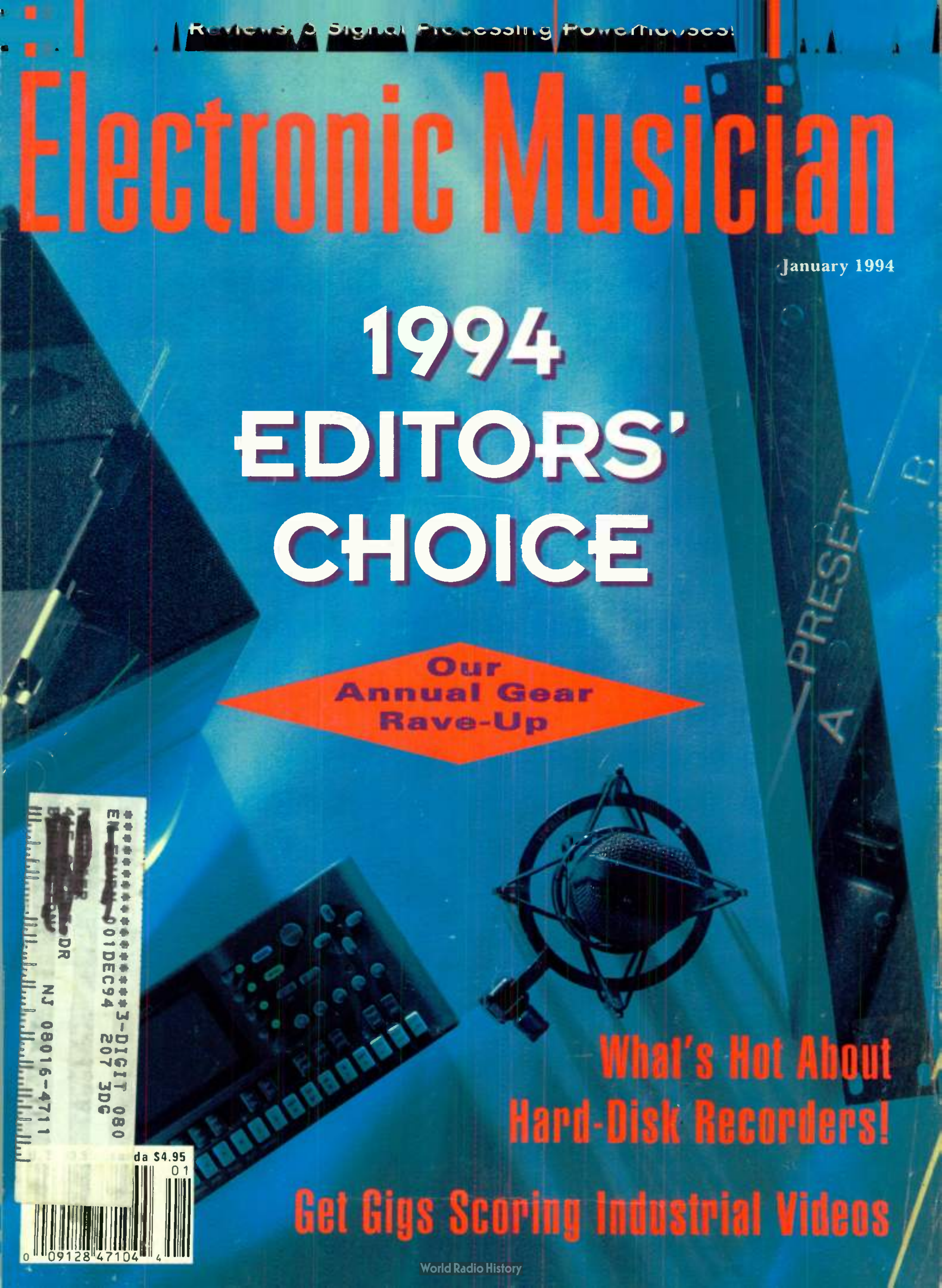

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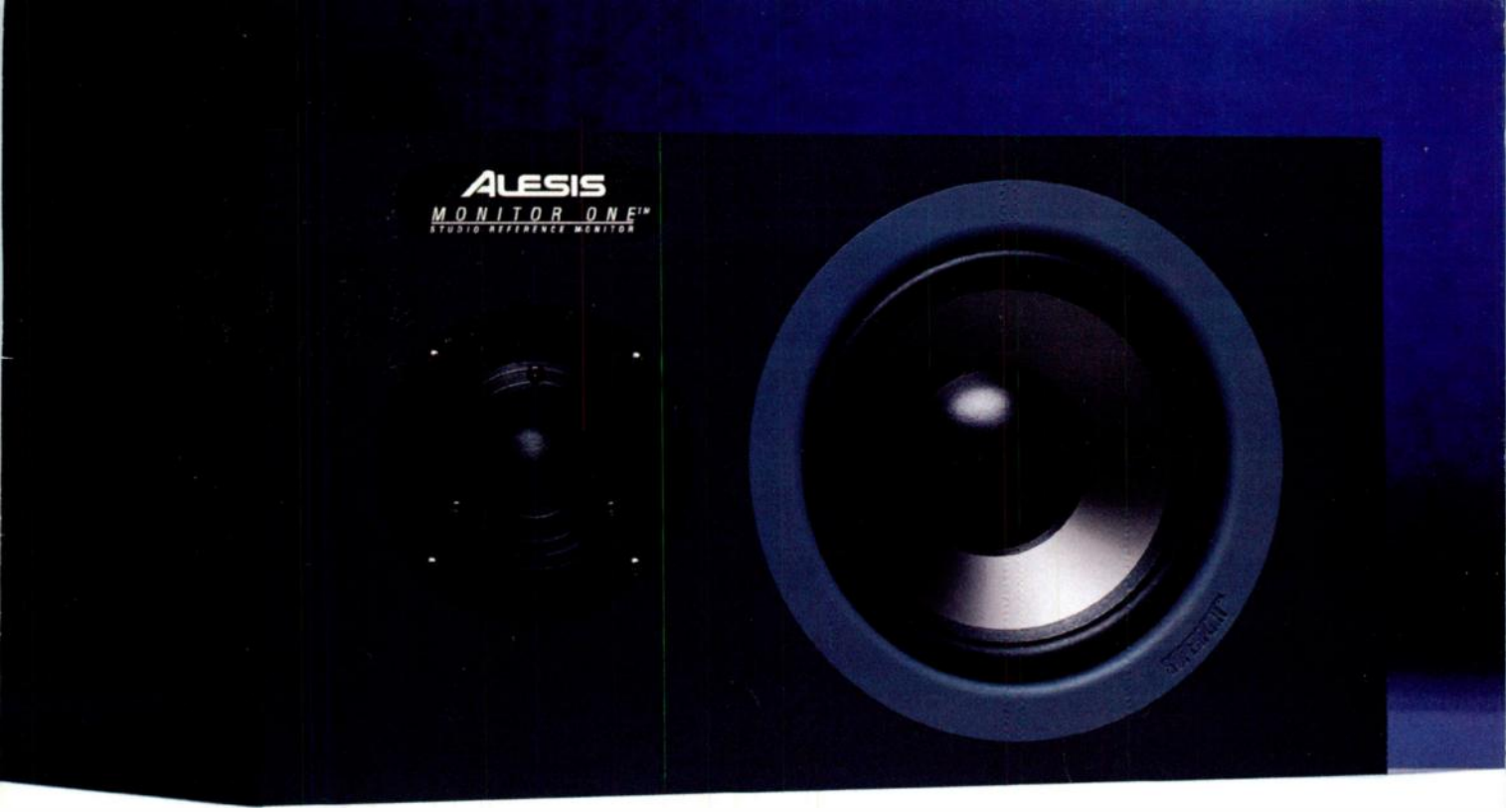
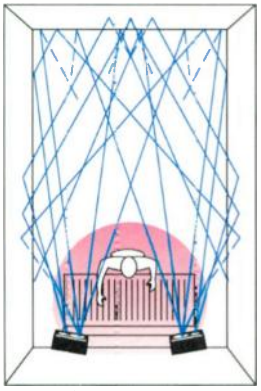


The Truth From

The truth...you can't expect to find it everywhere you look, or *listen*. But when mixing music, hearing the truth from your monitors will make the difference between success and failure. You'll get the truth from the **Alesis Monitor One™ Studio Reference Monitor**.

Room For Improvement

Fact: most real-world mixing rooms have severe acoustical defects. Typical home and project studios have parallel walls, floors and ceilings that reflect sound in every direction. These reflections can mislead you, making it impossible to create a mix that translates to other playback systems. Trying to solve the problem with acoustical treatments can cost megabucks and still might not work. But in the near field, where direct sound energy overpowers reflections, reverberant sound waves have little impact, as shown in the illustration. The Monitor One takes full advantage of this fact and is built from the ground up specifically for near field reference monitoring.



Does your living room double as your mixing suite? The pink area in the illustration shows where direct sound energy overpowers reflected waves in a typical mixing room. The Monitor One helps eliminate such complex acoustic problems by focusing direct sound energy toward the mixing position, instead of the love seat.

Working close to the sound solves the room problem but creates other problems, such as high frequency stridency and listener fatigue (typical of metal-dome and composite tweeter designs). Our proprietary soft-dome pure silk tweeter design not only solves these problems, but delivers pure, natural, incredibly accurate frequency response, even in the critical area near the crossover point (carefully chosen at 2500 Hz).

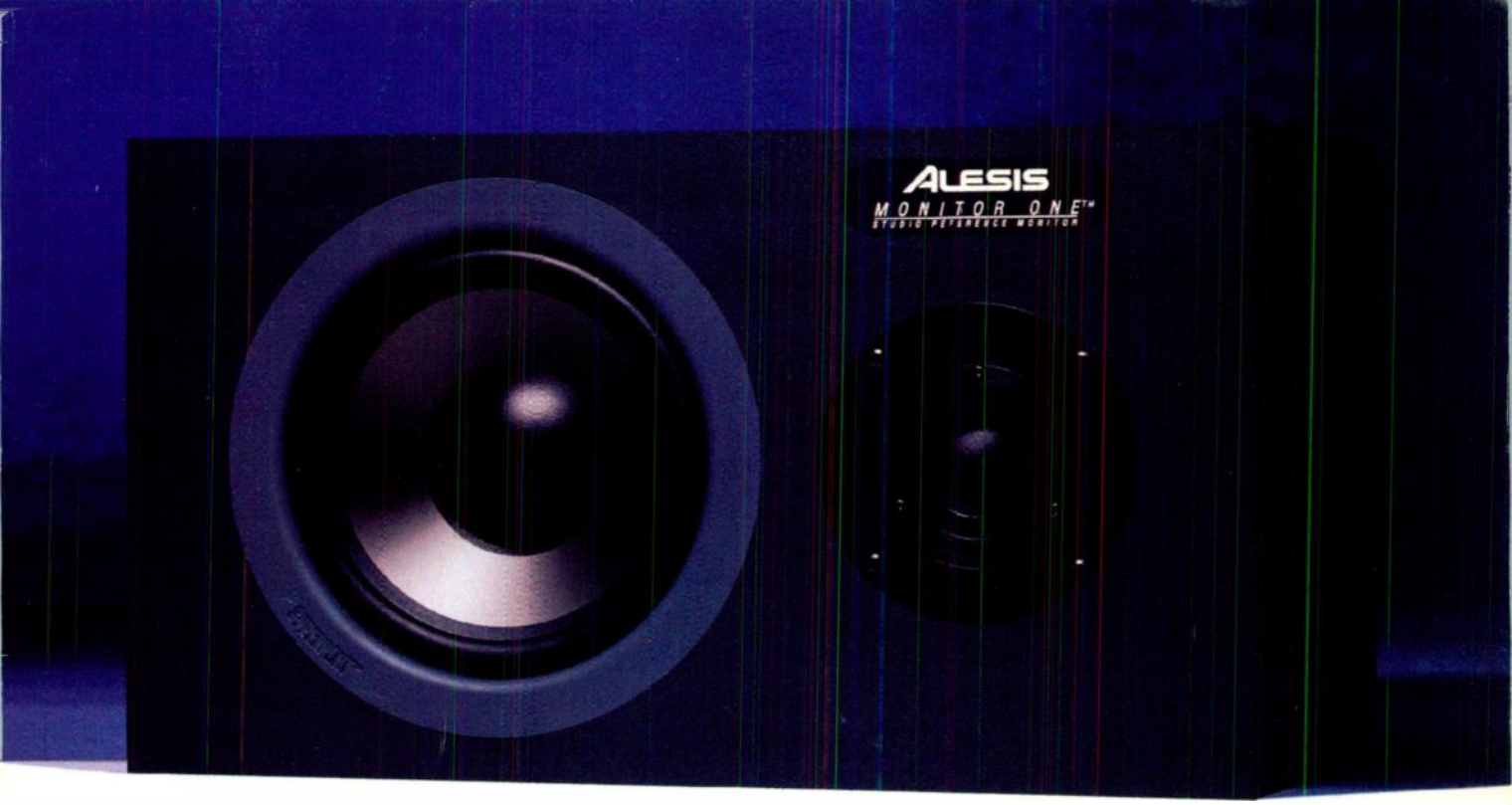
The Truth From Top To Bottom

The Monitor One gives you all the truth you want in the mids and highs, but what about the low end? You probably know that the inability to reproduce low frequencies is the most common problem with small monitors. Most of these speakers have a small vent whose effect at low frequencies is nullified by random turbulence, or they're sealed, which limits the amount of air the driver can move. Such speakers give disappointing results in their lowest octave.

The Monitor One overcomes wimpy, inaccurate bass response with our exclusive SuperPort™ speaker venting technology. The ingenious design formula of the SuperPort eliminates the choking effect of small diameter ports, typical in other speakers, enabling the Monitor One to deliver incomparable low frequency transient response in spite of its size.

Alesis SuperPort™ technology gives you the one thing that other small monitors can't: incredibly accurate bass transient response. No, the SuperPort doesn't have a blue light, but it makes the picture look cool.

The result? A fully integrated speaker *system* that has no competition in its class. You'll get mixes that sound punchier and translate better no matter what speakers are used for playback. Whether you mix for fun or for profit, you want people to hear what *you* hear in your mixes. The Monitor One's top-to-bottom design philosophy is a true breakthrough for the serious recording engineer.



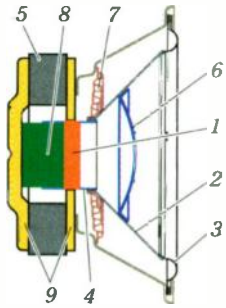
Left To Right

Power To The People

High power handling is usually reserved for the big boys. While most near field monitors average around 60 watt capability, the Monitor One handles 120 watts of continuous program and 200 watt peaks...over twice the power. Also, its 4 ohm load impedance allows most reference amplifiers (like the Alesis RA-100™) to deliver more power to the Monitor One than they can to 8 ohm speakers. That means the Monitor One provides higher output, more power handling capability, and sounds cleaner at high sound pressure levels.
If you like to mix loud, you can.

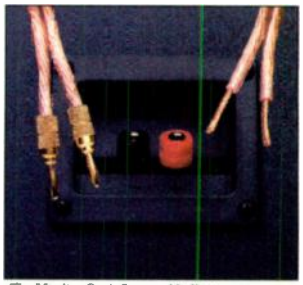
The Engine

Our proprietary 6.5" low frequency driver has a special mineral-filled polypropylene cone for stability and a 1.5" voice coil wound on a high-temperature Kapton former, ensuring your woofer's longevity.
Our highly durable 1" diameter high frequency driver is ferrofluid cooled (costly, but it's the best way to cool a tweeter), to prevent heat expansion of the voice coil which inevitably leads to loss of amplitude and high frequency response. Combined, these two specially formulated drivers deliver an incredibly accurate, unhyped frequency response from 45 Hz to 18 kHz, ±3 dB. The five-way binding posts provide solid connection, both electronic and mechanical. We even coated the Monitor One with a non-slip rubber textured laminate so when your studio starts rockin', the speakers stay put. Plus, it's fun to touch.



A cross suction of the Monitor One's proprietary Alesis-designed 6.5" low frequency driver.

1. 1.5" voice coil.
2. Mineral-filled polypropylene cone.
3. Damped linear rubber surround.
4. Kapton former
5. Ceramic magnet.
6. Dust cap.
7. Spider.
8. Pole piece.
9. Front and back plates.



The Monitor One's five-way binding posts accept even extra-large monster wire, banana plugs and spade lugs. Hookup is fast, easy and reliable.

The New Alesis Monitor One™

You don't design good speakers by trying hard. It takes years and years of experience and special talents that only a few possess. Our acoustic engineers are the best in the business. With over forty years of combined experience, they've been responsible for some of the biggest breakthroughs in loudspeaker and system design. The Monitor One could be their crowning achievement. They're the only speakers we recommend to sit on top of the Alesis Dream Studio™.

See your Authorized Alesis Dealer and pick up a pair of Monitor Ones. Left to right, top to bottom, they're the only speakers you want in *your* field.

The Monitor One is the speaker for the Alesis Dream Studio™. Need more information about the Alesis Monitoring System? Call 1-800-5-ALESIS. See your Authorized Alesis Dealer.

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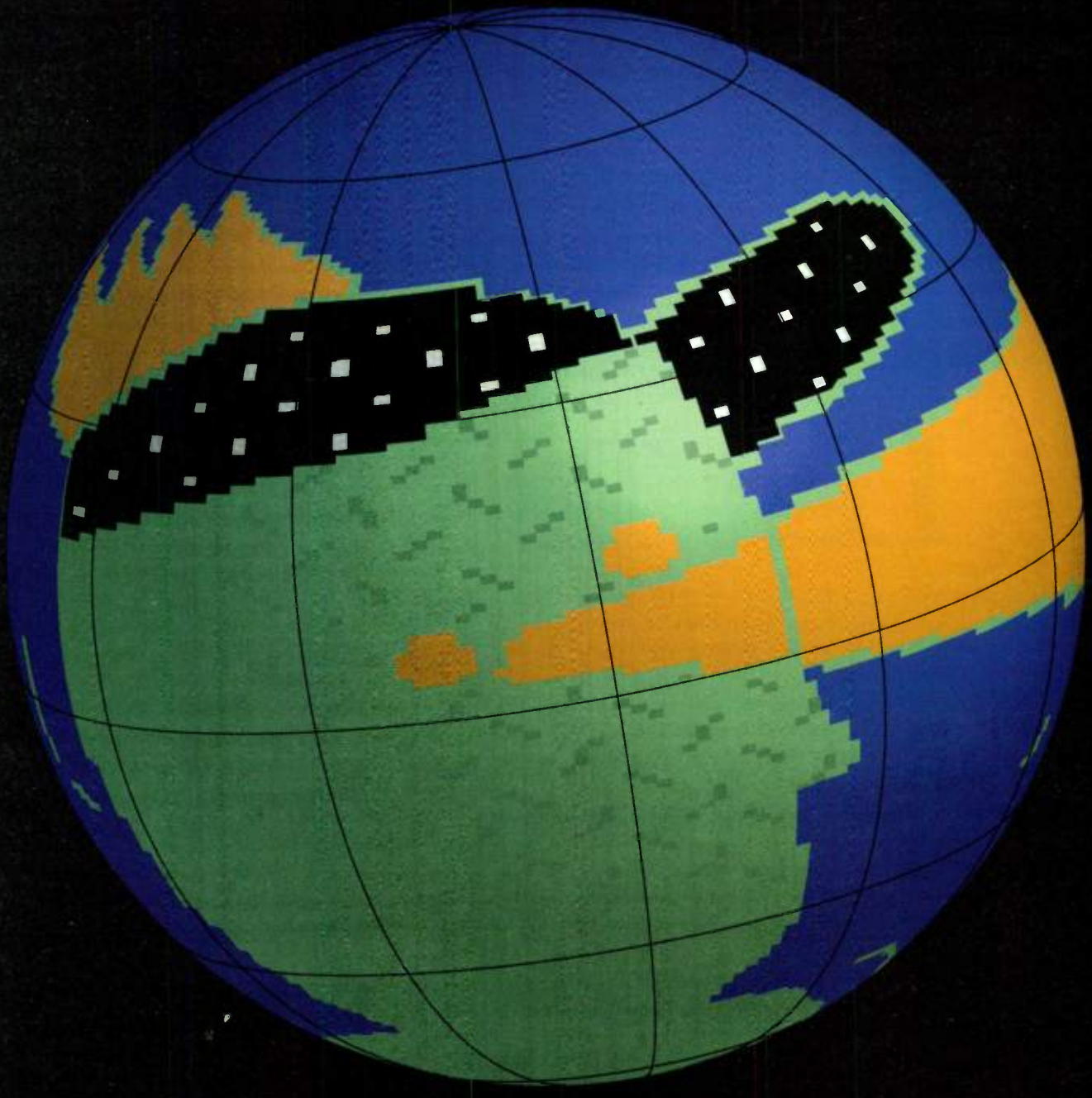

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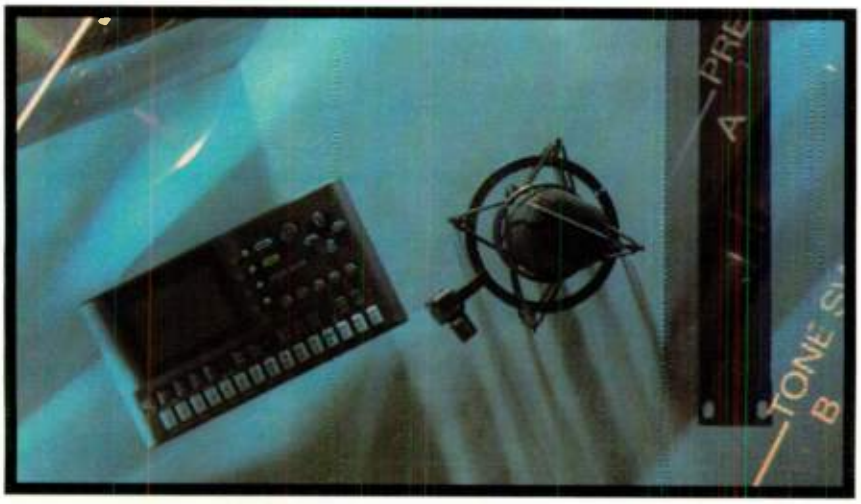

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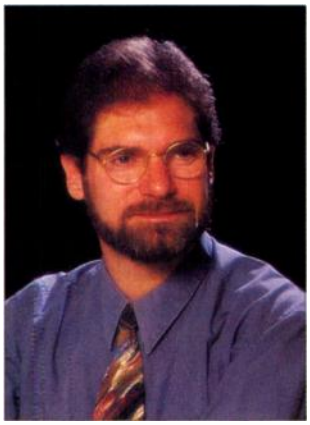
REVIEWS

DEPARTMENTS

Cover: Photo by Stan Musilek.
Special thanks to Audio-Technica, Mark of the Unicorn, Roland, Tannoy, and Yamaha.

Publisher's Note

Key changes in the musical staff.



KIM HARRINGTON

Periodic change is one of the elements that makes music interesting. The same can be said about magazine publishing and life in general. This month, I'm making a guest appearance on the "Front Page" to describe some recent changes at **EM**.

Electronic Musician has always strived to be the musician's guide to technology. The contents are constantly evolving, reflecting the changing nature of the music technology it covers. From my vantage point as the first official **EM** employee over eight years ago, I've seen your interests as a reader flow from MIDI to sampling to home recording, and most recently, to affordable digital recording. Your feedback, combined with new product introductions and a bit of guesstimation by our staff, determines what aspects of technology we cover. As such, we encourage you to keep letting us know where your interests are by sending a letter or filling out the "Rate the Article" section on the reader service cards.

This issue of **EM** is the last under the direction of editor Bob O'Donnell, who has joined the ranks of *MacWeek* magazine as Executive Editor/Reviews. Given his passion for computers and software, this position is a great match for Bob. During the four and one-half years of Bob's efforts, **EM** has grown from a hobbyist's journal into a full-fledged, professional magazine for serious musicians. He has contributed greatly to this growth, and all of us at **EM** are pleased that his experience here has enabled him to move ahead in his profession. We would like to thank him for his contribution and wish him well in his new gig.

The magazine has always been a team effort, and Bob's departure allows us to promote two **EM** veterans to new positions. Michael Molenda will step into the role of editor, and Steve Oppenheimer is our new senior editor.

Wildman singer/guitarist Michael Molenda has a colorful background as a successful performer, songwriter, and commercial studio owner. He was lead singer and guitarist for The Wobblies, enjoying critical acclaim and success in Europe during the late 1970s, and he rocks on as leader of the San Francisco band Ascot Jacket. Michael is also co-owner of Sound & Vision Studios in San Francisco, producing video soundtracks and many commercial albums. His words (and picture) grace this space next month.

Steve O. is **EM**'s technical wiz and review guru. When he was younger (and willing to live on a musician's salary), Steve put in over a dozen years as a professional session and road musician, working as a keyboard player, singer, arranger, and bandleader. This background has given Steve O. the perspective and great chops to keep the magazine's editorial content relevant and meaningful to electronic musicians who have a passion for keyboards.

We're sure that you will continue to enjoy **EM** with this latest key change in our musical staff. Congratulations to Michael and Steve!

Peter Hirschfeld
Publisher

Electronic Musician

Publisher Peter Hirschfeld

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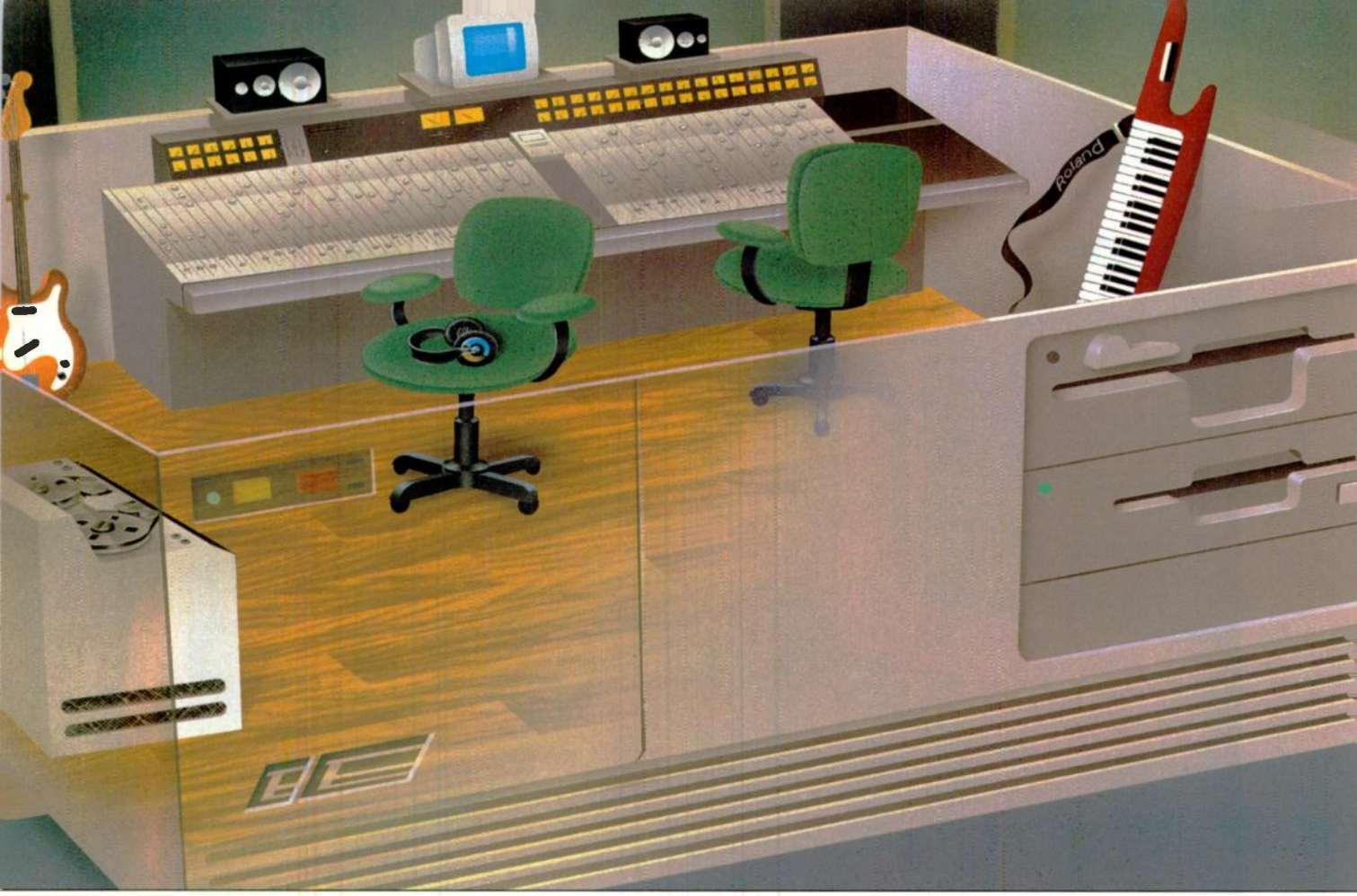

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And when you're ready for more serious entertainment, the RAP-10 is compatible with practically every DOS or Windows creative music application you can find—that's another feature you just can't get with any other sound card!

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...your own music! Only the Roland Audio Producer is a complete recording studio on your desk.

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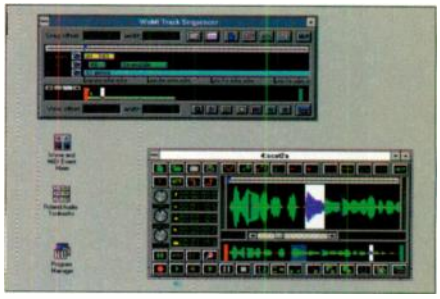
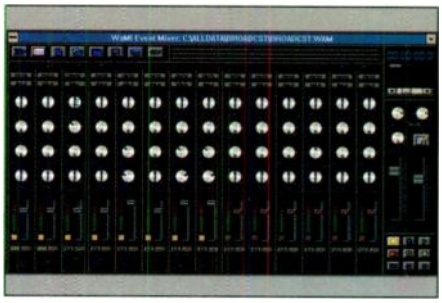
- Up to 2-tracks of direct-to-disk recording
- Reverb and chorus processing
- Real-time audio mixing of all parts and channels
- Digital cut/paste waveform editing
- Compatibility with most sequencer software

Just bring in any standard MIDI file, add vocals or acoustic instrument parts, and then you control the mix. You can even re-orchestrate the music to fit your own personal style. And spot production for broadcast is fast and easy using the RAP-10's digital track merging and visual waveform editing.

Audio Toolworks provides an easy, visual way to remove sections of audio and cut out pops or clicks. Plus, it allows synchronized playback of your MIDI files and digitized recordings.





With this 18-channel audio mixing console, you simultaneously control up to 16 channels of MIDI with two tracks of digitized audio. What's more, all on-screen controls are fully recordable.

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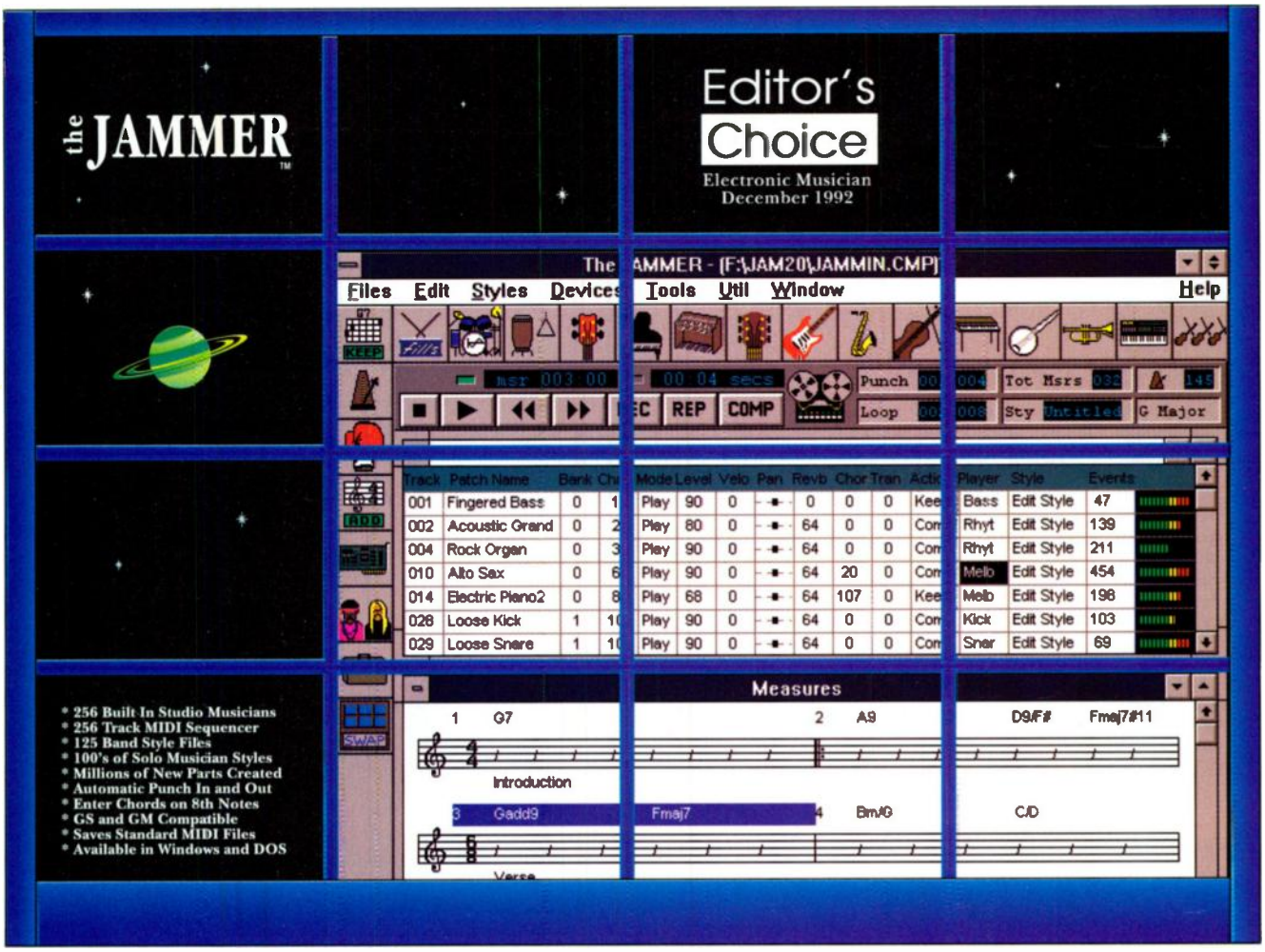

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CREATIVE COALITION

In response to Jim Devault's letter in the November 1993 **EM**, in which he said, "It's amazing no one has devised a system of communication between these far-flung artists. Perhaps the time has come for a newsletter," I inform Jim that not only is there a newsletter but a whole organization dedicated exactly to what he suggests.

It's the Creative Musicians Coalition (CMC). In addition to forming a meaningful bond among musicians, CMC takes the whole process several steps further. It is CMC's crusade to develop and nurture communication among and between artists, listeners, music dealers, music-product manufacturers, and even radio stations.

CMC publishes *AfterTouch—New Music Discoveries* and *I Share*, a newsletter for, by, and about its members. CMC also has a forum on PAN [Performing Artist Network] and a special section in CompuServe's new Music Vendor forum.

I understand why Jim thinks no one has devised such systems; it's because when someone does, they don't last very long for lack of support. CMC has managed to stick around for a few years and reach into fifteen countries, but it has been no cup of tea getting here.

If anyone is interested in learning more about CMC, they can write to: Creative Musicians Coalition, 1024 W. Willcox Ave., Peoria, IL 61604, or call (309) 685-4843.

Ronald A. Wallace
President
Creative Musicians Coalition
Peoria, IL

MORE GAIN

I have been involved with bands since 1971, amateur recording since 1980, computers and sequencing since 1988, and *Electronic Musician* since 1987. I continually find your magazine to be *the* source of information and answers for any questions I have. It seems funny that any time I approach a new step (sequencing, quantizing, synching, or even "live" situations) my next **EM** arrives with an article on what to do, or a review for a new piece of equipment I'm considering. Spooky!

This situation arose recently when I added some new pieces to my band's PA. I began having trouble with gain control because there were more I/O fader points added. I was pleased to see an article on gain stages ("Recording Musician: Gain Stages," November 1993), but I think Larry the O copped out. I was hoping to get some insight into techniques or tricks of the trade, but all he had to say was "do what's best for you...avoid highest and lowest points...stay at about 75%."

If anyone were to ask me about this subject, I could write for hours on the things I have learned, mistakes I have made, where I route things, which pieces I hardwire in as opposed to sending through auxes, and so on. Maybe it was a lack of space that forced Larry to touch each subject briefly and generally. Hopefully, there will be a follow-up article. If you decide to include readers' tips, mine is this: Don't over-amplify! It seems easier to run everything hot and have just enough power than to try to hold back an over-amplified system.

Steven R. Ivie
McKee City, NJ

Author Larry the O responds: *I agree with Mr. Ivie that more could be said about gain structuring than appeared in my column. It is true that most magazines have strict limits on article length. When covering such deep topics, we sometimes only have the space to identify primary issues, point out a few subtleties, and perhaps give one or two specific examples. Nonetheless, I did discuss some common scenarios, such as send levels to effects, with a fair degree of specificity; that is more than just advising avoidance of extremes.*

Some of the examples Mr. Ivie gives (what you hardwire, how you route) have more to do with interconnection than gain structuring, so they would not have been appropriate for this article, although they would make for a good article themselves.

By the way, Mr. Ivie's comments about not "over-amplifying" do not take into consideration the necessity of maintaining headroom in a system. Although the remark is too vague to address in more detail, his reference to power indicates he is talking about controlling power-amplifier output. Generally, the input-level control on a power amplifier is a passive attenuator that precedes virtually all of the amplifier's circuitry and is easily set to a level that allows an optimal adjustment of the previous stage's output, meaning that it is really no trouble to "hold the system back."

ORCHESTRA NOTES

Paul Lehrman's articles on electronic arranging and sequencing ("The Electronic Orchestra, Parts 1 and 2," September and October 1993) are possibly the most valuable articles I've seen in my three years as an **EM** subscriber. However, I take issue with his hard-headed stance against step- and mouse-entering. First, it's sometimes the fastest way to get the notes into the computer if you're not an able keyboard player; you can always randomize them if you want. But, more important, there's another way to unmechanize the sequence: Simply fine-tune the tempo. Professional sequencers will allow you to do this at intervals of a millisecond.

I would like to have Mr. Lehrman or someone else write on how to create orchestral sounds not found on most sample-playback modules, especially the bowing styles used on strings. This, by the way, is why I avoid General MIDI like the plague: There are too few program "slots" allowed in the specs for what's out there, a case of trying to be everything to everybody.

Gary Goldberg
Silver Spring, MD

DAVID SMITH

MINOR PLANETARY WOES

Would you buy a word processor that didn't let you remove a word without leaving a hole? Would you buy one that made you start a whole new line because you changed your mind about a previous part? No way! Then why does it seem that with some notation programs such things as being able to change an eighth note to a dotted quarter in the middle of a piece is impossible or very difficult to do? Am I the only one who wants to do this sort of thing?

For example, say you're composing by ear, making it up as you go, and you make a mistake and replay the passage, with the idea of later going in and removing the bad part (which could be any fractional part of a measure or beat). This seemingly simple operation is beyond the ability of most programs.

And why does wanting to do this seem so unusual that it's never mentioned in reviews, buyer's guides, or advertisements? Are we supposed to already have the music written before starting, or is there something wrong with the way I want to write music, and if so, could you please explain it? I realize that this problem is relatively minor compared to all the problems facing the planet and the human race, but still I stay up nights wondering.

Michael Shonle
Boulder, CO

Tom Kuder, vice president of Marketing and Sales, Coda Music Technology, responds: *Words and music are similar, but music has the added dimension of time. Your notation program should help you deal with this extra dimension, just like a word processor helps you format paragraphs and spell correctly.*

When you change an eighth note to a dotted quarter, you add time. Most notation programs available today let you do this fairly easily. But how should the extra time get treated? Should it squeeze into the next measure? Move to the next measure and push all the subsequent music forward in time? Leave extra beats in the measure, in conflict with the time signature? Delete the extra beats?

Ideally, the program shouldn't decide. You should because you're writing the music. This means you need a program that gives you a choice. (They do exist. For example, Finale *gives you all four of these choices.)*

If you're deleting time, you may want to replace a deleted phrase with rests. Or you may just want the program to neatly close up the "hole" for you, without leftover barlines or other debris. Again, you should have a choice. And to be truly useful, you'll need the ability to select and act on partial measures and beats. There are programs today that have these capabilities, to varying degrees.

Unfortunately, not all notation programs have the combination of musical intelligence and user-definability you dream about. If you still can't sleep at night, perhaps it's time for a new notation program.

BEGINNER SCHOOL

I read your article "Cool Schools" (September 1993) and was glad to see that music education is still going on. I think our country is going to see that education, in general, is the answer to many things. Regarding music, education gives more and more people the chance to participate, rather than just consume.

continued on p. 16

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DUE NEW GREG

8•BUS SERIES

6 AUX SENDS with Solo and Solo LED.

6 STEREO AUX RETURNS. All have 20dB gain, Solo and can be used in stereo & mono. 1 & 2 are pannable & bussable.

MIX B/MONITOR section can be used as an independent stereo out for PA monitor mix, 2-track recording, video/broadcast feed or assigned to L/R mix.

TWO SEPARATE HEADPHONE SECTIONS can be used totally independently of each other. Each features source selection between Control Room & any combination of AUX 3/4, AUX 5/6, Mix-B or External source. Solo allows control room to hear what musicians are hearing in their headphones.

TALKBACK assigns to all submasters, main mix, AUX 1, AUX 2 or Phones 1&2.

SOLO level adjust and ultra-rude LED.

MONITOR section with separate Control Room & Studio levels. Source selection between L/R mix, Mix-B, Tape & External. Can be switched to Mono.

–40 to +10 bar graph LED DISPLAYS for each sub-master & Solo/Main (with main L/R +28dB CLIP LEDs).

EXPANSION CONSOLES let you add channels in banks of 24 to either the 24•8 or 32•8. Expanders have their own internal mix amps so the main board only "sees" one extra channel per expansion console.

Built-in talkback MIC.

Trick BUS SOLO switches send odd-numbered buses to the left speaker and even-numbered buses to the right speaker — unless you've pressed the respective MONO L&R button. When a bus has been mono-ed, SOLO sends the bus to both speakers.

L MIX/R MIX & MONO L&R buttons assign buses to main L/R stereo bus.

All channels have Mackie's renowned discrete, wide-bandwidth MIC PREAMP circuit for ultrahigh headroom & low noise. All mic inputs have RFI choking, ferrite beads and +48V phantom power (switchable in banks of 8 channels).

Optional tilt-up METER BRIDGES are globally switchable to see tape return preamps or channel output and include VU meters for main L/R output. MB•24 meter bridge for 24•8 console is $799*. MB•32 for 32•8 is $899*. Our soon-to-be-released 16•8 16x8x2 console's meter bridge will retail for $699*.

Rugged, non-flexing STEEL CHASSIS.

4-BAND EQ with "Expensive British Console Sound." Includes TRUE PARAMETRIC HI-MID, swept LO MID, shelving HI & LO plus 18dB/oct HI PASS (lo cut) filter at 75Hz. Users are raving about the sound quality.

YE OLDE ENGLISH SOUNDE. Greg started out by asking "What is it that makes the finest British mixing boards perform the way they do?" For example, "classic," older English consoles have much wider-band midrange EQ than lower-priced consoles — it really has an effect on overall sound quality. So we incorporated the same capabilities on our new consoles. This also enabled us to add the flexibility of a variable bandwidth control for true parametric HI-MID EQ. It wasn't easy to engineer in the expensive circuitry necessary and still keep our consoles affordable, but we did it.

You'll like the increase in both sound quality and versatility.

We paid the same kind of attention to fader quality. Instead of less-accurate D-taper faders, we commissioned a totally new custom 100mm fader with the logarithmic taper found in mega-expensive consoles.

EVEN THE FEATURES HAVE FEATURES. Naturally each channel has In-line monitoring with split EQ. But our MIX-B Monitor section also has a SOURCE switch to tape off the channel (pre-fader) to create independent mixes for taping, broadcast feeds or headphone mixes. Dual independent headphone sections offer the ability to switch between Control Room and any combination of AUX 3/4, AUX 5/6, MIX-B or External sources. Tape inputs and outputs feature internal

*Suggested Retail Price. Your actual

+4dBU balanced TAPE RETURNS, switchable to to –10dBV unbalanced in banks of 8 returns.

Balanced MIC, bal./unbal. LINE IN, MIC/LINE switch, DIRECT OUT & CH. INSERT on every channel.

Three TAPE OUTPUT jacks per bus (total of 24). +4dBU balanced, switchable in banks of 8 to –10dBV unbalanced.

TO THE UNEXPECTEDLY HIGH DEMAND FOR OUR 8•BUS CONSOLES, WE WON'T EVEN LET MACKIE HAVE ONE YET.

HE WORKED. HE SLAVED. He created the 8-bus console HE always wanted to own. In fact Greg kept adding features until we threatened to whack him upside the head with a rancid salmon. Now the first notices are in from 8•Bus owners: Spontaneous raves from recording studios, PA companies and video post houses. Quotes like "It's so quiet I had to check to see that it was on" and "Blows away my old board that cost $20,000." In other words, Greg really DID succeed at creating the first truly affordable high-headroom, low noise, feature-laden 8-bus consoles. Unfortunately, we can't build them fast enough to meet demand. Unlike our competitors, Mackie can't just order up consoles by the container-load. Instead, we build each 24•8 and 32•8 at our factory in Woodinville, Washington. Even though we're working day and night (and shipping more and more each week), there's still a waiting list at Mackie dealers. Even Greg hasn't gotten one yet! Serves him right for designing so much performance into consoles that retail for $3995* and $4995*. Read on for the deliciously explicit details.

220-watt, Class A POWER SUPPLY with enough juice to also power a meter bridge.

+4dBU to −10dBV level conversion so you can use semi-pro tape decks without the inherent noise penalty found in mixers that operate at −10dBV internal levels.

MACKIE'S SIGNATURE MIC PREAMPS. At the urging of legions of satisfied CR-1604 and MS1202 users, we didn't mess with a good thing. Our 8•Bus consoles' mic preamps deliver −129.6dBm E.I.N. at 0.005% THD with a 300K bandwidth, yet can handle +14dBU inputs without a pad. The consoles' working S/N is 90dBu with 116dB internal headroom. For any application where noise is especially noticeable (such as hard disk or multi-track digital recording), you've found your board — for as little as $3995*!

SOME OF THE FEATURES GREG ADDED SINCE WE FIRST ANNOUNCED OUR 8•BUS CONSOLE LINE*:

- External 220-watt, Triple-Regulated, Low-Ripple Power Supply
- Mic/Line switch on every ch.
- "Triple-bussed" tape outputs
- −4/−10 tape inputs & outputs (switchable in banks of 8)

*Before we threatened to whack him upside the head with a rancid salmon if he didn't stop.

EXPANDABLE AND AUTOMATABLE. Need 24, 48 or even 72 extra channels? Add one or more 24-channel expander consoles (complete with inputs, tape returns and their own power supply) at any time in the future. Just by connecting one cable between the expander and your 24•8 or 32•8 board. External fader and muting MIDI automation will also be available soon.

OPTIMIZED FOR PA AND RECORDING. Along with elaborate monitor capabilities, balanced XLR main outputs and 18dB/octave hi pass filters, you get non-flexing steel construction, fiberglass thru-hole plated, horizontal circuit boards that minimize impact damage, gold-plated internal interconnects, sealed rotary pots and a rugged 220-watt, super-regulated power supply. You won't find more roadable, compact PA boards anywhere.

READ ALL ABOUT IT. Call us toll-free and we'll ship you a comprehensive brochure including application hookups. We think you'll be impressed enough to be willing to wait a little while before you get your 24•8 or 32•8. After all, Greg is still waiting for his.

Conventional faders have a second layer of resistive material that attempts to approximate logarithmic a taper. Our PRECISION NETWORK FADERS are single-layer screened with both the primary linear resistive elements and also a complex auxiliary element to create the true logarithmic curve found in ultra-expensive studio console faders (blue line on graph).

In-line FLIP reverses tape and mic/line inputs between channel strip and Mix-B/Monitor section.

AUX SENDS 1-2 PRE button selects pre-fader/post EQ or post-fader/post EQ.

AUX 3-4/5-6 SHIFT changes 3-4 to 5-6.

SOURCE selects signal source of AUX 3-4/5-6 from channel strip to channel's Mix B/Monitor send so you can build an effects mix (pre or post-MIX-B level) to assign to phones during tracking.

True parametric, 3-control HI MID EQ that has seasoned engineers swooning (quotes and raves on file...we're not kidding). Ultra-wide 500-18k frequency sweep range; bandwidth can be adjusted from a very wide 3-octave width to a very narrow 1/12-octave width. 15dB boost/cut.

LO MID EQ with ultra-wide 45Hz-3K sweep, 15dB boost/cut.

±15dB shelving HI (12kHZ) & LO (80Hz) EQ.

Multipurpose 18dB/oct. LO CUT filter @75Hz. Cleans up "mix mud," cuts PA rumble, creates a "neo-peaking" bass control when used with LO shelving boost.

Independent MIX-B (Monitor) section with pan, level & source. During mixdown, use as extra pre-fader stereo AUX send or double your inputs.

Mix-B SPLIT EQ assigns HI & LO EQ to Mix-B.

MIX-B SOURCE can route the monitor section to an extra stereo output for 2-track taping or broadcast feed during live mixing.

Constant power, buffered PAN pot for rock-solid panning.

Overload LED and Hyperactive −20dB Signal Present LED.

Selectable SOLO with CHANNEL METERING allows soloing in full stereo perspective; displays soloed channel operating level on master L/R meters so input trims can be adjusted for optimum levels.

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price, like your mileage, may vary. Prices are slightly higher in Canada.

As few high schools were mentioned, I'd like to say that music education is happening at our level as well. John Adams High School began a pilot electronic-music class in 1990. I had to put in my own equipment to get it off the ground, but the school has purchased some additional gear, as well. The physical situation of the lab is not perfect and the equipment is getting outdated, but the kids enjoy it and are getting their fingers and ears wet.

Keep the education going. If any of the companies are giving away old stuff, or even selling it cheaply, let me and other music educators know! I'm working on our school principal for "a little of this and a little ADAT."

Lavon Oke
Music Department Head
John Adams High School
South Bend, IN

INTERFERENCE

About three months ago, I started experiencing *really* bad ham-radio interference from an unknown neighbor. It leaks into everything I work on and use: The multitrack, DAT, CD player, and cassette deck all suffer. I even have the ham-radio interference coming over my guitar amplifier! When I take all the microphone and instrument cords out, I can still hear the interference through the headphone jack or the monitor out. What are my options?

Ken Lee
Tujunga, CA

Contributing Editor Alan Gary Campbell responds: *Ham-radio interference is often really caused by CB transmitters used with overpowered—and illegal—amplifiers. Try to detect the call sign of the transmission in question. Most ham operators are very conscientious and will gladly try to help. Depending upon the circumstances, the owner of the transmitter, whether private or commercial, may be required by law to fix the problem. Suspected illegal operators should be reported to the FCC.*

Note that in station-heavy urban areas, or locations near remote transmitters, the only recourse may be shielding the room with a wire-mesh grid, or "Faraday cage." This was discussed in the October 1992 "Service Clinic." We are considering an in-depth article on interference suppression techniques, if there is sufficient reader interest.

WHICH IS WHICH?

Does middle C on an acoustic piano correlate with C3 or C4 in the MIDI world?

Eddie Horst
Atlanta, GA

Eddie—The answer to your question is: Yes. Actually, it depends on which manufacturer you talk to. In most cases, C4 corresponds to middle C. However, Yamaha refers to middle C as C3. But hey, what's in a name?—Scott W.

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.

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WHAT'S NEW

▲ SHURE BETA 87

Shure has added the BETA 87 supercardioid condenser mic ($420) to its BETA Series of sound-reinforcement microphones designed for vocal applications. The mic's polar response is said to be uniform at all frequencies, providing excellent feedback rejection. In addition, the handheld mic offers internal shock-mounting and a 3-stage pop filter inside its dent-resistant, hardened-steel grille. The BETA 87 capsule will also be available in a wireless version, the L2/BETA 87 ($480). Shure Brothers Inc.; tel. (800) 25-SHURE or (708) 866-2200; fax (708) 866-2279.

Circle #401 on Reader Service Card

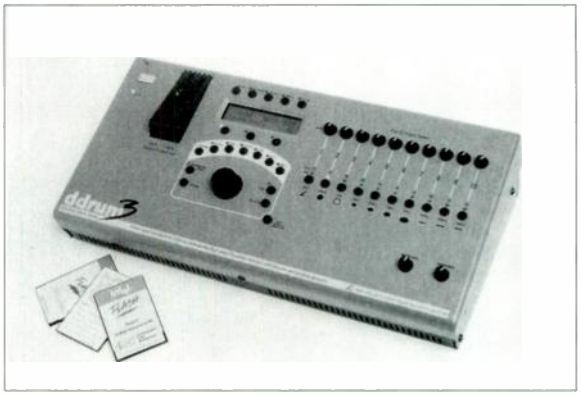
▶ DDRUM DDRUM3

The ddrum3 ($5,000) is a percussion sound source and triggering system that features a new, pressure- and position-sensitive Precision Pad that can play different sounds from different areas of the pad. The system's 16-voice "brain" offers 8 MB of 16-bit, 44.1 kHz percussion sounds (200 samples); a high-speed (1.6 ms response time) triggering interface; and MIDI Sample Dump support.

With an optional ROM or Flash EPROM expansion board, the unit can handle up to 256 MB of samples. Additional expansion-card slots accept two 64 MB PCM/CIA Flash EPROM cards, which are commonly used in PC compatible laptops. A SCSI and S/PDIF interface for importing user samples is optional.

A Subtle Sample Shaping feature lets you apply factory-preset algorithms to modify user samples. Other special features include a dynamic parametric EQ, sample merging, and resampling. The sounds can be transposed over a 5-octave range.

In addition to its MIDI ports, the ddrum3 brain has ten trigger inputs, a pedal input, and a remote-control input. It has a headphone output and eight assignable outputs with 18-bit DACs. Front-panel buttons and rotary level controls provide convenient, single-handed editing. The brain is 4U rack-mount and can also sit on a tabletop. ddrum; tel. (800) 882-0098 or (203) 380-0000; fax (203) 380-1780.



Circle #402 on Reader Service Card

▶ PERTEK MONITORMATE

Pertek's MonitorMate Personal Monitoring System ($349) provides a custom mix of microphone and line sources for each performer on the stage or in the studio. The device offers an XLR mic input and a ¼-inch, stereo, line/speaker input with a loop-through output. The inputs have separate level-control pots, and the mix is processed by bass and treble controls (±20 dB). The mix is then routed to a powered, monaural, speaker output (15W into 8Ω; ¼-inch) for driving Hot Spot monitors; a stereo, line-level output (¼-inch TRS); and a headphone jack. There also is a direct mic output (balanced XLR) with level control.

The compact MonitorMate is AC powered, weighs four pounds, and clips to a mic stand. Frequency response is 20 Hz to 20 kHz (±3 dB) with a S/N ratio (unweighted) of 70 dB for the speaker and headphone outs and 75 dB for the line-level mix out. Pertek Engineering; tel. (714) 858-1685; fax (310) 545-0576.

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Here's an easy way to figure out which software will help you get the most out of your MIDI setup: call the MIDI software experts at Soundware and get the kind of reliable service and support that our customers have come to rely upon. Simply dial (800) 333-4554. Orders gladly taken at the same number.

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▲ E-MU MORPHEUS

E-mu Systems has introduced the Morpheus Z-Plane Synthesizer ($1,495), a 1U rack-mount, 32-voice, 16-part multitimbral synth module that utilizes a unique, dynamic, digital-filter technology.

Instead of the usual 4-pole filters, the Morpheus has one 14-pole, resonant filter per voice, which consists of six bands of parametric EQ and a lowpass filter. Each 14-pole filter can produce one of 198 preprogrammed formants, or filter models, that emulate the natural characteristics of certain acoustic instruments, the human voice, or completely new sounds. These filter models can be applied to any waveform in the instrument, so you could start with, say, a vibes sample and apply the resonant characteristics of an acoustic guitar, or a human voice speaking the vowel "a," to the vibes waveform.

That's just the first step. Z-Plane synthesis lets you interpolate, or "morph," between filter models in real time using a Control Change message or MIDI note numbers. For example, an acoustic guitar resonance applied to a vibes sample could evolve into a human voice or piano resonance, moving from one filter model to the other. Morphing between filter models operates in a manner similar to morphing between digital video images; it's not crossfading or switching, but true interpolation, and all the points between filter settings are available.

Not only can you morph between two 14-pole filters as a function of, say, keyboard position (note numbers), but also between those two filters and another pair of filters using a second controller, such as Velocity. You can then morph between those four filters and the other four using a third controller, such as Modulation. For instance, you could use this process to emulate the subtle timbral changes that result from picking a guitar progressively closer to the bridge, or striking a drum at different points on the head.

The Morpheus also offers two LFOs, three envelope generators, and two 8-segment function generators per voice, plus an enhanced version of the MIDI-Patch modulation scheme used in other recent E-mu synths. A HyperPreset mode lets you split and/or layer up to sixteen presets, with velocity-switching between layers. The Loop Offset feature allows a single voice to access multiple, sequential samples to produce a type of wave-sequencing. The unit provides 128 ROM-based presets, 128 user memory locations, and 128 user HyperPreset locations. A front-panel slot accepts program RAM and ROM cards. E-mu Systems; tel. (408) 438-1921; fax (408) 438-8612.

Circle #404 on Reader Service Card

▼ MARION SYSTEMS MSR-2

Marion Systems is shipping the MSR-2 Modular Synthesizer ($1,495). The synth is based on a 1U rack-mount "Mainframe" that holds up to two plug-in sound modules, which are easily swapped. Each module is a complete synth, which you can combine in any way as new modules are developed. A Superpatch mode lets you mix, EQ, and save patches from different modules as a single program.

The Mainframe includes a programmable, 6-channel, stereo mixer for the module outputs; a pair of external inputs; a programmable, stereo, graphic EQ; and two sets of MIDI ports. The

manufacturer describes its MIDI processing capability as "extensive." The user interface features a flat menu structure (i.e., no pages behind pages), which is accessed with two rotary knobs and a large, fluorescent LCD.

The first synth module, which is included with the unit, is an 8-voice polyphonic, 8-part multitimbral, analog synth that offers proprietary, digitally controlled, analog oscillators (not regular DCOs); 2- and 4-pole, resonant VCFs; external inputs into each filter; and matrix modulation. RiCharde & Company (distributors); tel. (408) 688-8593; fax (408) 688-8595.

Circle #405 on Reader Service Card

▶ PASSAC EC-100

Passac is shipping the EC-100 Acoustic Guitar Preamp ($149), a 9V battery-powered device that comes with a heavy-duty belt clip. The preamp's circuitry generates a tunable range of low harmonic frequencies that can be mixed with the pickup signal at an adjustable level. This is designed to create a more natural acoustic guitar sound from a single piezoelectric pickup, which is usually placed near the bridge, overemphasizing the high harmonics.

The preamp does not create phase distortion or response peaks that could cause feedback. In addition, the unit acts as a buffer for the high-impedance piezo pickup, reducing radio-frequency interference. The EC-100 has a built-in battery-tester and a momentary audio mute. Battery life is approximately 500 hours. Whitenton Industries; tel. (713) 772-1404; fax (713) 772-7360.

Circle #406 on Reader Service Card

continued on p. 25

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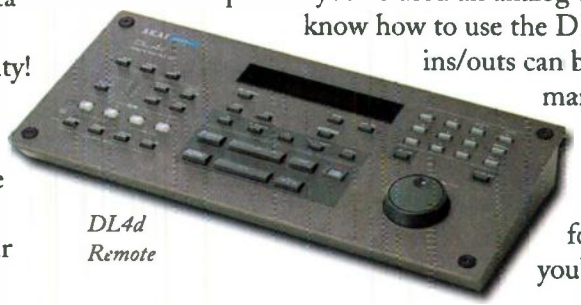
1. TAPELESS EDITING The DR4d can simultaneously record 4 tracks directly to standard SCSI-compatible hard disks, not tape. Tape recorders which use a cassette format (VHS, 8mm, etc.) have a huge problem: without at least two machines, you can't edit. But even a single DR4d allows random access editing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

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

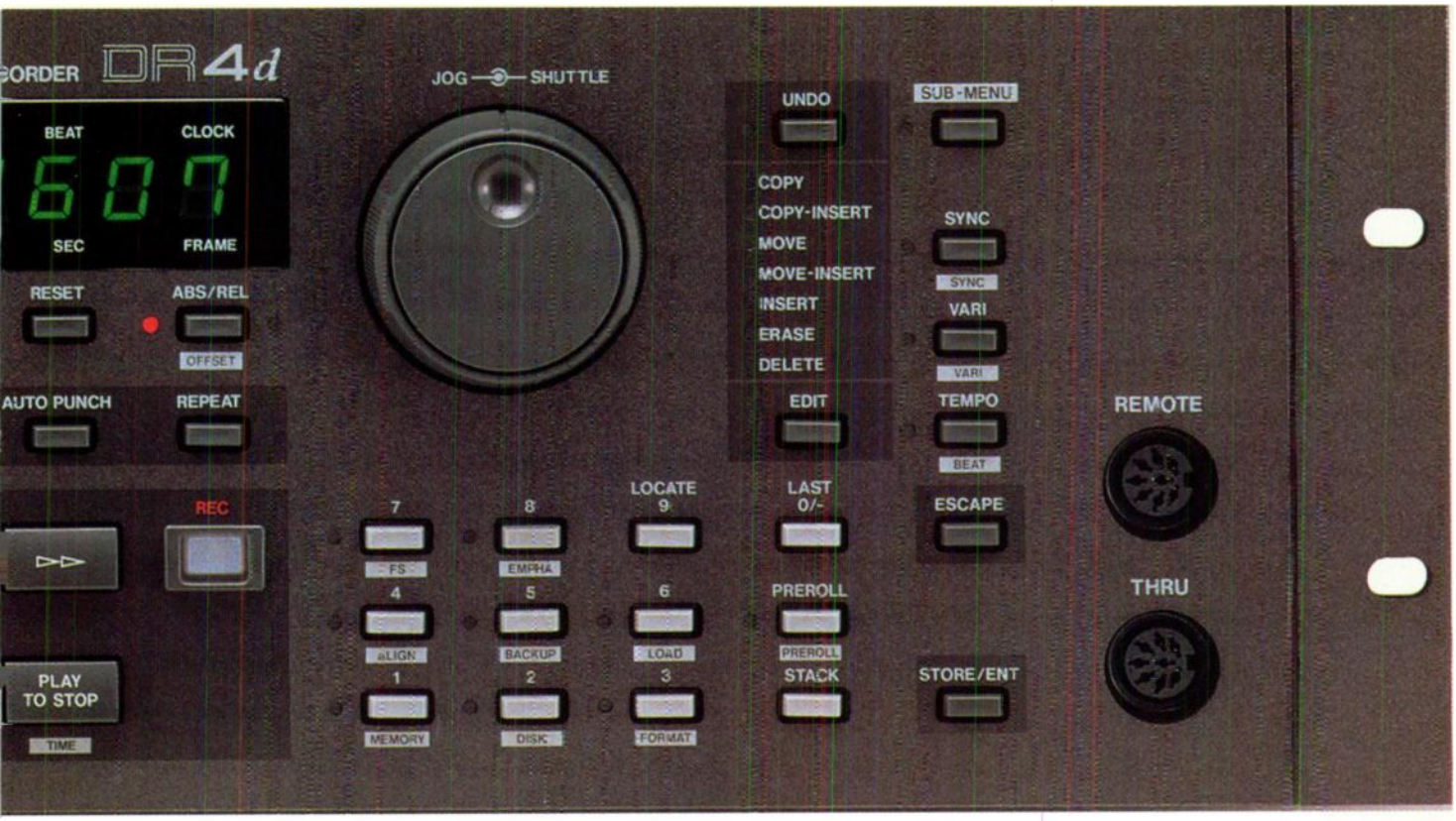
3. JOG/SHUTTLE Another cool DR4d advantage is the ability to offer scrubbing of audio, like "reel-rocking" on analog decks - only with much better quality. Our Jog/Shuttle wheel lets you scrub through the audio at various speeds, forwards or backwards. So finding precise editing points is only as complicated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

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



DL4d Remote

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



ose the DR4*d* Hard Disk Recorder

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

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

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

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

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

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

DR4d

AKAI DIGITAL

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

1500 SERIES

WHATEVER YOU DO — DON'T BUY THE WRONG MIXER.

Especially if you're doing multitrack recording — whether digital or analog. Fact is, a mixer that's not specifically configured with the features essential for multitrack recording just isn't a recording mixer. Bottom line is, general purpose mixers make multitrack recording a nightmare.

You see, mixers that aren't designed and engineered for multitrack recording will torture you with the endless hassle of patching and repatching — every time you track, overdub or mixdown. It's frustrating, wastes valuable time and leaves you tangled in cable.

So before you choose a mixer for your studio — be sure it has the features of a dedicated recording mixer.

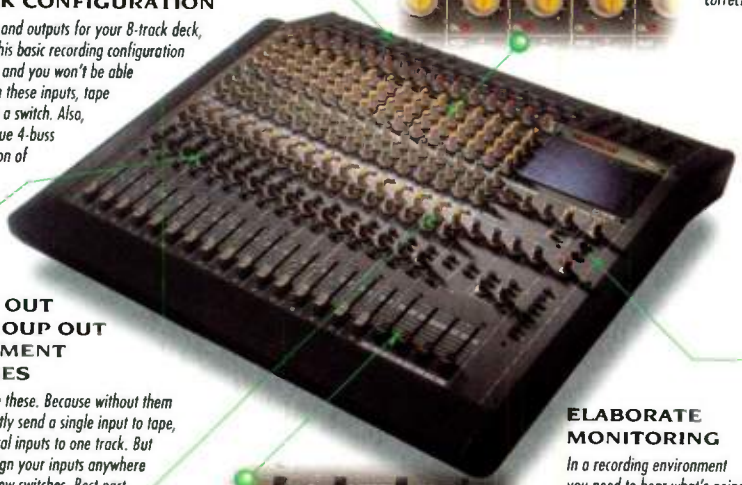
IT'S NOT A RECORDING MIXER IF IT DOESN'T HAVE THESE FEATURES.

SWEEPABLE MIDRANGE EQ

Ask for it. Because when it comes time to tailor your sound, you need the flexibility where the action is — in the midrange. The M1500's sweepable midrange lets you isolate specific mid frequencies allowing you to make the subtle tonal corrections you want.

MULTITRACK DECK CONFIGURATION

If you don't have dedicated inputs and outputs for your 8-track deck, where do you plug it in? Without this basic recording configuration you'll be repatching day and night and you won't be able to record on 8 tracks at once. With these inputs, tape monitoring is as simple as pressing a switch. Also, because the TASCAM M1500 is a true 4-buss mixer, you can mix any combination of your input signals to any of the 4 output busses directly to tape.

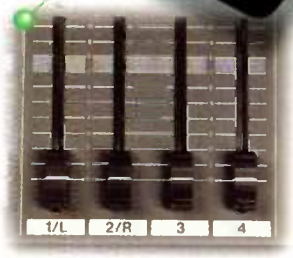


DIRECT OUT AND GROUP OUT ASSIGNMENT SWITCHES

You gotta have these. Because without them you can't directly send a single input to tape, or record several inputs to one track. But with them, assign your inputs anywhere by pressing a few switches. Best part is, you'll never have to refer to any complex patch diagrams.

ELABORATE MONITORING

In a recording environment you need to hear what's going through your board at all times. With the M1500's comprehensive monitoring matrix you are able to hear any sound source at any time — inputs, tape, AUX sends, anything — it's your choice, just press a switch.



IN-LINE MONITORING

A sure sign of a recording mixer. This lets you monitor your tape tracks at any time without sacrificing an input channel. Just press a switch. With the M1500's dual section not only can you monitor tape tracks, it can be used for additional effects sends, or to double your inputs for virtual tracking at mixdown. And do any of this by flipping a switch.

TRUE TRANSPARENCY AND LOW NOISE

In recording, your signal goes through the mixer several times. And each time it goes through, it is important not to lose or gain anything. Especially an identifiable "mixer sound." Test any mixer for its transparency. Take any signal and bounce it 3 or 4 times on your favorite digital recorder. With the truly transparent M1500, you'd be hard pressed to differentiate between the bounced tracks and the original signal.

At TASCAM, we've been making multitrack recording equipment for more than 20 years. We pack that experience into every mixer we make — and we make more recording mixers than any other company in the world.

For our M1500 Series of recording mixers, the result is an affordable mixing console configured for 8-track recording. A truly transparent mixer that makes tracking, overdubbing, and mixdowns easy. An extraordinarily flexible console loaded with the features and specs you'd expect on consoles costing thousands more.

But the M1500 Series of recording mixers are priced less than many general purpose mixers on the market. They're available in a 16-channel/32-input tabletop version (M1516) and a compact rack mountable 8-channel/16-input version (M1508). So if you're involved in digital or analog 8-track recording, you've just found the best recording console value in the industry.

TASCAM M1508 $999 M1516 $1599

Get your hands on a true recording mixer today: the TASCAM M1500 Series. There's one waiting for you at your authorized TASCAM dealer. Go ahead — test it and play with it. It's your next recording mixer.

TASCAM.
Take advantage of our experience.

▶ ALLEN & HEATH GL2

Allen & Heath has debuted the GL2 ($1,495), a 4-subgroup mixer with ten mono input channels and two stereo channels. The unit offers balanced, XLR and ¼-inch inputs for the mono channels, while the stereo channels use ¼-inch and RCA connectors. The stereo channels have a dual-input select switch that lets you choose either of two stereo inputs. Four-band EQ is available on all fourteen channels and includes high and low shelving and two wide-band, peak/dip, sweepable mids. An In/Out switch lets you A/B the raw and equalized signals. The L/R levels are monitored with a pair of 8-segment, LED peak meters.

The GL2 has six aux sends; sends 1 through 4 are collectively switchable pre- or post-fader, as are sends 5 and 6. There are four stereo aux returns, as well as L/R RCA tape sends and returns.

The aux returns include pan, level, and a switch that determines whether the input is from the line return jacks or the same-numbered subgroup fader. When used as a sound-reinforcement board, for example, this lets you route the subgroups through a second post-fader level control (besides the subgroup outputs) and on to the L/R mains.

The subgroup, L/R main, and mono outputs use XLR connectors. Inserts are provided for the mono channels, subgroups, and L/R bus. The subgroup section includes post-insert AFL monitoring, mutes, and peak meters. A recessed Group/Aux Reverse switch transforms the GL2 into a monitor mixer: The stereo L/R bus becomes subgroups 5 and 6, providing six separate monitor mixes.

An optional SYS-LINK module allows two or more GL2s to be connected at the bus level. An additional optional connector panel allows consoles from other manufacturers to be bussed to the GL2, including aux buses and subgroups. The manufacturer's specifications include a frequency response of 20 Hz to 20 kHz (+0/-1 dB), THD of 0.01% (line in to mix out at 1 kHz), channel crosstalk better than 90 dB (at 1 kHz), and S/N ratio of -88 dBu (line). Allen & Heath; tel. (800) 777-1363 or (801) 566-8800; fax (801) 566-7005.

Circle #407 on Reader Service Card

▼ FOREFRONT FT3

ForeFront Technology is shipping a series of MIDI devices, including the FT3 Patch Commander Plus version 2 ($129.95), FT8 MIDI Merge ($149.95), and FT5 MIDI Thru box ($69.95). The FT3 transmits MIDI Program Changes on any channel, or the same Program Change on all sixteen channels. Up to eight Program Changes can be stored as a group and triggered simultaneously with one keystroke. A dual-footswitch jack lets you connect two footswitches, or the optional DF1 dual footswitch, to increment/decrement Program Changes or step through a chain of Program Changes. Two types of MIDI data filters are included: One removes user-selected Channel and System message data on all channels, and the other filters specified messages on selected channels. A Panic mode sends individual Note Off messages for all notes on all channels.

The FT3 can also send a MIDI Bank Select message, a Song Select message, and a typed-in MIDI data byte (000 to 255). An onboard MIDI Clock generator ranges from 39 to 255 bpm, and a footswitch can send Start/Stop messages. In addition, the FT3 provides a cable checker, a keyboard-split feature (notes above the split point transmit on the next MIDI channel), rechannelizing, and Program Change translation (incoming Program Changes 001 to 008 are translated to user-selected, outgoing Program Changes). All setup data can be saved via SysEx.

The palm-sized FT8 is an intelligent 2 x 1 MIDI merger that analyzes which of the two inputs takes priority when the data stream becomes dense. Finally, ForeFront's FT5 is a 2-In/8-Out thru box, which can be configured as two 1 x 4 routers or as a 1 x 8 device with A/B switches. Music Industries Corp. (distributor); tel. (516) 352-4110; fax (516) 352-0754.

Circle #408 on Reader Service Card

▲ TECH 21 SANSAMP PSA-1

Tech 21 is offering the SansAmp Model PSA-1 ($795), a programmable version of the company's analog tube-amplifier emulator. The single-rackspace unit comes with 49 user program locations and 49 presets that emulate the sounds of well-known guitar and bass amps. Programs can be saved and loaded via MIDI SysEx, and remote Program Changes can be made via MIDI or a momentary footswitch. Parameters are adjusted in real time with 256-increment, rotary, analog potentiometers.

Front-panel controls include Preamp Level, Buzz, Punch, Crunch, Drive, and Low and High tone controls. The unit has dual ¼-inch and XLR outputs for stereo processing, and either output pair can be set at line or instrument level. The two sets of outputs can also be used simultaneously. The outputs can be routed to full-range speaker systems or guitar/bass cabinets. Tech 21; tel. (212) 315-1116; fax (212) 315-0825.

Circle #409 on Reader Service Card

TECH PAGE

Big Blue Laser

IBM takes the lead in the MO storage-capacity race.

By Scott Wilkinson

Magneto-optical (MO) disks have become a staple in many home and project studios, and with good reason. They offer removable, rewritable optical storage with a capacity that exceeds most magnetic-disk cartridges. On the other hand, they are relatively slow, and their capacity is still small when you consider the requirements of large-scale, digital-audio and video applications.

Among the most important areas of research in MO storage is the effort to increase its capacity, which depends on the density of the bits encoded on the disk surface. The bit density is determined by the size of the tiny spots that are heated and magnetically oriented in the recording layer of the disk (see "Personal CD Recorders" in the October 1992 **EM**). The size of these spots is ultimately determined by the wavelength of the laser used to make them. Most commercial MO drives use an infrared laser, which operates at a wavelength of around 856 nanometers (nm). However, IBM recently performed some promising experiments with a blue laser operating at a wavelength of 428 nm (see **Fig. 1**). With a shorter wavelength, smaller spots can be made in the recording layer.

As the spot size decreases, it becomes more difficult to accurately position the read and write heads over the correct point on the disk surface. Current disks have spots written on tracks between preexisting grooves, which helps the heads find their way. But to achieve higher densities, the data tracks and grooves must be thinner, making them much more difficult to fabricate. Besides, these grooves generate noise, so eliminating them is an attractive side benefit.

IBM used a technique called *sample servo* to position the laser correctly over a grooveless disk by analyzing a periodic pattern of tracking bits embedded in the data. In addition, the disk was made with a recording layer of magneto-optical material that is optimized for blue wavelengths.

These experiments achieved a world-record density of 2.5 billion bits/square inch, which is five times greater than conventional MO drives. This translates to a storage capacity of 6.5 GB on a 5.25-inch MO disk, which is enough for almost eleven hours of stereo CD-quality audio, or three and a half minutes of uncompressed digital video at 30 MB/second. (The technology cannot yet read data from the disk at this rate; IBM reached a realistic data-transfer rate of 2 MB/second in these experiments.)

FIG. 1: Dr. William J. Kozlovsky, research staff member at IBM's Almaden Research Center, demonstrates a compact, blue-laser, MO storage system. (Photo courtesy IBM Corp., Research Division, Almaden Research Center.)

You may think that cutting the wavelength in half should double the bit density, not quintuple it. However, remember that when the diameter of the spot is cut in half, the area it occupies is one quarter of its previous size, which increases the density by a factor of four. In addition, *pulse-width modulation* (PWM) is applied to the laser during its write cycle, resulting in a more complex pattern of spots that encode information in their leading and trailing edges. This technique alone can increase the data density by up to 50 percent.

For the moment, this technology is targeted at large, multidisk libraries, sometimes called "jukeboxes," which are used by insurance companies, hospitals, and banks to store and access up to five terabytes of data, on hundreds of disks, in a box the size of a refrigerator. However, according to Edward M. Engler, program director of IBM's Optical Storage Laboratory, "We're working to make this blue-laser device small enough to fit inside a personal computer or workstation." On that day, media mavens everywhere will rejoice.

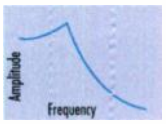
The Future. Plane and Simple.

Does the world of electronic musical instruments seem like it's stuck in an endless rut? New bells. New whistles. Same old sound...

Well, if so, take E-mu's new Morpheus™ Z-Plane™ Synthesizer for a test drive. Sure, it's got bells and whistles in abundance. But it's got something else that sets it apart from the digital crowd: new sounds and expressive control that you've never experienced in a MIDI instrument.

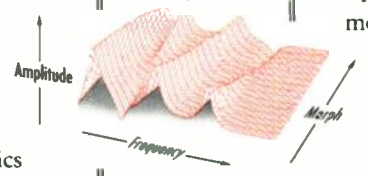
At the heart of Morpheus is E-mu's new Z-Plane Synthesis technology. Unlike the simple 2-or 4-pole filters of traditional synthesizers, Morpheus' 14-pole Z-Plane filters are capable of modeling virtually any resonant characteristics and then interpolating (or "morphing") between them in real time.

Imagine sending a saxophone through the body of a violin and then smoothly morphing it into a distortion guitar. Or send a piano through the resonances of the human vocal tract pronouncing a variety of vowels. Or sweep a synth pad with 32 polyphonic flangers. Or use a mod wheel to control the subtle timbral changes that result from picking an acoustic guitar at different distances from the bridge. These are just hints of what Morpheus is all about.



Traditional Synthesis

Single, 4-pole lowpass filter with resonance.



Z-Plane Synthesis

Allows you to "morph" sounds through multi-dimensional, 14-pole filters.

And remember those bells and whistles? Morpheus gives you everything you need to harness its Z-Plane filters. Like a seriously enhanced version of our powerful MIDIPatch™ Modulation System. Like multi-segment function generators for microscopic sound-sculpting. Like a new Hyper-Preset mode that lets you split, layer and cross-switch between 16 presets at once—for sounds so thick you can swim in them.

And since Morpheus is from E-mu, all this power comes wrapped in the industry's clearest, most straightforward user interface. Add 32-voice polyphony, 16 part multi-timbral operation and dual stereo effects processors, and you've got the synthesizer to move your music into the next century.

Best of all, you won't have to wait for the next century. Check Morpheus out today at your local E-mu dealer. Where the future is now.

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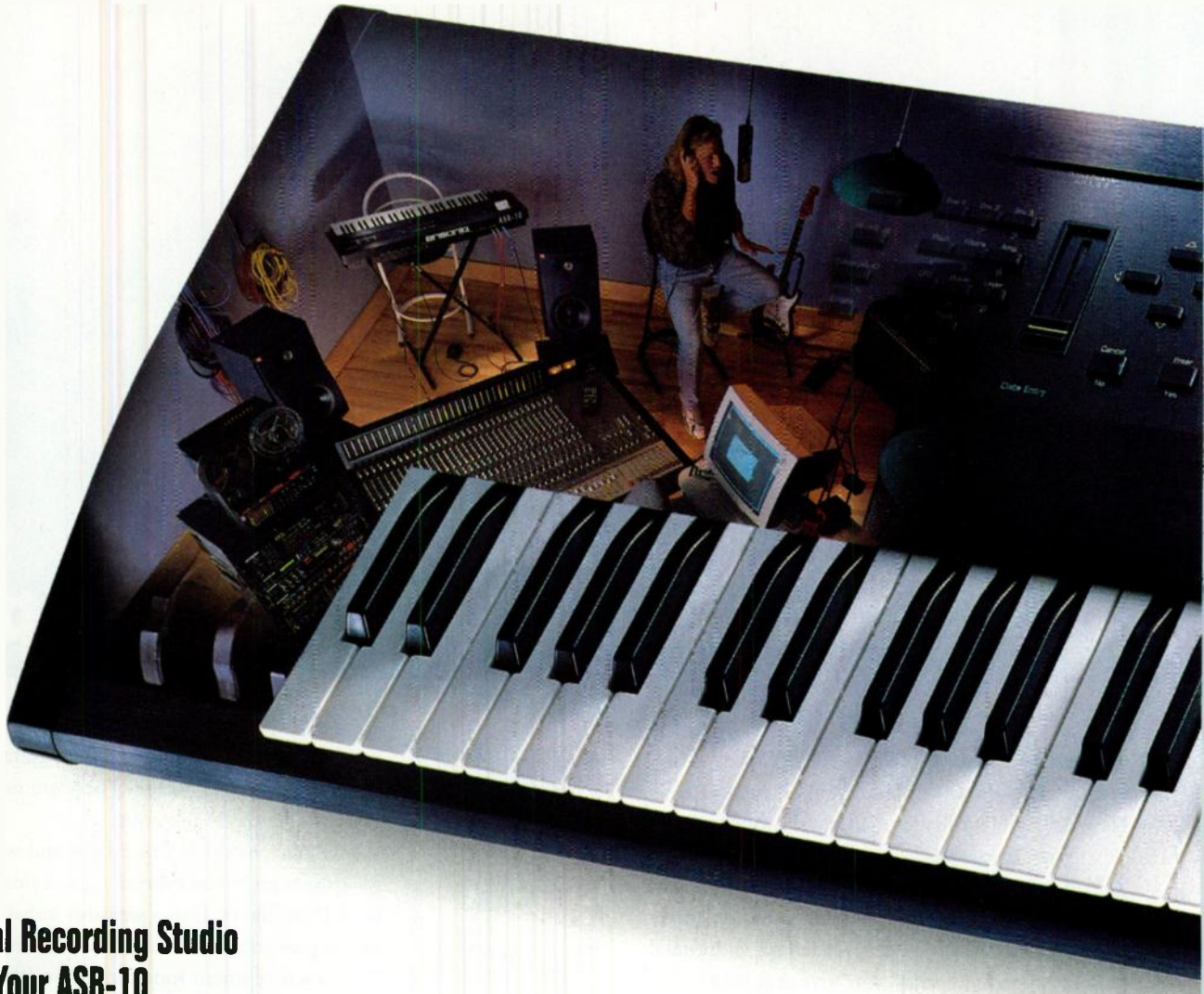

A Digital Recording Studio Inside Your ASR-10

The ENSONIQ ASR-10 is the *only* musical instrument that combines the equivalent of a sampler, digital tape recorder, signal processor, and MIDI sequencer—for a fraction of the cost!

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TRADING REELS

Scoring industrial videos is a great opportunity for industrious composers.

Professional composers are always looking for new markets. However, an often overlooked niche is industrial music. Now, we're not talking about the dark, cacophonous music produced by bands such as Nine Inch Nails. In the business world, "industrial" defines corporate communication tools—such as instructional videos—that often require music. Admittedly, composing for business *industrials* may not be as glamorous as playing a Strat with a chainsaw, but writing music for the corporate world can be challenging and satisfying. Best of all, it can be profitable.

The most common type of industrial work consists of scoring personnel-training and staff-motivation videos. Industrial music is also used to spice up sales presentations and provide background ambience for trade-show booths. In the software world, music clips accompany multimedia games, presentation software, and interactive CD-ROMs.

PHOTO ILLUSTRATION BY DAVID PERK

By Ernie Rideout

Once you have your score in the can, you can mix directly to a copy of the finished video, or to a blank video tape with SMPTE striped on it. In addition, many professional 2-track (audio) mastering decks can record time code on a special center channel that doesn't interfere with the stereo music mix. Another common mixdown medium is ¼- or ½-inch 4-track. A 4-track recorder allows you to mix a stereo music track and still have room for a regenerated time-code track with a buffer track in-between. If dialog or sound effects must be mixed to the open track, be sure to listen critically for any signal bleed that may compromise the time code.

Mixing to DAT is another option, although DAT machines with time-code capability cost about $5,000. However, DAT has the advantage of being so time-accurate that time code is sometimes unnecessary. If the composer specifies absolute tape times for each musical cue, the video editor can usually cue sound to picture with minimal problems. (Eric Guthrie and Chris Knudson, the composers for the hit independent film *El Mariachi,* recorded the entire soundtrack without time code.)

Once your score is submitted, the production house usually lays the music to video on a 1-inch, reel-to-reel format—the current video industry standard—or on a completely digital format such as Sony's D2. (Due to ongoing price reductions, digital formats are starting to usurp the popularity of the 1-inch analog medium.) Some video editors prefer to lay the music during the on-line session, while others wait until the sweetening session, where sound effects may also be added.

SURVIVAL TIPS

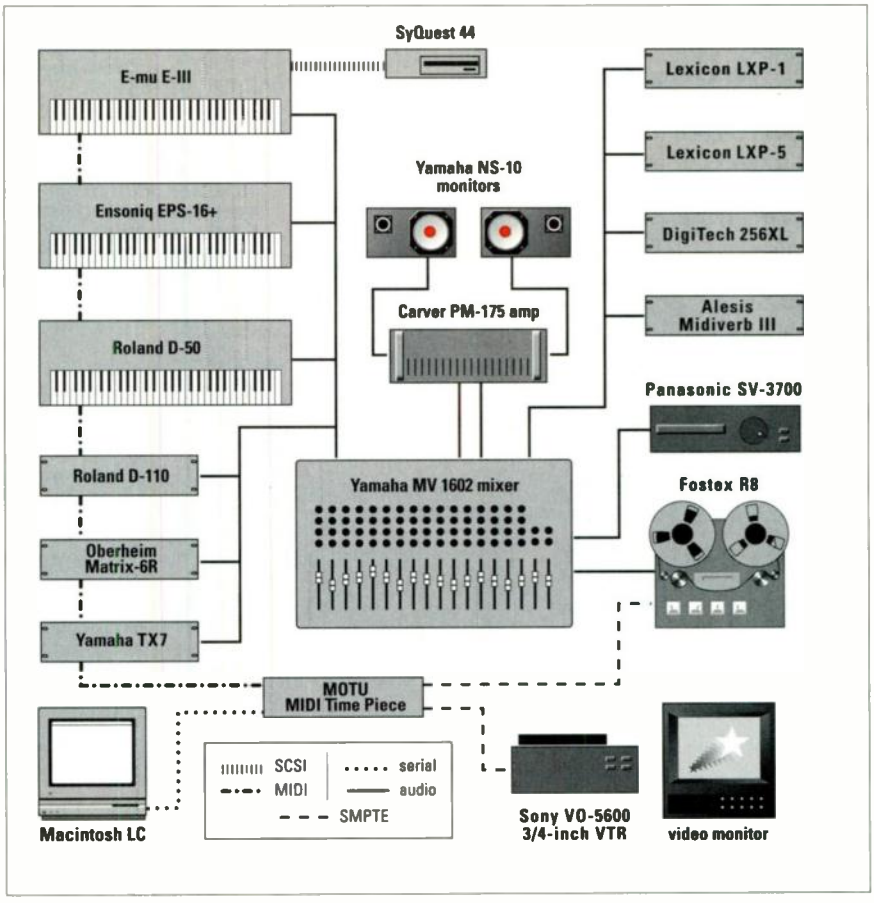
Like most projects, industrials have deadlines. However, unlike television and film productions, the deadlines are often negotiable. "Schedules are usually tight," says Shaw. "Often you only have a couple of days from conception to completion. If there's just an opening theme, a closing theme, and a couple of hits, two days is fine. But if the client wants more, I'll work with the producer to gain some time for myself. You need to negotiate deadlines so you don't get put in the position of not being able to do a good job."

As the project develops, keep in contact with your client. "It's important to work with the creative team to realize the [musical] concept," says Herb Ferrette of First Generation, a video-editing service in San Francisco. "I try not to wait until the product's finished before I hear the music. I meet with composers constantly throughout the off-line editing period. In the early stages, they may have just beats and bars with some orchestration. But I can help guide them, asking if they can do this here, do that there. By our third meeting, the music is usually locked in.

"In addition, it's essential to understand the producer's vision," continues Ferrette. "The composer must work with the producer to enhance ideas, rather than working off preconceptions and ignoring the producer's needs. If you take a risk and don't follow directions, then you won't get hired again, no matter how good you are. It doesn't matter that nine out of ten songs were great; they'll remember the one that didn't work."

Shaw often invites jittery clients to his studio. "In the studio, the client can hear the music through good speakers and watch the off-line edit on a high-resolution broadcast monitor. Sound and picture are all synched up, and everything should look and sound great," he explains. "Then I can make quick adjustments if they want. If they want more extensive changes, it's often just an evening of work. Usually, it's not that they don't like the music, but that they need to change the narration, want another sound effect, or just want to hear more music because it sounds cool!"

First-time industrial composers should realize that *every* job establishes a reputation. "If you want more work," says Sanders, "you must go above and beyond the call of duty. Sometimes that means being present when they're laying the music to make sure that it fits. If you have to force your way into the on-line suite, do it. It's your product on that tape. If someone hears it and doesn't think it sounds good, they will

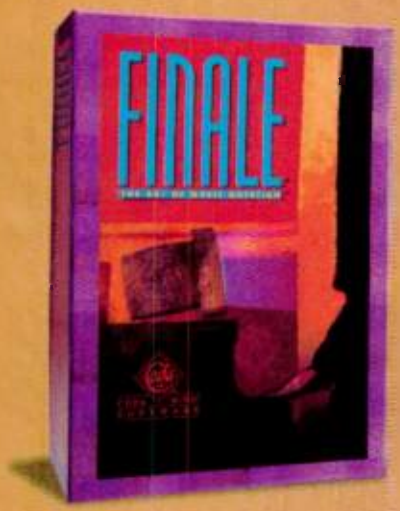


Rick Shaw's audio-video production system.

WHAT DO

Jurassic Park, The Baptist Hymnal, Malcolm X, *The Chicago Symphony*, Frank Zappa, The Tonight Show, Sesame Street Songbook, Hal Leonard Publishing *and* A Few Good Men

HAVE IN COMMON?



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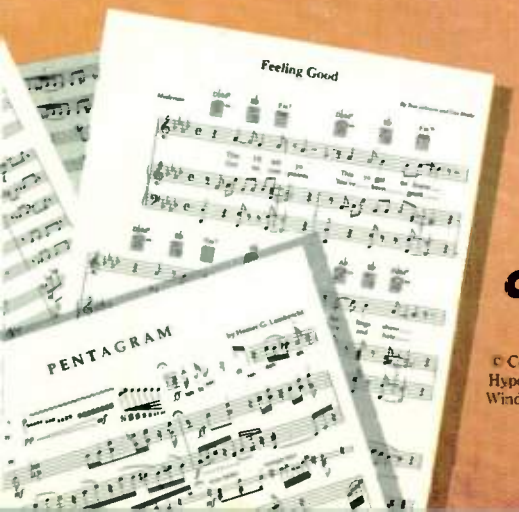

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• Second generation AWM2 sampled voices • 32-note polyphony • General MIDI • Built-in DSP • Mac/IBM Interface • MSRP: $TBA

TG100 TONE GENERATOR
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• 76 keys • Combines 16-bit sample playback with most advanced FM synthesizer ever • 22-bit D/A conversion • 512K sample RAM (expandable) • MSRP: $3995.00

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• 88 keys with initial and after-touch response • Total MIDI control, including real-time performance effects, voice and function programming • MSRP: $1995.00

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"The QY20's user interface is excellent, its sequencer is surprisingly flexible and the fact you can operate it anywhere is wonderful."
-Greg Rule, Keyboard-

QY20 MUSIC SEQUENCER
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• 8-track sequencer • 28-note polyphony • 76 preset patterns • 24 user patterns • MSRP:$399.95

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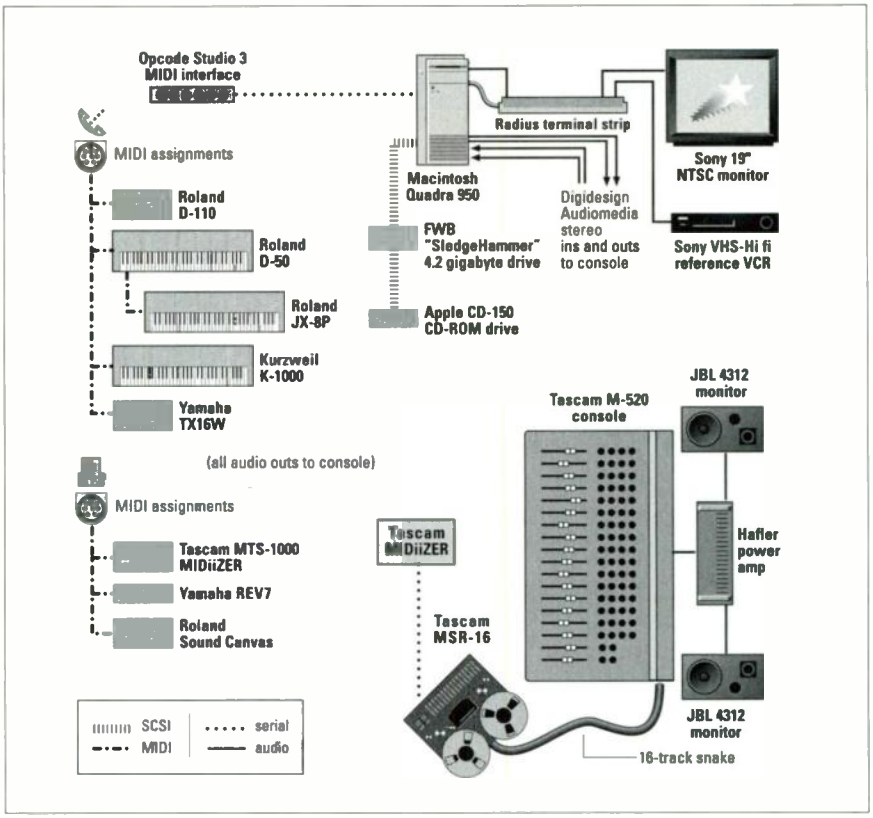
not assume that the audio transfer was poor. They'll simply think that this subpar score reflects your work."

Be aware that the video world is very different from audio in terms of pace, mixing, terminology, and methods of working. As a composer seeking to work with video, it pays to familiarize yourself with video production as much as possible.

Shaw offers a final bit of advice: "As with any creative endeavor, no one can master all styles. Don't let it get to you if someone else gets the gig. It's a fact of the composer's life that he or she may be right for one particular job, but not another."

THE FUTURE

Recent technological and business trends have made a tremendous im-



The production suite at Concorde Music Productions.

pact on the industrial market. Economic conditions are forcing cutbacks, and many companies are closing their in-house production departments. But opportunities may open up in new guises.

"I've been looking to get into the multimedia business," reveals Quinn. "There may be opportunity there, but the budgets are only half of what they'd be for video productions. I've talked to a lot of people who create interactive CD-ROMs and presentations. These presentations are meant to run on laptop computers so a traveling sales staff can show them to clients. The salespeople used to pop a demonstration video into a VCR. I think multimedia is going to replace corporate videos."

Jeff Rona, author of the book *Synchronization From Reel To Reel*, also predicts that multimedia presentations will overrun the industrial market. "Productions will be tapeless," he says. "You'll get a hard disk with video on it. You'll plug it into your computer system and score directly to disk. Time code will only be necessary for conversion to tape."

The game may change somewhat, but

▼

Unlike television and film productions, video deadlines are often negotiable.

as long as there's commerce, there will be a need for music to enhance communication. In any event, there's probably a corporate video in your town right now that could use some music. Give it a shot. Be informed, be cautious, and, above all, be industrious.

(Special thanks to Herb Ferrette, Kevin Quinn, Marvin Sanders, Rick Shaw, Jeff Rona, and Albert Dugas.)

When he's not editing the Roland Users Group *magazine,* **Ernie Rideout** *writes, teaches, and performs in the Los Angeles area.*

Editors' Choice Awards

Everyone loves awards. In fact, people love them so much that there seems to be kudos for just about any kind of thing or activity you can think of. Except, that is, for new products developed by and for the electronic-music industry.

EM created the Editors' Choice awards to acknowledge the best new products for musicians released by the electronic-music industry in the last year. The eligibility requirements are simple: The product had to ship between November 1, 1992, and October 31, 1993 (to coincide with our publishing schedule), and must be priced in a range (under $5,000) that is within reach for most of our readers. The main criterion in choosing the products is value, based on our belief that **EM** readers are interested in getting the most bang for their buck.

By Bob O'Donnell

EM editors

photograph by Stan Musilek

You've got a musical idea you want to get down in a hurry without losing the feel. So you turn to the instrument you're playing for ideas that'll help you finish the composition quickly and easily.

Sound impossible? Not with the new *i*3 from Korg, the next step in music workstations. The *i*3 is the first interactive music workstation that works with you as a creative partner to speed the music-making process.

interactive

At first glance, the *i*3 is a full-blown music workstation with all the things Korg is famous for: hundreds of huge sounds with 32-voice polyphony, a powerful 40,000-event, 16-track sequencer, dynamic digital multi-effects, a 3.5 inch disk drive and a card slot. But that's where the similarities end.

Unlike other workstations, the *i*3 is capable of producing musical "ideas" of its own – phrases and patterns called *Styles* that can be modified, looped and combined to block out songs in minutes.

interactive

The interactive *i*3 extrapolates or produces chords and patterns from the notes you play. And with Korg's unique *Full Range Scanning* feature, your chords won't be forced into the simplistic, default versions found on other instruments. The *i*3 also includes a unique new Backing Sequence mode, enabling you to record Arrangement performances and eight regular sequence tracks on top on the backing tracks.

In addition to being the perfect interactive compositional tool, the *i*3 also shines in live performance. When you need sounds in a hurry, the *i*3's 256 programs cover all the basses, and then some. And Korg's dynamic digital multi-effects processors enhance every mode with real time control. If you want even more range, the *i*2 has an expanded 76-note keyboard, plus an additional acoustic piano.

interactive

Even if you're not a keyboard or sequencing virtuoso, the *i*-Series gives you the power to write music you could never write before. And if you are, it takes you to a new level of creative musical composition so quickly you won't believe it.

*i*3 from Korg. The first music workstation smart enough to work with you, not for you.

KORG *i*3

GENERAL MIDI

Interactive Music Workstation

Special video offer: See the incredible i3 in action. Send $3.95 to Korg U.S.A., 89 Frost St., Westbury, NY 11590. Allow 4-6 weeks for delivery. Offer good in U.S. only, while supplies last.

Rather than choosing categories first and forcing products into those predefined limits, we let the year's top products determine the categories that were appropriate. This approach allowed us to create categories for unique products and freed us from having to acknowledge a product in a category that didn't have any deserving winners.

Nineteen ninety-three was a fruitful year for the industry, and many developments affected the editors' choices, including the enormous impact of digital tape recorders and hard-disk recording systems, renewed interest in analog processing and tube mics, and the increased presence of multi-effects processors. Ultimately, choosing the winners came down to numerous lively discussions and several rounds of changes as we worked our way to the final list.

Of course, lots of other good (or even great) products were released over the last year, but we think this list presents a good selection of the best the industry has to offer.

And now, the envelope please....

ANALOG PREAMP

Rane MAP33 ($1,995)
Hughes & Kettner Tubeman ($299)

Only a small percentage of EM readers may have a need for a MIDI-controlled, acoustic-instrument preamp, but for those who do, nothing comes close to the Rane MAP33. The unit offers sophisticated tone-shaping features, several stages of level control, and numerous audio-routing options. The sophistication of the MAP33 may scare off a few users, but if you're willing to surf the learning curve, the rewards are great.

On a completely different level, Hughes & Kettner's Tubeman represents the best of the new generation of affordable, vacuum tube-based, analog preamps. Operation is simple, the sound is great, and the price is good. Oh, and tubes are not just for guitarists anymore. MAP33 reviewed May 1993. Tubeman reviewed October 1993.

DYNAMICS PROCESSOR

dbx 172 SuperGate ($889)

With the explosive growth of ultra high-quality recorders, interest in what were once considered boring, old, analog, variable-gain devices has reached a new high. Dbx's latest addition to the category is anything but old and boring. The SuperGate includes all the functions of a traditional gate along with sophisticated keying and the near-magical TCM (Transient Capture Mode), which opens the gate just before the signal appears to avoid clipping entrances. With the sudden, dramatic interest in getting top-notch pieces of gear along every stage of the recording chain, devices like the SuperGate are going to play an increasingly important role in the recording lives of all electronic musicians. Reviewed August 1993.

COMPUTER PERIPHERAL

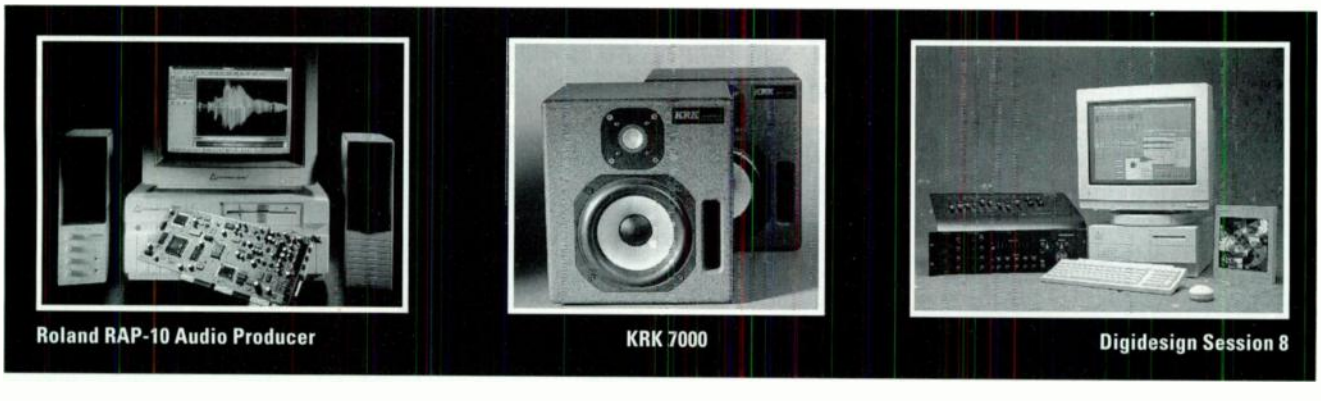
MOTU MIDI Express ($349, Mac; $295, PC)

Mark of the Unicorn filled an important gap between simple and complex MIDI interfaces by bringing out these powerful, midrange, multiport products. The 4-In, 6-Out Mac MIDI Express offers six well thought-out, preset routing configurations, and the 6-In, 6-Out PC MIDI Express offers inexpensive routing power.

DAT RECORDER

Panasonic SV-3200 ($1,045)

Panasonic's SV-3700 DAT has long been a staple of high-end professional studios, so when the company answered the calls for a lower-cost version with the SV-3200, home- and project-studio owners were eager to hear the results. Not surprisingly, they were pleased, and the result is a top-notch, professional, feature-laden DAT at a home-studio price.



Panasonic SV-3200

Roland JD-990

Neumann TLM 193

SYNTHESIZER

Roland JD-990 ($2,195)

In some ways, Roland's JD-990 is a rack version of their critically acclaimed JD-800 keyboard, but in other ways it is much more. By offering patch and waveform compatibility with several earlier-generation instruments, the JD-990 really represents the best of previous Roland synths, complete with the bright, punchy sounds the company's instruments are known for. By adding cross-modulation to the ring modulation and resonant digital filters found in previous instruments, it also takes the sample-playback voice architecture close to the logical end of its capabilities. Reviewed October 1993.

SAMPLE-EDITING SOFTWARE

Jupiter Systems Infinity ($495)

Every once in a while a program comes along that tosses aside convention and brings a unique approach to an existing problem. Jupiter Systems's *Infinity* sample-looping software does just that to the unpleasant task of creating good-sounding loops in digital samples. Through a variety of sophisticated algorithms, Jupiter's engineers have reduced what used to be a several-hour experiment in terror to a brief jaunt through the wonders of digital sound. Reviewed November 1993.

SAMPLER

Kurzweil K2000RS ($3,595)

It's amazing how much power and flexibility Kurzweil's engineers put into the nearly 2-year-old design of the K2000 synth. Their foresight allowed them to set aside space for a sampling option that turns their synth into the most powerful and expandable sampler on the market. The sampler-equipped K2000S keyboard and K2000RS rack includes analog and digital I/O, all the processing functions of the K2000, on-screen sample-editing, and excellent SCSI support. Reviewed May 1993.

SOFTWARE SEQUENCER

Steinberg Cubase Audio 1.1 ($999)

The days of sequencers functioning solely as tools for recording and editing MIDI data are over. Today, the sequencer is the central hub of music-making activity, and it's expected to include controls for digital audio, automated mixing, music creation, and even music notation.

Steinberg's *Cubase Audio* for the Macintosh is the first program to soundly integrate all these elements into a single package. Of course, numerous competitors are hot on their tail, but for now, Steinberg's depth and integration sets the standard. Reviewed December 1992 (Version 1.0).

LIVE-SOUND MIXER

Allen & Heath GL3 ($3,495-$4,495)
Soundcraft Spirit Folio ($499-$825)

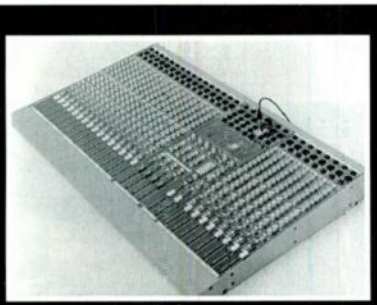
When Allen & Heath set out to create a reasonably priced, high-quality mixer for live-performance applications, they obviously did their homework. The GL3 offers a 16 × 4 × 2 or 24 × 4 × 2 channel structure, 4-band EQ, six dedicated aux sends, 100 mm faders, and more in a great-sounding package.

If your sound-reinforcement needs are a bit less ambitious, Soundcraft's tiny Spirit Folio mixers are hard to beat. They combine straightforward operation, clean sound, and a nice-looking package at a very attractive price. Plus, the carrying handle makes them the most portable mixers you'll probably ever come across. Reviewed October 1993.

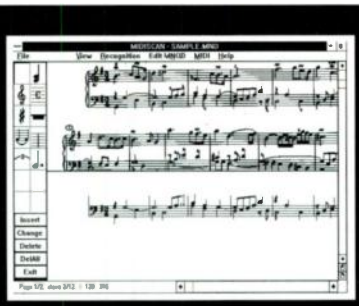
RECORDING MIXER

Mackie 8 • Bus ($3,995/24-channel)

They took a while to arrive, but these eagerly awaited, large-scale mixers lived up to their prerelease hype. Offering an enormous variety of routing options, top-notch audio quality, and a clean layout, Mackie's latest mixers once again set a new standard for price/performance ratio. Tie one together with a digital tape recorder or hard-disk system, and you'll be able to compete with almost *any* studio.



Allen & Heath GL3



Musitek *Midiscan*

Hughes & Kettner Tubeman

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Allen & Heath; tel. (801) 566-8800; fax (801) 566-7005
dbx; tel. (510) 351-3500; fax (510) 351-0500
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Hughes & Kettner, Inc.; tel. (215) 558-0345; fax (215) 558-0342
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Steinberg/Jones; tel. (800) 888-7510, or (818) 993-4091; fax (818) 701-7452
Yamaha; tel. (714) 522-9011; fax (714) 739-2680

SPEAKERS

KRK 7000 ($1,095)

With the home/project-studio revolution in full swing, new sets of monitor speakers are appearing in abundance. In fact, there are so many on the market, it's getting hard to tell systems apart. KRK's 7000 series brings you to attention with their amazing clarity and excellent stereo imaging. Reviewed July 1993.

CONCLUSION

Choosing the best from a wide range of products is always a challenge, but this year's crop yielded an excellent variety of powerful new instruments, software, and other gear. It really is a great time to be a musician.

With developments toward the all-digital studio continuing apace, our editors' choices for next year should be even more exciting. Here's to a great 1994!

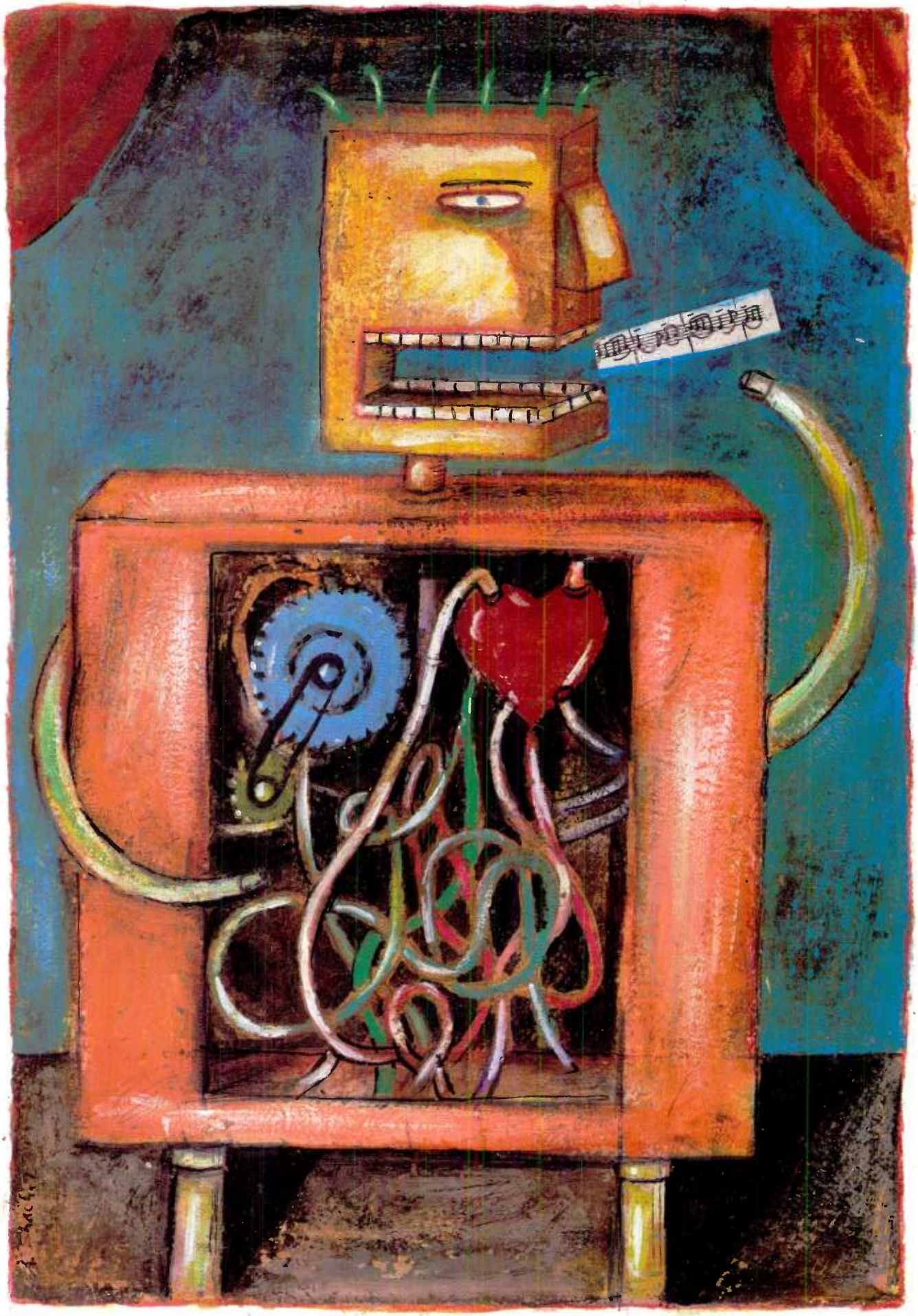
EM *editor* **Bob O'Donnell** *enjoys playing with all the coolest new toys.*

The bottom line on the HOT cable controversy.

THE GREAT CABLE·DEBATE

Whenever anyone starts talking about their studio, they usually mention synthesizers, samplers, signal processors, microphones, mixers, tape decks, amplifiers, speakers, the computer, and software. They almost never mention the one component without which the rest would be useless: the cables that connect everything together. If MIDI cables are the nervous system of a studio, carrying messages that control the equipment's behavior, then audio cables form the circulatory system, carrying the lifeblood of any studio: audio signals.

BY SCOTT WILKINSON



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The effect of various components on audio signals is relatively well known. Specs such as frequency response, total harmonic distortion, and dynamic range indicate how a signal changes as it passes through a piece of gear. However, the effect of audio cables is not so clearly understood. Most **EM** readers are familiar with induced noise, hum, and ground loops. (See "The Last Noise Reduction Article, Parts 1 and 2" in the October and November 1991 issues and "On Solid Ground, Parts 1 and 2" in the September and October 1992 issues of **EM**.) But what about the effect of the cables themselves? How do their design, materials, and construction influence the audio signals they carry from one component to another?

This question is at the heart of a heated debate throughout the audio industry. For some people, exotic designs and materials make a clearly audible difference in the quality of the audio signal, albeit at a steep price. For others, exotic cables are a waste of money; going beyond certain minimum electrical and mechanical requirements does not improve the quality of the signal to their ears. Unfortunately, objective measurements are scarce, so the debate rages on.

Regardless of where you stand in this debate, it's important to understand the four basic types of analog audio signals that travel through cables: microphone, instrument (guitar), line level, and speaker level. (See "From The Top: Basic Audio Connections, Parts 1 and 2" in the October and November 1993 **EM**.) These signals use different types of cable, each with different requirements for the best possible sonic performance.

ELECTRICAL FACTORS

Several electrical factors clearly affect the aural performance of audio cables. For example, all conductors (except superconductors) exhibit electrical *resistance*, which is measured in *ohms*. When this resistance changes as a function of the signal's frequency—as with an alternating current such as an audio signal flowing through a conductor—it is called *impedance*. AC impedance is independent of the conductor's length.

In cables, resistance to direct current (DC) is measured in ohms per foot; the longer the cable, the higher the DC resistance, unlike AC impedance. However, the size of the conductor must also be considered; the larger the diameter of the wire, the lower the DC resistance.

AC impedance is important only for digital cable (see sidebar, "Digital Audio Cable"), and DC resistance is important only in the case of speaker wire. "If you run a small-gauge wire, such as a guitar cord, 100 feet to a subwoofer, you're just going to burn up the wire," says Marc Dimmitt, technical-support manager for Clark Wire & Cable. "Most of that energy is going to dissipate as heat; it's not going to make it to the voice coil and move the speaker cone back and forth. This tends to compress the dynamic range of the sound, as well."

Another important electrical factor is *capacitance*, which arises when two conductors are separated by a small distance. Minimizing capacitance is most important in cables connected to high-impedance inputs, such as most line-level inputs.

Says Dimmitt, "All manufacturers spec their cable at some number of

CANARE GS-6

FIG. 1: A guitar cord or unbalanced line-level cable consists of a central, insulated conductor and a shield, which is often braided. The Canare GS-6 pictured includes an extra inner shield to reduce handling noise from high-gain, onstage amplification.

picofarads per foot, conductor-to-conductor and conductor-to-shield." Michael Laiacona, president of Whirlwind Cable, explains the audible result, "The lower the capacitance, the better the frequency response of the cable. If the capacitance is too high, you start hearing a high-frequency loss."

Perhaps the most difficult factor to optimize in audio cables is *inductance*, which arises when current flows through a conductor. The resulting electromagnetic field interacts with the current in the conductor and any nearby conductors. For low-impedance, high-current sources, such as power-amplifier outputs, minimizing the cable inductance is of primary importance. This is often accomplished by separating the conductors as much as possible.

EXOTIC CONDUCTORS

One of the most hotly contested issues is the conducting material. Most of us are familiar with copper; its electrical conducting properties have been exploited for many years. But how do different copper formulations affect the audio signal?

Bill Low, founder of AudioQuest, explains the different grades of copper. "Tough-pitch copper, which is also known as *high-purity*, or *electrolytic*, copper, is the standard grade. *Oxygen-free* copper, or OFC, is a step up from that, and there is a significant advantage to it. The only way to prove that is to listen; you can hear the difference. You can also see the difference under a microscope. A strand of copper consists of many separate grains. The current has to jump between them and suffers as a result. Impurities in the copper, including oxygen, coalesce at the grain boundaries, which is why reducing the oxygen content makes such a big difference.

"Normal high-purity copper has about 1,500 grains of copper per foot, and the oxygen content is about 235 parts per million [ppm]. In OFC, there are 40 ppm of oxygen, and the average number of grains per foot is around 400. Then there's another type of cop-

DIGITAL AUDIO CABLE

Digital audio cables must meet certain criteria that don't affect analog cables. Perhaps the most important factor is impedance. Unlike analog audio, digital-audio signals are sent at frequencies in the megahertz range. This requires a cable that exhibits a specific AC impedance: S/PDIF requires an impedance of 75Ω, while AES/EBU requires 110Ω.

According to Marc Dimmitt, technical-support manager for Clark Wire & Cable, "A lot of people try to make AES/EBU transfers from one digital machine to another with regular mic cable and wonder why they get errors and glitches. Mic cables are not specified at any particular impedance; they may be all over the map. With high-frequency digital audio, the impedance must be carefully matched. If something is out of tune, you get stray bits, dropouts, and glitches."

Another problem to overcome in digital cables is *return loss.* According to Bruce Jackson, vice president at Apogee Electronics, "If the cable and connectors are mismatched in terms of impedance, the digital pulses travel from one end of the cable to the other and bounce back and forth, interacting with each other, which causes them to distort. When you have it all correctly terminated, you don't get reflections."

per called *linear crystal,* or LC OFC, which is similar to something out of Europe called *mono crystal.* It is significantly better, with about 70 grains per foot. The next grade above that is FPC, or *functionally perfect copper.* That has single grains that are 700 feet long. It makes a big difference. It costs a lot more, but there's a clear benefit."

Noel Lee, founder and head monster at Monster Cable, takes exception to some of these ideas. "We've experimented with the purity of the copper and found that there is little or no benefit to different types of copper, as long as it's OFC. Beyond that, we've found that other factors are much more important than the purity of the copper, which isn't to say that copper purity doesn't have any effect. In general, there's no need to pay for exotic coppers when you may or may not hear a difference."

Others feel that the copper refining and drawing process has improved dramatically over the last few years to the point that OFC is not much better than "regular" copper. According to Kip Coates, senior product-marketing specialist for audio/video cables at Belden, Inc., "We're now able to get most of the oxygen and impurities out of 'regular' copper; for all practical purposes, it's as pure as OFC. It's hard to tell the difference in lab tests or by ear. There's an ASTM [American Standards and

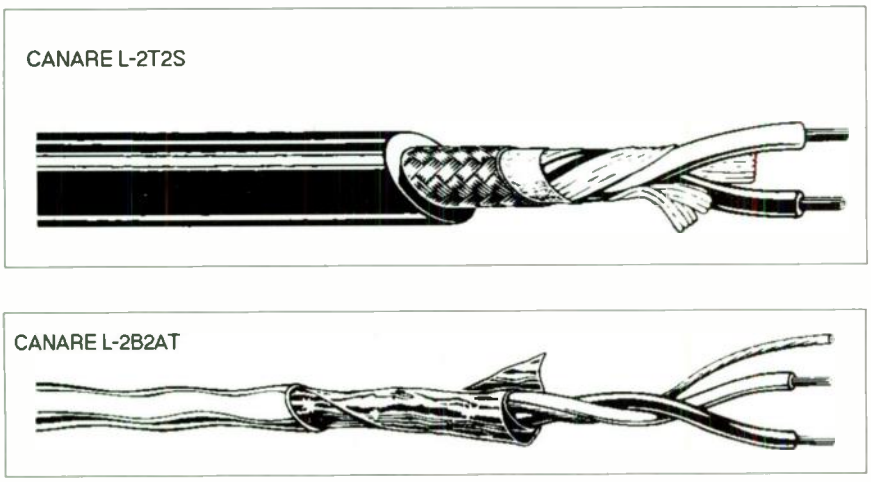

FIG. 2: Balanced mic and line cables include two conductors, twisted around each other, and a shield. In the Canare L-2T2S (top), the shield is braided. The L-2B2AT (bottom) uses a foil shield and includes a drain wire, which connects to the ground of the connector.

Test Methods] procedure that tests for OFC; standard copper sometimes passes that test. OFC may still have a slight advantage, but it's much less than it was a few years ago."

Another controversial electrical factor is called *skin effect*. It is well known that alternating current tends to travel on the outer surface of any conductor, stranded or solid. That's why high-tension power lines are hollow; there's no need to support the added weight of a solid conductor. But does this affect the audio signal in a cable?

Dimmitt maintains that this is not an important factor at audio frequencies. "In terms of sound, the only documentation I've seen is subjective. I've seen little hard evidence that it makes a difference. If there is a difference, it's so subtle that it's not worth the expense of exotic cable."

However, Low disagrees. "The subjective effect in a single strand that's too large, anything above 18 gauge or so, is that the top end seems rolled off. The imaging and sense of space is lost. Fortunately, the solution to skin effect is easy: Just use a single strand that is smaller than 18 gauge."

BALANCING ACT

Microphone cables and some line-level interconnects are *balanced* to help reject extraneous RFI (radio-frequency interference) and EMI (electromagnetic interference). Unlike cables with two conductors (positive and negative, or hot and ground), balanced cables have three conductors: positive, negative, and a separate ground in the form of a shield surrounding them. (In some balanced cables, there is a third conductor along with the positive and negative, which is called the *signal ground*. This is separate from the shield ground that is connected to the connector casing and equipment chassis.)

The positive and negative conductors both carry the signal from the balanced source, but the signal in one of them is 180° out of phase with respect to the other. If there is any RFI or EMI in the vicinity, the noise is induced with the same phase in both conductors. A differential amplifier or transformer in the destination device reverses the phase of the signal in one of the conductors, which amplifies the intended signal and cancels the induced noise.

MECHANICAL FACTORS

The majority of cable conductors consist of many hair-like strands of copper wound together in a bundle. Stranded conductors are insulated, combined, and wrapped in an electrical shield and outer jacket to form a complete cable. The simplest type of cable is a guitar cord or unbalanced

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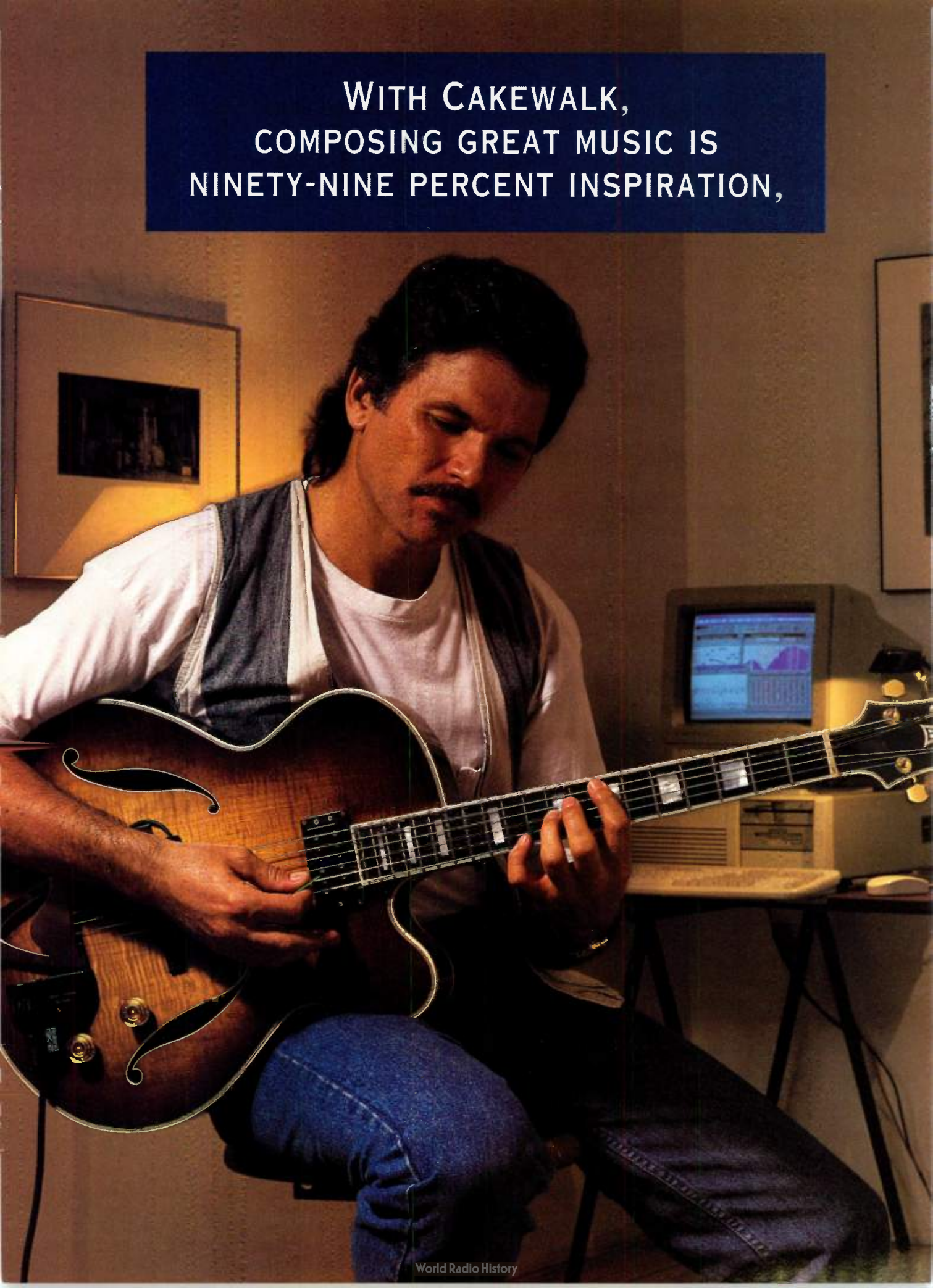

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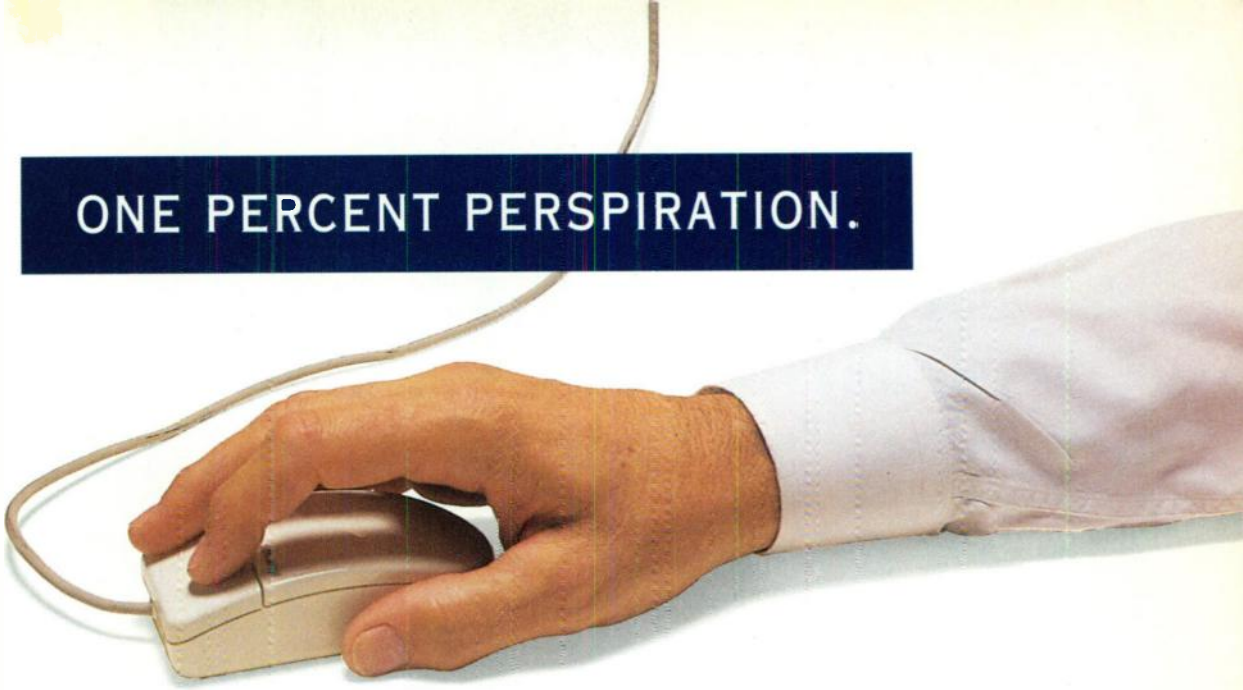

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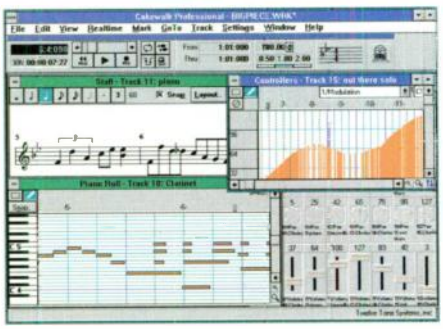

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line-level interconnect (see **Fig. 1**). Most speaker cables consist of two conductors with no shielding.

Most microphone and balanced line-level cables include two conductors wound around each other in a *twisted pair* surrounded by a shield (see **Fig. 2** and sidebar, "Balancing Act"). This is effective in rejecting external RFI (radio-frequency interference) and EMI (electromagnetic interference) from nearby cables, transformers, and other sources.

Several companies use a *quad* configuration in their balanced cables, instead of a twisted pair; Canare calls this Star Quad. The design uses four conductors, twisted around each other; opposing pairs are connected at either end. According to Canare Chief Operating Officer Barry Brenner, "Star Quad gives you 20 dB better noise rejection than standard 2-conductor cable. You can be less concerned about running a Star Quad microphone cable near a high-level line, such as AC." Quad construction is great for rejecting RFI and EMI, but it has a little higher capacitance, so the high-frequency response may not be quite as good as with a twisted pair.

Canare also uses a quad configuration in their speaker cables (see **Fig. 3**). As Brenner explains, "Instead of rejecting outside interference, it reduces the electromagnetic radiation due to high speaker-level signals by keeping the noise within the cable bundle, helping to prevent interference with nearby low-level cables."

Monster Cable touts the use of different-size strands, winding patterns, and conductor configurations for different frequency ranges, particularly in speaker cables. According to Lee, "A thick strand will carry low frequencies more easily, whereas a thin strand will carry highs. Beyond that, the differences are in the winding, the way the conductors are made up, and the groupings of different conductors."

THE RIGHT CONNECTIONS

Connectors are just as important as cables when it comes to preserving audio quality. According to Dimmitt, "No matter how much you spend on the cable, you can have horrible sonic problems at the connector if you don't have a good termination. People often blame problems on the cable when it's really the quality of the termination to the connector."

Low believes that speaker cables need no solder in the termination. "The ideal connection is a *cold weld* or *gas* type. If you crimp hard enough, all the round strands develop flat spots where they either touch each other, or touch the connector. Even if you solder, it will go into the leftover spaces, not into that primary connection where you made the flat spots. Solder is useless in this case."

Then there's the contact between the connector and the jack. "Cheap connectors are often poorly plated," says Dimmitt. "Silver-plated contacts are especially prone to corrosion. Gold connectors are a fallacy. Gold-to-gold is an excellent contact, but if you have silver or tin contacts on your equipment,

you're throwing your money away and asking for problems by using a gold-plated connector. When you put electricity through a junction of dissimilar metals, there are electrochemical migrations over time that can cause problems. That's not necessarily true in the field, where you're plugging and unplugging things all the time."

Lee prefers to avoid connectors whenever possible. "If I could get into the amplifier boards, I'd solder directly into them. In some recording studios, they bypass connectors altogether, because they degrade the sound." Of course, this isn't always practical, so Monster Cable connectors are soldered, welded, or crimped.

EXOTIC DESIGNS

Another controversial phenomenon is the electromagnetic interaction between the conductors within a cable. Lee notes that a twisted-pair configuration can reduce the problem. "Time-domain distortions are electromagnetic in nature. If you twist together the plus and minus conductors in a balanced cable, some of the intrinsic magnetic field is canceled out, in addition to rejecting outside interference."

This interaction also affects the individual strands in a conductor. According to Low, "The magnetic field around each strand changes as the current moves back and forth. This tends to alternately pull and release adjacent strands, which changes the contact resistance between them. The harder the jacket on the stranded cable, the more dynamic and less distorted the sound, because this mechanical component of the magnetic interaction is more restricted."

Low's solution to this problem is a modified *litz* design (see **Fig. 4**). In AudioQuest's Hyperlitz construction, the conductor consists of several solid, separately insulated strands that are wound in a multiple helix along the length of the cable to form a sophisticated twisted pair. This is said to reduce the problems associated with skin effect and electromagnetic interaction, while improving RFI and EMI rejection. As Low notes, "If you compare a cable made with bundled strands and a litz cable with the same number of strands of the same size, you hear a large difference in the sound."

CONCLUSION

It appears that the debate over the effect of cable on the audio signal won't die down any time soon. Those with "golden ears" continue to insist that the subtle effects are real and significant, while their opponents contend that it's all hype.

Many manufacturers have tried to measure the subtle effects in an effort to improve their own products. For example, Whirlwind bought several different "exotic" cables about six years ago and sent them to Belden for analysis. According to Laiacona, "They couldn't discern much difference in them, so they took the cables to an independent testing lab. Belden felt if there was a better product to be made, they wanted to make it. But the independent lab came up with nothing."

Nevertheless, some famous engineers are convinced that these cables sound better than "ordinary" cables. Joe Harley is the producer for AudioQuest Music, a record label associated with the cable manufacturer. "Last year, we recorded a string octet with two Neumann M50 tube mics. As usual, we ran AudioQuest Diamond balanced mic cables [with solid silver strands in a Hyperlitz configuration] back to the mic preamps in the control room.

"Then, just as an experiment, we changed the mic cable to something more standard, something considered perfectly fine by many professionals, and had the group play the same piece again. The engineers thought something must be wrong; the connection must be dirty. It couldn't possibly be just the cable they were hearing. There wasn't a lot of hum or extraneous noise; it just sounded grungier. There was a graininess and harshness that hadn't been there before, in addition to sounding closed down." As a result of this experiment, Harley was able to convince Bernie Grundman to rewire every link in his mastering facility with AudioQuest cables.

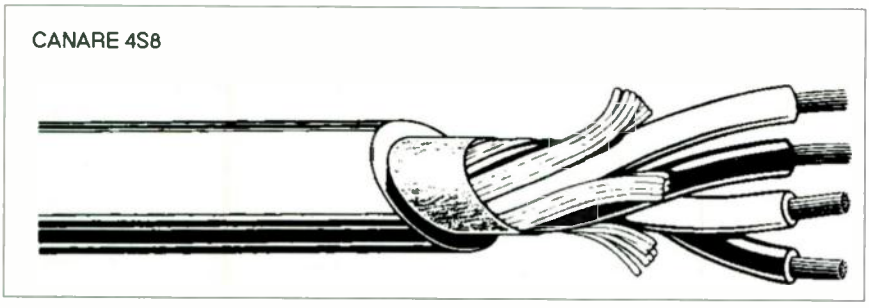

FIG. 3: Canare's 4S8 speaker cable uses a Star Quad design to prevent electromagnetic radiation from extending beyond the outer jacket. Their Star Quad microphone cables use smaller-gauge conductors, but they are otherwise similar to the speaker cables, with the addition of a braided or foil shield.

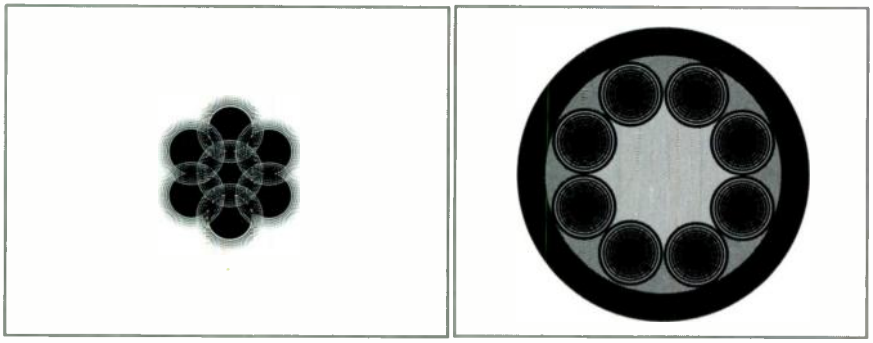

FIG. 4: Normally, the electromagnetic fields generated by each strand in a cable overlap (left), which some say can degrade the sound. AudioQuest Hyperlitz construction (right) significantly reduces electromagnetic interaction between strands by isolating each strand in a circular geometry.

In the end, such exotic cables probably *do* make a difference in the sound. Low makes a good point about the effect of all audio components, including cable. "The only way to get good sound is by not damaging what you started with. Every piece of equipment puts out a signal that's distorted compared to the input. Better equipment causes less damage to the signal. The process is like a descending staircase. Every piece of equipment, including the cable, is like a step, taking its toll on the sound. If you replace any step with one that doesn't descend as far, the entire staircase doesn't descend as far, and you have a better sound."

Can you hear a difference between various cables? If so, how much can you afford to spend on them? Try to arrange a listening test with a dealer who specializes in cable. You might even be able to perform some experiments in your own studio. As with the rest of your equipment, get the cable that sounds best to you (within your budget). That way, your sound will be as good as it can be. Who could ask for anything more?

EM *technical editor* **Scott Wilkinson** *finds this debate fascinating.*

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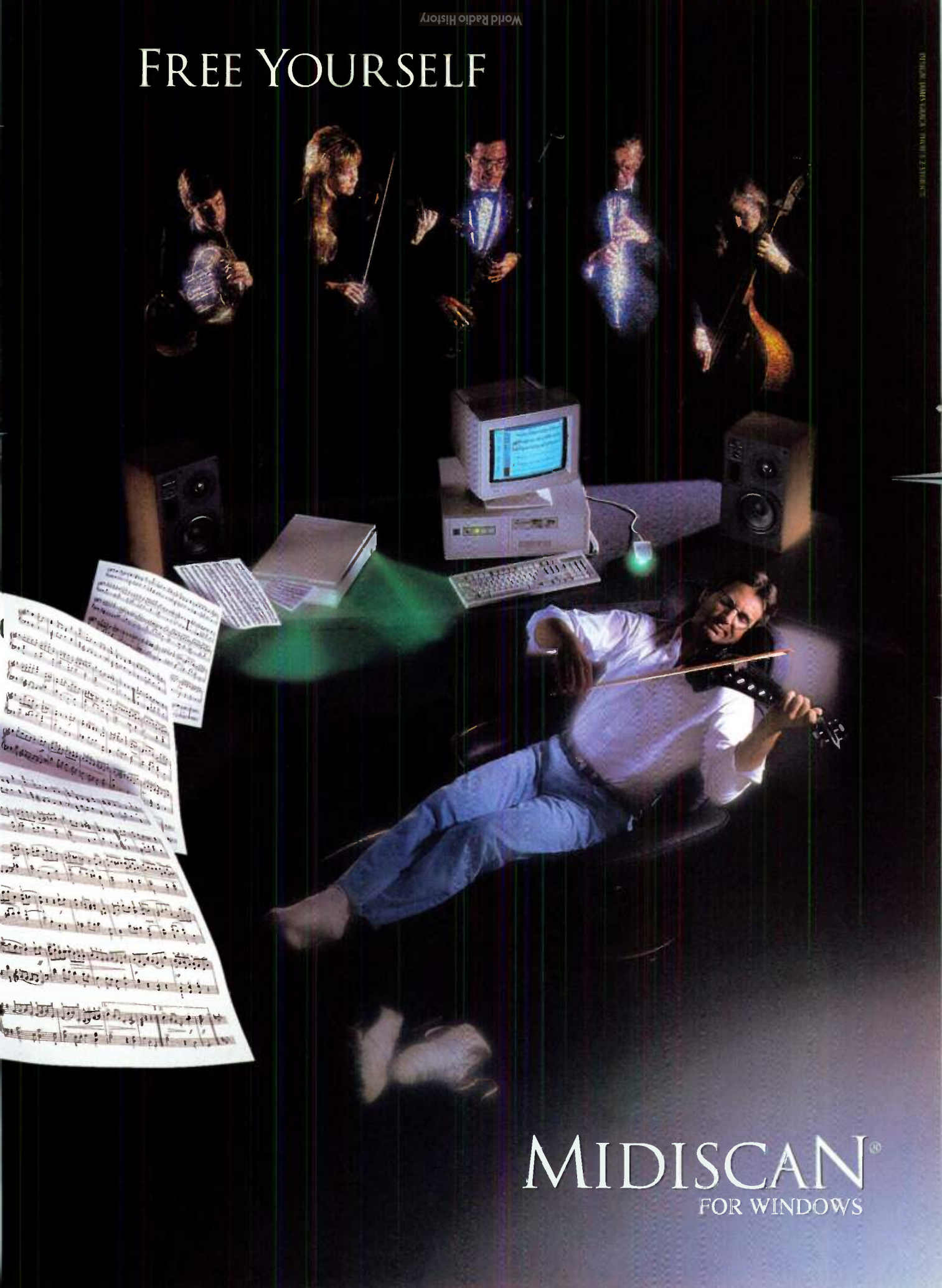

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RANDOM ACCESS

A look at the current state of hard-disk recording.

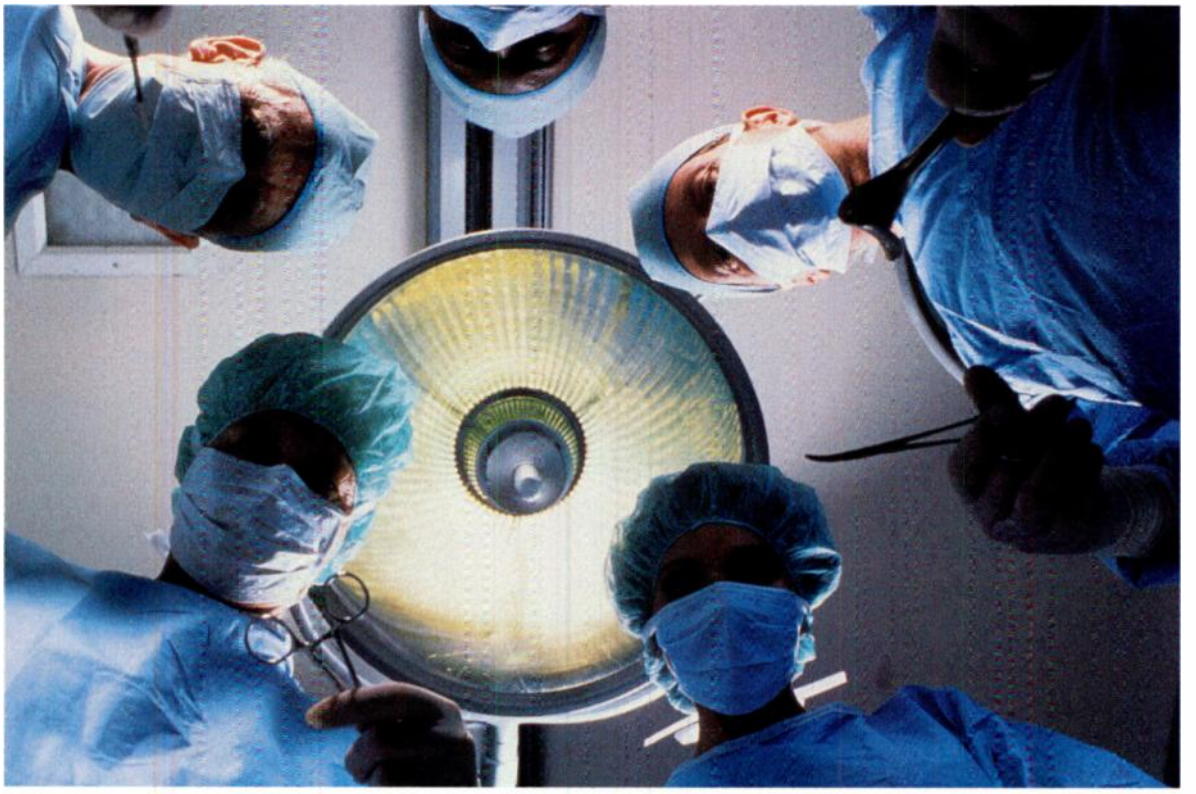
It seems so seductive. You record your tracks into a device that offers familiar-looking controls, but as soon as you finish recording, you're offered a tantalizing variety of ways to turn those tracks into aural extravaganzas. The magical devices that offer such musical power are hard-disk recording systems. Hard-disk recorders allow musicians to manipulate digital audio in much the same manner that sequencers provide control over MIDI tracks. Not surprisingly, musicians and engineers are flocking to them.

By Larry the O
Illustration By Brian Razska

Hard-disk recording systems were first introduced in the mid-1980s, but like many other types of technological revolutions, the history of tapeless recording contains some mistaken identities. In many people's minds Digidesign invented hard-disk recording; they didn't, but their 1989 introduction of Sound Tools unquestionably established hard-disk recording as a tool for the masses.

Since then, hard-disk, digital-audio systems, loosely dubbed "Digital Audio Workstations" (DAWs), have proliferated. They're available in many flavors on a variety of platforms, particularly Macintosh and *Windows* machines. In fact, hard-disk recording is commonplace in home, project, and professional studios doing music work, post-production for film and video, CD premastering, and radio production (see "Going Tapeless: Hard-Disk Recording and Editing" and "The Legend of Digital Audio" in the October 1990 **EM**).

If you're interested in finding out more about hard-disk recording systems, you need to learn some of the principles involved, how they're being used, and where they are headed.



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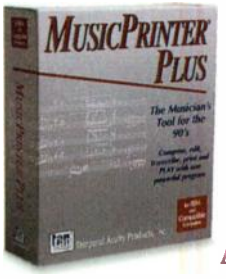

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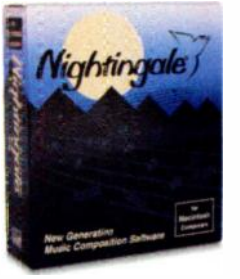

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TAPELESS RECORDING

A DAW can record, edit, play back, and often mix and/or process two or more channels of digital audio. Until recently, multichannel systems were fairly rare and more limited in functionality than 2-channel systems.

Recording in a DAW is done with at least 16-bit resolution, usually at a 44.1 kHz sampling rate, although most DAWs also offer 48 kHz. Systems usually include analog-to-digital (A/D) conversion, which is often performed by a separate box. Isolating the converter offers the most protection from noise and gives you the option to choose a higher quality, third-party A/D converter. Also, DAWs usually have some form of digital I/O, either the professional 2-channel standard (AES/EBU) or the consumer standard (usually called S/PDIF).

Hard-disk systems let you play back part or all of a recording, or pieces of different recordings "spliced" together. Most systems have tape recorder-like interfaces with real or "virtual" (onscreen) buttons for Play, Stop, Record, and Fast Wind.

Controlling onscreen buttons with a mouse is frustrating for many users, however, so DAW and third-party manufacturers have developed hardware controllers, such as JLCooper's CS-1 and CS-10, to give familiar tactile controls over basic functions. These control stations may include transport buttons, faders, and trackballs for scrubbing or moving an onscreen cursor.

The one area where hard-disk systems depart from familiar interfaces has no comparison in analog equipment: waveform editing. The advent of Macintosh sample-editing programs introduced time-domain waveform displays for viewing and editing. Users are now accustomed to zooming the display into the sample level for precise tweaking and then zooming out to view an entire track. This type of interface allows you to easily perform both microediting for correcting small glitches and large-scale editing to create composite tracks with larger chunks of audio.

Information about the audio chunks and how they are placed may also be displayed as text. This is called a playlist, or edit list, and is particularly useful when you need to see exact times or time-code addresses, such as in audio post-production.

The number of tracks that a hard-disk system can play simultaneously is usually limited by the number of digital-to-analog (D/A) converter channels available, or by disk speed. Many systems offer "virtual mixing," in which several tracks can play, as long as the number that contain sound at any given moment does not exceed the number of channels in the system. You can also think of this as a sophisticated switching system. Other systems have real-time mixing onboard, usually incorporating snapshot or dynamic automation.

DAWs may also include some amount of signal processing. The most common is equalization, but some systems offer other functions, such as compression or effects. Yamaha's CBX-D5, for example, contains two SPX1000-class multi-effects processors. Some hard-disk systems offer MIDI support, although it varies widely from product to product.

Digital-audio sequencers, such as Steinberg/Jones's *Cubase Audio*, Mark of the Unicorn's *Digital Performer*, and Opcode's *Studio Vision*, integrate several tracks of digital audio into full-blown MIDI sequencers. Sonic Solutions's SonicStation, on the other hand, only receives on one MIDI channel and uses MIDI solely for external control of its own functions.

DAWs also vary in their ability to synchronize to other devices. Many systems claim synchronization to SMPTE or MIDI Time Code, but some act like samplers, triggering playback of audio chunks at predetermined times. Far fewer perform true time-code locking, in which playback may be varispeeded to match a less-than-rock-steady source of master code, such as an analog tape machine. True locking with varispeed playback is difficult enough that most DAW manufacturers encourage using their systems as the master. The lack of standardized transport-control protocols makes this difficult for many existing tape machines, but the continued growth of MIDI Machine Control—which incorporates these and other standards—should improve the situation in the future.

Another synchronization issue in the digital-audio realm involves sharing a master timing source, or clock. Although many DAWs rely on the self-clocking nature of AES/EBU and S/PDIF, some provide inputs for locking their internal sample clock to a stable reference, such as video black burst or AES/EBU DARS (Digital Audio Reference Signal).

DISK VS. TAPE

These days, most questions about the state of hard-disk recording concern its role versus digital multitrack tape

Digidesign recently introduced a Mac version of their 8-track Session 8 hard-disk recording system.

recorders, such as the Alesis ADAT and Tascam DA-88. Direct head-to-head comparisons of multitrack digital tape and hard-disk recorders often miss the fact that 2-channel, hard-disk systems are much cheaper and more plentiful than multichannel systems, or that disk and tape shine in different applications. Some may find it more worthwhile to have a multitrack digital tape machine for recording and a 2-channel, hard-disk system for editing and mastering. Others may have an absolute need for a multichannel, random-access system.

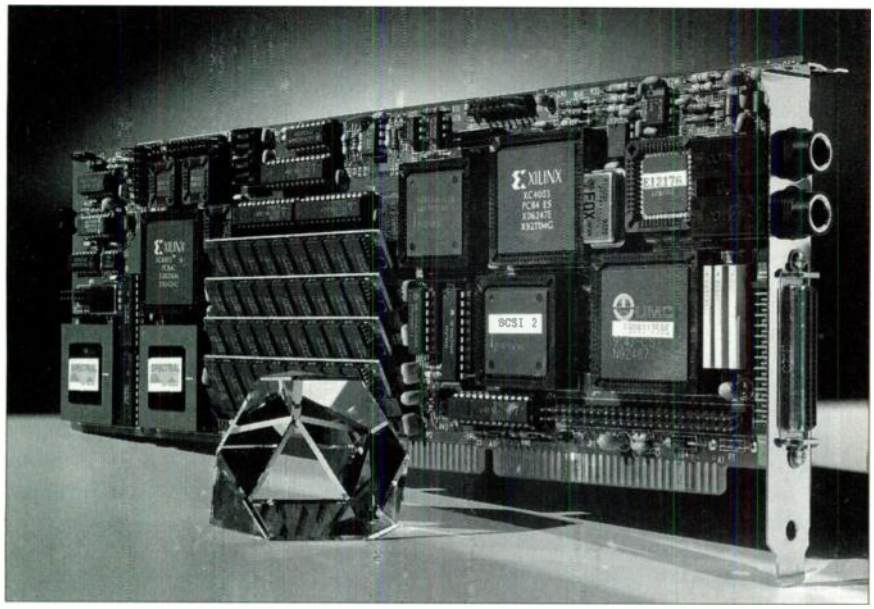
If you need to make a decision between the two, there are a couple of important differences to keep in mind. First, tape is cheap, and you can store a lot of sound on a single, inexpensive videotape. It is also removable. These qualifications make strong arguments for tape in the recording process, where fast setup (inserting the tape) and teardown (popping it back out) and the ability to cheaply record numerous takes are compelling advantages. Editing or making a safety copy of anything, however, requires the availability of another unit. ADATs and DA-88s are also self-contained, making them well-suited for remote recording.

Hard-disk recorders, on the other hand, offer random access to the recorded material, which has important ramifications. The greatest of these is the power and flexibility it brings to editing. Chunks of audio can be effortlessly moved around in time, and edits can be individually fine-tuned for placement and fade characteristics. Random access also enables non-destructive editing.

On the other hand, though prices are still falling, hard disks are not cheap. At roughly 5 MB of disk space per track/minute, it takes 1.6 GB of disk space, costing more than $1,000, to fit the amount of data that goes onto a $7 S-VHS ADAT tape.

Furthermore, once you fill up the disk, then what? Until disk capacity and/or prices fall by an order of magnitude (which they will), or removable media get that much faster (which they will), hard-disk systems require regular off-loading (backup) and on-loading (restoring). After one or two times on this merry-go-round, you'll find that sessions take several hours longer if audio must be loaded into a DAW before starting and backed up when finished. To highlight the severity of this problem, one of SonicStation's claims to fame is the ability to on- or off-load material in the background while editing takes place in the foreground. The Digidesign System Accelerator for Pro Tools also has this capability.

There are numerous media suitable for backing up from a DAW, including regular, old audio DAT, which is about as cheap as videotape (see "Computer Musician: Covering Your Tracks" in the December 1993 **EM**). Many DAWs have a backup feature that codes all the editing information into a burst, then lays the audio onto tape two tracks at a time. This backup information can be reloaded into the DAW, which then reassembles the tracks according to the information in the burst. The catches are



Spectral Synthesis's AudioPrisma is a lower-cost version of their popular AudioEngine recording system for the PC.

that: (1) You're still paying for an extra piece of equipment; (2) DAT is not infallible; and (3) the backup formats are proprietary. That is, you can't restore an edit-list backup made by a Digidesign system into a Spectral Synthesis product. At least, not yet. Of course you can't swap tapes between an ADAT and a DA-88 either, but that is a difference in media, not just file formats.

File exchange between DAWs of different makes is a compatibility issue currently under discussion. Avid Technology introduced the Open Media Framework (OMF) as a suggested standard to facilitate file exchange between DAWs. The industry has shown a lot of interest in OMF, but there aren't many products in place yet. One difficulty is the performance of DAWs is often tied to the file format the manufacturer has created. As a result, there would need to be a time- and resource-consuming conversion step to and from OMF.

COMPUTER OR STAND-ALONE

Recording, playing, editing, and processing digital audio is data-intensive work that requires special-purpose hardware. Accordingly, hard-disk recording packages typically take one of two forms: a stand-alone unit with all computing and processing power inside the box, or a personal computer-based system that includes custom hardware cards. Many computer-based systems also include external boxes that connect to the computer and software that supplies the user interface on the host and manages the work of the card.

Examples of self-contained systems are the Roland DM-80 and the Akai DR4d, while Digidesign's Pro Tools, Sonic Solutions's SonicStation, Spectral Synthesis's AudioEngine, and Digital Audio Labs's the CardD are representative of the latter approach. The Roland DM-80 is a peculiar case in that it can be a self-contained unit operated entirely from its remote controller or placed under computer control via a Macintosh program.

One of the great strengths of self-contained systems is portability. Moving and setting up an all-in-one hard-disk recorder is not too different than any other piece of audio gear: Throw it in a rack, hook up the audio, plug it in, and turn it on. This makes them well-suited for location recording (but not field recording) and applications in which multiple units may reside in separate rooms or sites, then are synched together for a final mix.

Personal computer-based systems, on the other hand, exhibit the flexibility inherent in personal computers: more display options, availability of third-party utilities, and the ability to use the machine for purposes other than digital audio. But the general-purpose architecture of personal computers can also pose a limitation to digital-audio systems. The current trend is to have a plug-in card (or cards) that provides an interface to the host computer, a

SCSI bus entirely separate from any the host may have (for communicating with sound disks), and one or more DSP chips that perform some or all of the audio processing.

In systems well-endowed with DSP power, such as the AudioEngine or SonicStation II, the host computer only has to provide the user interface and translate commands for the processor on the board to execute. These systems may simultaneously perform automated mixing, equalization, background processing, and even fancier tricks on a number of channels at once. Of course, stand-alone systems are equally capable if they contain the hardware horsepower. However, it's not as easy to add new processing software developed by the manufacturer or third parties. Digital Audio Labs's CardD system, in contrast, executes all processing with the host computer's CPU, which helps keep the price down.

The ease of changing software in personal computer-based systems also makes it possible for the same plug-in hardware to be used by different front-end software. The most obvious examples are Digidesign's line of plug-in cards and Yamaha's CBX-D5, which are used by programs from manufacturers such as Opcode (*Studio Vision*), Mark of the Unicorn (*Digital Performer*), OSC (*DECK*), and Steinberg/Jones (*Cubase Audio*).

NETWORKING

In response to users' demands for more integration of studio functions, hard-disk systems are encompassing an increasing number of tasks. These include audio routing, greater MIDI support, enhanced mixing and signal processing, and more. Digidesign's latest product announcements—which include an as-yet-unnamed control surface; a powerful, general DSP card called the DSP Farm; and a time-domain multiplexed backplane called the TDM bus—are intended to position their line as a platform on which third parties can build. Lexicon's NuVerb reverb card is one of the first products to support the Digidesign platform.

Yamaha's forthcoming CBX-D5 will work in conjunction with digital-audio sequencers, such as MOTU's *Digital Performer*, to give four independent audio tracks to MIDI sequences.

Other companies are not subscribing to the openness that Digidesign is espousing, but there is a strong movement toward greater interconnection between systems. This is true not only at the file-exchange level, but through digital-audio networks. However, to carry multiple channels of digital audio, a network must be pretty fast and, currently, that translates to expensive and proprietary.

As with DSP chips, high-speed network technology is driven not by the small professional audio and music fields, but by the much, much larger communications field. One heavy contender is ATM (no, not your bank machine, but Asynchronous Transfer Mode), which incorporates digital audio and video at its lowest level, more or less putting it into the network's "DNA."

Whatever network technology emerges the winner, the applications will go far beyond multiple users in the same facility sharing resources. For example, imagine dialing up a service a thousand miles away, and, for a price, downloading selected sounds or tracks.

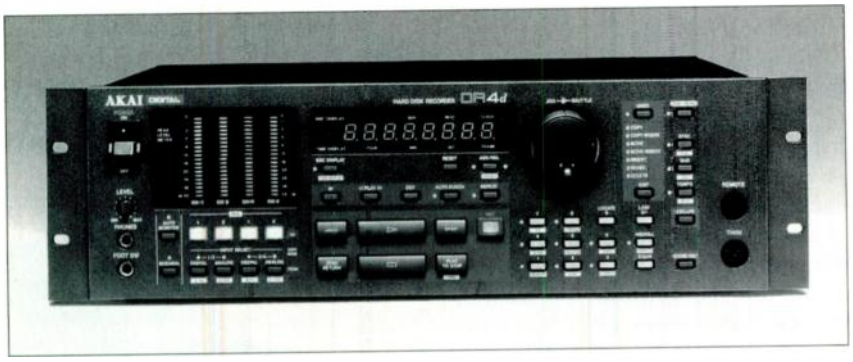
THE FACE OF THE INTERFACE

Interestingly, as DSP architectures and the underlying structure of DAWs get more general, users want interfaces increasingly specialized to their applications. A radio station couldn't care less about looking at audio in terms of bars and beats, or the number of virtual tracks available. All they want to know is how fast the system can do cut-and-paste editing. (And the fewer buttons and controls the better!) In contrast, classical music editors may spend 45 minutes painstakingly tweaking a single crossfade. Film sound editors need to make extremely tight edits between events as small as two coughs in a dialog track, while video sound editors need to see SMPTE time-code numbers at all times.

Each of these users wants lots of processing power but without distracting features that they don't need. What's needed is a product line that uses the same audio-processing code but differs in the user interface.

WORK YOUR DAW

There are, however, two important new applications for DAWs that require significant additional hardware and/or software beyond the user interface. Although most systems can perform basic mastering operations (level and EQ adjustments, sequencing of cuts, fade editing), CD premastering systems also generate PQ subcode data and can interface to one of the emerging crop of desktop CD recorders. By using this type of system, you eliminate the need for the previously required Sony 1630-format master. Recordable CDs also let the producer and client hear exactly



Akai's new DR4d is one of several stand-alone, hard-disk recording systems.

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what the final product will sound like on their own CD players. Premaster CDs are not universally accepted by pressing plants yet, but they are gaining wider use.

The other important new application for hard-disk audio systems is the integration of random-access digital video. Film and video post-production has always required a major amount of time and effort to lock the audio and video machines together. With time-stamped video onboard on the computer's hard disk, however, locking is no longer necessary. Instead, you can easily scroll the audio or video and have the other media scroll along with it.

Not surprisingly, Avid, having introduced the first system to allow offline video editing on the Macintosh (*Media Composer*), has now introduced *AudioVision*, which integrates audio editing with digital video. Not to be left behind, Digidesign has announced *PostView*, a digital video add-on for ProTools.

Hard-disk recording has come a long way from its introduction: It is common, it is affordable, and it is accepted. However, the current state is clearly transitional. The first generation is behind us, but the next generation lies well within sight.

Many people, considering technology's rate of advancement, wonder how long they should wait before investing in a hard-disk recording system. With DAWs, solid functionality and decent affordability are currently there.

But with the use of DAWs so widespread and in demand, the question really is not how long should you wait, it's how long *can* you wait?

(Special thanks to Gary Tobin of Spectral Synthesis, Jeff Wilson of Digital Audio Labs, Andy Moorer and Gary Hall of Sonic Solutions, Brent Hurtig and Peter Gotcher of Digidesign, and Marcie Lacher of Avid Technology.)

Larry the O *is currently working at Wavegroup Sounds, where he is using DAWs exclusively to edit audio for ABC's* Mr. Bumpy.

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LucasArts Games

By Peter McConnell

Composing the music for Sam & Max Hit the Road.

In LucasArts's *Sam & Max Hit the Road* graphic adventure game, Sam (the dog) and Max (the rabbit) show up at a carnival to start their search for the missing bigfoot.

Writing music for computer games is like flying the Millennium Falcon in *Star Wars*. Picture Han Solo, TIE fighters hot on his tail, surrounded by technology, and banging at the works with a monkey wrench, trying to get the thing to hit light speed before it's too late. To stay competitive as a multimedia musician, you need an artistic vision and Han Solo's "hacker" mentality. As you might guess, it's exciting and a heck of a lot of fun. It also provides a unique challenge to composers: making music that's interactive.

In this sense, interactive refers to music that responds quickly to unpredictable events triggered by the user. This interactivity makes game music fundamentally different from music for movies, television, and other "passive" media. Yet, with movies as an obvious comparison, it's important to create the *illusion* of inevitability in the music. In other words, the music should respond to the user's actions, while sounding as seamless as a movie score.

So how do you solve the problem of music that has to change at a moment's notice, yet sound natural? Not surprisingly, the answer lies partly in software and partly in compositional approach.

LET'S GO INTERACTIVE

The software part of the solution is conceptually simple, but it is tricky to implement and even trickier to use efficiently. It involves using MIDI drivers that can navigate through MIDI files *conditionally*. In conventional music applications, a MIDI file is read through by a sequencer from start to finish, much like playing a record or tape. Every MIDI message in the file is interpreted as an unconditional command: Turn on the note; OK, now turn off the note. Interactivity calls for a completely different approach: turn on the note, but only if condition X is true; jump to this point later in the sequence, but only if condition Y is true. Several game developers have written this type of interactive system; the one we use at LucasArts is called *i*MUSE, which stands for "Interactive Music and Sound Effects."

*i*MUSE is an internally developed, patented technology that provides two dimensions of control over our music. First, it allows us to change, on the fly, *where we are going* in a MIDI file. If you visualize a written score, think of this as horizontal control. Second, it gives us control over *what is playing* at a given time, at what volume, timbre, even what key, in short, vertical control. The game-system software can either invoke this control directly, or by setting conditions to be checked when certain conditional messages are encountered in the file. This gives us the power to change the music at moments that are appropriate both to the flow of the game and to the state of the music itself.

SAM & MAX

Even with this interactive music system at our disposal, most of the challenge (and the fun) of interactivity comes in writing the music itself. So let's get down to how we scored *Sam & Max Hit the Road*, a new game from LucasArts.

The game is about two detectives: a dog named Sam and his sidekick Max, a rabbit with a penchant for dangerous sports. The two heroes are called to track down a yeti (that's right, as in Abominable Snowman) named Bruno who, with his girlfriend Trixie, has escaped from a carnival sideshow. To find them, the detectives must crisscross America, investigating every piece of roadside kitsch you ever begged your

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One of the many roadside attractions visited by our heroes in *Sam & Max Hit the Road*.

parents to stop at. Along the way they must battle the evil Conroy Bumpus, an English country music star (!) who wants to put Bruno in his private menagerie.

Long before we ever wrote a note for *Sam & Max*, we met with the game designers to get a sense of their artistic intent. They wanted a combination of early '50's jazz, surfer music, and other styles of music that suggest Americana. After the meeting, we listened to music that captured the aesthetic the game designers wanted. We also determined which of us would be the "lead" composer. The lead composer guides the musical aesthetic for a game.

Once the visual art and the programming structure of the game started to approach their final forms—about three-quarters of the way through the project—we started composing for it. We began by doing rough sequenced sketches, trying to capture the feeling of the game. Most of the sketches were only 10 to 30 seconds long, were often very messy, and were designed only to convey a mood and style to the game designers.

We set up a music development system that allowed us to hear the MIDI files on real game hardware as we wrote them. Our authoring system uses a Macintosh IIfx, running *Performer*, connected to a PC via a MIDI cable. The PC runs a simple program that interprets the incoming MIDI messages and sends them to different sound cards. This permits us to run the game we're scoring on the PC, so we can get a rough sense of sound and picture together.

After working on several sketches, a blues-oriented, cool jazz style began to gel. Musical style is paramount to the mood of a game, and a lot of time is spent hammering it out. Even when scoring games for classic Lucas properties such as *Star Wars* or *Indiana Jones*, where the style and themes are given, we spend many hours studying the movie scores and recordings of John Williams to home in on the sounds that are right for a game.

Once the musical style is established, it's time to get a closer look at the game. The most important and inventive composing usually occurs in these early stages. Typically, we huddled around the computer, played the game,

and started bandying about ideas specific to each scene. The score then began to come to life as a unified map of these ideas. We're usually pretty literal about this map; we even use database software to create a record of every event and place in the game we want to score. This approach was necessary because of the sheer volume of music needed to meet the requirements of interactivity. For example, a typical graphic adventure game may use a hundred MIDI files.

At this point, we had enough of a feeling for the game to start doing theme sketches for the important characters and locations in the game. These sketches were sequenced or just written out on paper. Even if they were realized as full MIDI orchestrations, they often ended up as mere building blocks in scenes using those characters and locations. This is a common trick of movie music and is identical in function to the *leitmotifs* of Wagnerian opera. Once this initial phase of generating theme and character music was done, the process of writing specialized music for each scene in the game began.

STATES AND SEQUENCES

The music is classified according to how it scores two types of situations: states and sequences. A state is any situation in the game that may last an indefinite period of time. A sequence is a predetermined chain of events with a prescribed length and usually involves a special animation triggered by some user action. State music is the "wallpaper" of the game. It's challenging to write, because it must be interesting enough to contribute to the mood and keep the player engaged in the game world, without being obtrusive enough to become tedious. We try to do the more extended state music first.

The "Wak-a-Rat" game-within-a-game provided an excellent opportunity to introduce interactive music elements.

Here's an example of this type of music in *Sam & Max*. Early on in the game, the two heroes spend a lot of time at a carnival, looking for the fugitives Bruno and Trixie. This was difficult to score, because carnivals are raucous, obnoxious places, and carnival music is not exactly subtle.

Our solution was to start out with a simple, 2-minute loop of in-your-face carnival music. On successive repetitions of the loop, we used *i*MUSE conditional messages to drop out some of

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the instrument parts, then eventually brought the parts back in, but with different, less obtrusive instrument sounds. In this way, we used the vertical control features of the system to get variety and drop the energy level at the same time. Then, we broke the monotony of the loop form by inserting conditional jump commands (horizontal control), activated by variables set randomly by the game system. The result is a continually evolving form of shifting orchestrations, which can last longer than ten minutes without repeating exactly.

Once the game is paved with ambiences such as this, we focus on special situations that require the music to follow some action closely. For example, in the carnival there is a game our heroes can play called "Wak-a-Rat," in which the player tries to clobber as many rats as possible as they pop out of holes cut in a wooden box. It's a twisted concept, so it was a lot of fun to score. A total of 40 rats are available to whack, and we wanted to increase the tension of the music as time runs out in the game. We chose a simple solution: When the 32nd rat appears, the music changes, via conditional jump messages, to a more intense section. When the game ends, the player has either won or lost, and the music does the same kind of transition to one of two endings accordingly.

Ending "Wak-a-Rat" is a miniature example of a sequence of events. A special animation is triggered telling you how you did, and the music is designed to follow the animation.

Our interactive music system also allows us to do the opposite: sync the animation up to the music. Later in *Sam & Max* there is a banquet scene in which a band of yetis plays some cocktail music. In this situation, the role of the music suddenly changes from soundtrack to part of the scene itself. In movies, this phenomenon is called "real music." We wanted to enhance this effect by somehow synchronizing the band with the music. To accomplish this, the animation of a yeti guitarist's strumming hand was made to depend on a certain variable. In the MIDI file, a special message was placed at each prominent guitar strum. When the file is played and each message is encountered, the variable is set and—presto!—the yeti strums to the music.

MAKING THE SYNC

Synchronizing the music at this level of detail is a time-consuming process involving a lot of coordination between musicians, programmers, and game designers. Once a file is authored in Type 0 Standard MIDI File format, the conditional messages are tested on the composer's development system. Then the file is converted to a special format so that it can be read on the game platform itself; in this case, a PC.

The files are incorporated into the game using the game's scripting language. At this point, the conditions the interactive parts of the music will respond to are also set. The person who usually does this scripting is not the composer, but he or she works closely with the composer.

BUGGING OUT

The final step is to fix all the things that didn't work right. The process is similar to testing for bugs in computer programs, with one big difference. Often, only the composer can detect a problem. Here again, the scripter and composer work together. This final testing phase is also the time when the game designers have final say over what works and what doesn't. They sometimes ask for adjustments, or even a rescoring of the scene.

Despite all the work, the results are gratifying. Ideally, the music enhances the mood and gives the player a few good tunes to hum, without imposing on the rest of the experience. In addition, we get the added satisfaction of having solved problems from which movie and television music are virtually exempt. Of course, all of this should be transparent to the game player. Ironically, when interactive music is doing its job, you usually don't notice it. But you do get a feeling, a sense that you are really part of a drama. You see the Millennium Falcon cruising through space, unaware of all the fancy toolwork Han Solo had to do to get it to move that way.

(Special thanks to Clint Bajakian and Michael Land, my co-composers on *Sam & Max Hit the Road.*)

When **Peter McConnell** *isn't composing and designing music software for LucasArts Games, he writes, sings, and plays in the Bay Area band Lotus Eaters.*

SysEx Hex

By Scott Wilkinson

Cast a spell on your favorite synth and bend it to your will with hexadecimal System Exclusive messages.

Your high school math teachers were right. You really should have paid attention to everything they taught you, because one day it would have real-world relevance to your life. Like it or not, that day has arrived. If you really want to take the best advantage of all your electronic-music gear, you need to know a fair bit of math. This is particularly true if you want to dive into the daunting but powerful world of MIDI System Exclusive, or SysEx.

System Exclusive messages represent the specific parameters of each instrument. Unlike all other MIDI messages, they are different from one device to another. (There are a couple of exceptions to this; Universal System Exclusive messages are defined for all devices to represent things such as MIDI Machine Control and the Sample Dump Standard.) With SysEx, you can do all sorts of things, such as requesting parameter values and bulk dumps, remotely controlling parameter values in synths and signal processors in real time, and programming custom applications in *HyperMIDI* or Opcode's *Max* (see "The Secret World of System Exclusive" in the February 1993 **EM**). Before you can use it, however, you need to know a number system called hexadecimal.

HEXADECIMAL NOTATION

Most computers use groups of eight binary digits, or *bits*, to represent data and instructions in a code; these 8-bit groups are called *bytes*. MIDI devices are nothing more than dedicated computers that use bytes to represent messages. Each byte can have one of 256 different values: the lowest value is 00000000 = 0, while the highest value is 11111111 = 255. Each value represents a different message.

Unfortunately, humans find binary bytes cumbersome to work with, so a more compact number system called *hexadecimal*, or *hex*, is used to represent bytes. The derivation of the name is straightforward: "Hexa" (6) plus "decimal" (10) indicates that this system uses sixteen digits. As a result, the hex system can represent any byte with just two digits.

The hex system uses the same digits as the familiar decimal system, 0 through 9, for its first ten digits. The other six digits are the first six letters of the alphabet. Therefore, the digits of the hex system are 0 through 9, followed by A through F. This lets us write any 8-bit byte as a 2-digit hex number (see **Table 1**).

The numbers 0 through 9 are equal in appearance and value in the decimal and hex systems. However, some of the numbers above 9 may look the same, but they are not equal. For example, 10 in hex is equal to 16 in decimal. For this reason, hex numbers are written with a "$" before the number or "H" after the number. (The latter form is more common in MIDI.) For example, $10 = 16 or 10H = 16.

SYSTEM EXCLUSIVE

As mentioned earlier, most SysEx messages do not represent performance gestures and other musical information common to all devices. Instead, SysEx messages represent the parameters for sound generation and modification, samples, sequences, bulk-data dumps, and settings for effects processors. For example, editor/librarians use SysEx to communicate with devices in a system.

Unlike all other MIDI messages, System Exclusive messages can be any length because they represent individual

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parameters and bulk dumps in different instruments. So how do devices know when a SysEx message is finished? The last byte is always the same: It's called *EOX* (End Of eXclusive). This is actually one of the System Common messages, but it's used to end all SysEx messages.

The exact format of a SysEx message varies from one instrument and manufacturer to another, but they all begin with the hexadecimal number F0H, which indicates the start of a SysEx message. This is followed by an ID number that identifies the manufacturer of the device; each manufacturer is assigned a unique ID number by the MIDI Manufacturers Association (MMA) or the Japanese MIDI Standards Committee (JMSC). Some manufacturer IDs are one byte long, but more recent IDs are three bytes long to accommodate the growing number of manufacturers.

The next byte in most cases is the *basic channel* to which the device is set. The basic channel is sometimes replaced by a *device ID*, which is also set in the device itself; this allows several identical devices to be addressed separately. The next two bytes are often a *product* or *model ID*, which identifies the specific product model, and a *message type*, which specifies the type of message it is.

The specific data bytes follow these initial header bytes; the data can be of any length, but some devices limit it to 256 bytes or another fixed amount. The last byte is always the hex number F7H, which represents the end-of-exclusive message. By the way, the format of these first few bytes sometimes varies between devices, but the preceding example is a good guide to get you started.

USING SYSEX HEX

Understanding hexadecimal notation and the general format of SysEx messages is vital to using this part of MIDI successfully. Another crucial step is the ability to read the SysEx implementation chart at the back of most owner's manuals. This chart usually covers several pages in very small type, unlike the MIDI implementation chart (see "From The Top: Reading MIDI Implementation Charts" in the March 1993 **EM**). The SysEx codes for all parameters in the device are listed here.

DECIMAL	BINARY BYTE	HEX
0	00000000	00H
1	00000001	01H
2	00000010	02H
15	00001111	0FH
16	00010000	10H
28	00011100	1CH
31	00011111	1FH
32	00100000	20H
63	00111111	3FH
64	01000000	40H
127	01111111	7FH
128	10000000	80H
240	11110000	F0H
247	11110111	F7H
253	11111101	FDH
255	11111111	FFH

TABLE 1: This table shows a series of numbers in decimal, binary, and hex format. Notice that each byte can be divided into two 4-bit "nibbles"; 0000 = 0H, 1111 = FH. Each nibble can have one of sixteen values; two nibbles can have one of 256 values.

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Some instruments require *bidirectional* connections to send or receive SysEx messages; in other words, you must connect both MIDI Out and MIDI In to the appropriate ports on the other device. This is not true for all MIDI devices, so check the owner's manual to be sure.

Bidirectional connections allow a process called *handshaking*. This lets the devices establish an active communications link before any data is sent; it also allows the receiving device to send a message requesting a SysEx bulk dump from the transmitting device. In addition, the receiving device can send an acknowledgment to the transmitting device after each packet of data is received.

FOR EXAMPLE

Consider the Roland Sound Canvas. Most of its programmable parameters are available remotely via SysEx or from the front panel in Micro Edit mode. However, this mode presents parameters in hex in the display, so the following discussion is applicable in either case.

The Sound Canvas's SysEx messages include three main sections: Header, Body, and EOX. The Header is virtually identical for most Sound Canvas SysEx messages:

F0H	Start SysEx
41H	Roland ID
dev	Device ID (The possible numbers range from 00H to 1FH, specified by front-panel controls.)
mdl	Model ID (This number is 42H if the instrument is in GS mode, 45H if it's in native Sound Canvas mode.)
cmd	Command ID (The value is 11H if the message is a request for data, 12H if it is sending data.)

You can have up to 32 Sound Canvases in a system with Device ID numbers ranging from 0 to 31 (00H to 1FH). The Model ID depends on whether the unit is in GS mode (Roland's superset of General MIDI) or native Sound Canvas mode. There are two basic types of SysEx messages: requests for data and data to be sent. These are indicated by the Command ID.

If the message is a request for data, the Body of the message includes three bytes that specify the internal *address* of the parameter. Following that are three bytes that specify the number of data bytes requested. If the message is new data for a parameter, the 3-byte address is followed by the new data (up to 256 bytes).

The last byte in the Body is called the *checksum*, which is not found in the SysEx messages of most other manufacturers. The checksum provides error correction in the following manner: The message is valid if the sum of the address bytes, data bytes, and checksum byte is a multiple of 80H (or 10000000 in binary). To calculate the checksum, simply add the address bytes and data bytes and subtract the result from 80H. I strongly recommend you use a calculator that can deal with hex, such as the Casio fx-115d. Performing hex arithmetic in your head or by longhand is a pain in the butt.

Let's look at a specific example. Suppose you have a Sound Canvas set to Device ID 1 (00H) and GS mode (Model ID 42H). The device is bidirectionally connected to a computer running a sequencer that lets you type and send individual SysEx messages; the program also displays SysEx messages sent by the Sound Canvas. (This can also be accomplished with a hardware sequencer such as the Roland MC-50.) For the sake of this example, let's say you want to find out what MIDI channel is assigned to Part 1, then turn that Part off altogether.

The first step is to send a request for the required data. The address of the Receive Channel for Part 1 is 40H 11H 02H (the address for Part 2 would be 40H 12H 02H, and so on). The Receive Channel is specified with one byte, so we want to see only the single byte at the specified address. To calculate the checksum, start by adding all the address bytes and number of bytes requested.

40H + 11H + 02H + 01H = 54H

This is the number you subtract from 80H to calculate the checksum.

80H - 54H = 2CH

So the checksum byte is 2CH.

The entire message you type looks like this:

F0H	Start SysEx
41H	Roland ID
00H	Device ID
42H	Model ID

11H	Request Data
40H	Address of Receive Channel for Part 1
11H	"
02H	"
00H	Number of Data Bytes Requested (specified in three bytes)
00H	"
01H	"
2CH	Checksum
F7H	EOX

The response should look like this:

F0H	Start SysEx
41H	Roland ID
00H	Device ID
42H	Model ID
12H	Send Data (from Sound Canvas to sequencer)
40H	Address of Receive Channel for Part 1
11H	"
02H	"
00H	Receive Channel (00H = channel 1)
2DH	Checksum
F7H	EOX

To turn Part 1 off altogether, send a value of 10H to the same address. First, calculate the checksum by adding the address bytes and data bytes.

40H + 11H + 02H + 10H = 63H

Then, subtract this value from 80H to find the checksum.

80H - 63H = 1DH

The entire message looks like this:

F0H	Start SysEx
41H	Roland ID
00H	Device ID
42H	Model ID
12H	Send Data
40H	Address of Receive Channel for Part 1
11H	"
02H	"
10H	Data Byte
1DH	Checksum
F7H	EOX

ENOUGH ALREADY!

Admittedly, this hex stuff takes some practice. In particular, the Roland checksum is an additional pain that doesn't affect most other manufacturers. Nevertheless, learning SysEx hex is worth the trouble if you enjoy exploring beneath the surface of your synths. Give it a try; you'll soon be spouting hex with the best of them!

Classic Recordings

By Neal Brighton

Recording classical music concerts is often a matter of capturing maximum sound with minimal gear.

String quartets, such as the internationally renowned Kronos Quartet, usually position themselves in a close semicircle. Discreet stereo miking can be achieved by placing a matched set of condenser mics approximately seven feet above each pair of musicians.

Classical music concerts provide one of the few venues where minimal recording equipment can deliver good-sounding, professional master tapes. I'm not saying that other musical styles cannot be recorded well live, but you typically need racks and racks of gear to document the average rock or jazz concert.

By comparison, classical musicians seldom embrace the wizardry of recording technology. Multitracking, for example, is not necessary in a discipline unaccustomed to overdubbing and submixing. Trained classical musicians have excellent performance technique, know how to manage individual dynamics within an ensemble, and are more concerned with natural sound than with multi-effects and EQ curves. These factors allow most classical concerts to be wonderfully recorded "live to stereo" with little more than a DAT machine and a couple of microphones.

PRE-PRODUCTION

Optimum preparation for recording a classical concert usually requires two steps. First, be sure to meet with the artist. You'll need to know what pieces are being performed, the number and type of instruments, approximately how long the performance runs, and how the artist feels about having microphones on stage. It also helps to arrange an informal sound check before the public is allowed into the venue. Because most artists warm up before the performance, it's usually no problem to schedule time to set basic recording levels and troubleshoot the system.

Second, if possible, take a trip to the performance venue before the show. Audition the acoustics of the church, concert hall, or auditorium, and determine the best location for your recording equipment and microphones. Look for power outlets and make sure a clean circuit—meaning that no other equipment is running off the circuit—is available for your system. It may save frustration if the concert promoter or stage manager can meet you at the venue to approve your setup plans. If someone in charge is unavailable, it's smart to select an alternative area for your gear, as on the day of the gig, the venue may find a reason to bump you from your chosen spot.

EQUIPMENT LIST

The tape recorder of choice for most live classical situations is the DAT machine. Aside from the fact that they are much smaller and lighter than analog, open-reel decks, DAT recorders offer excellent dynamic range and a blissful signal-to-noise ratio. DAT's impressive sonic specs are well-suited to capturing the crescendos and soft passages inherent in most classical pieces.

It's also a boon that 90-minute (and longer) DAT tapes are available, because you'll seldom, if ever, stress out about changing cassettes in the middle of a performance. Open-reel recordists often must employ the sonically inferior tape speed of 7½ ips to ensure that operas or long symphonic works are recorded unabridged. Even so, a 12-inch tape reel running at 7½ ips is only safe for documenting a continuous performance of one hour. And if more recording time is needed, changing tape reels is infinitely clum-

sier than popping in a DAT cassette.

The second piece of equipment I recommend is a mixing board. Many recordists may dispute this choice, because a DAT deck with built-in mic preamps, or an outboard, stereo mic preamp plugged into the recorder, offers a cleaner signal path. However, current compact mixers offer excellent sonic quality, and I've found that a little EQ during recording is often handy. It seems I'm always diminishing low-end room rumble with a highpass filter or a 5 dB to 10 dB cut at 100 Hz. In addition, the phantom power available on most mixers allows use of condenser microphones without worrying about batteries. (Don't ask me why, but condenser batteries always seem to die in the middle of a performance, even if fresh cells were inserted prior to the concert.)

Whether you use a mixer or not, quality condenser microphones are essential for documenting the subtle tonal collage of classical performances. In this arena, Shure SM57s and other venerable dynamic mics just don't cut it. My best classical recordings were tracked with Neumann U87s, AKG C-414s, and Audio-Technica AT4033s. Few recordists own a large collection of high-quality mics, but don't forget that you can rent whatever you need. And it shouldn't be too difficult to convince an artist that mic-rental expenses will reap sonic dividends. However, if the mic budget will not budge, inexpensive PZM models offer good sound quality and, to my ear, perform better than conventional dynamic microphones.

Finally, make sure that you have enough mic cables, mic stands, gaffer's tape, extension cords, and other recording paraphernalia to handle any situation. Don't assume that the venue will provide everything you need. (For more information on preparing equipment lists for live recordings, see "Recording Musician: Location Recording" in the August 1992 **EM**.)

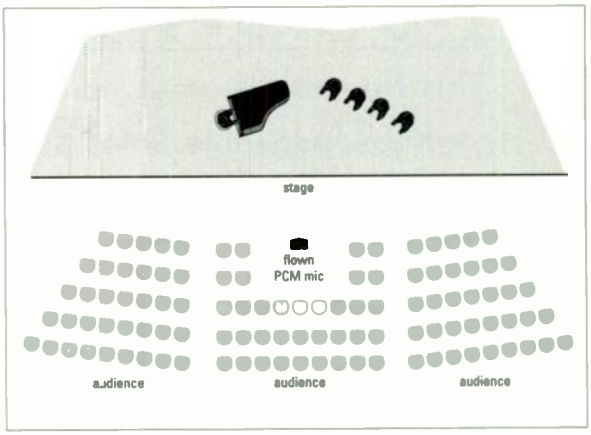


FIG. 1: At the Community Music Center in San Francisco, a pulley system secures a stereo PZM microphone over the heads of the audience. This mic position accurately documents the sound of the musicians in the auditorium and relieves the performers from the psychological impediment of onstage mics and mic stands.

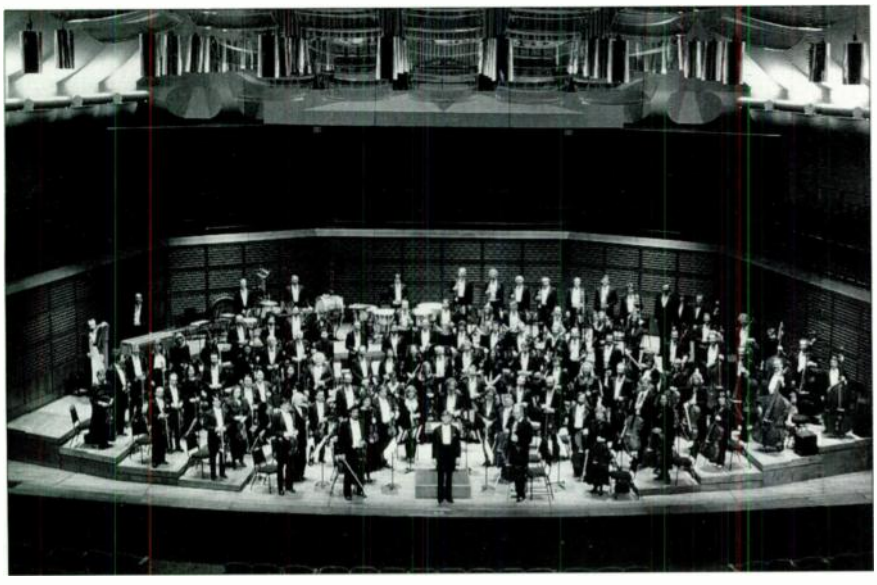
MIC PLACEMENT

Unlike pop musicians, many classical artists are uncomfortable with microphones and mic stands cluttering the stage. Also, few classical instruments sound natural when close-miked. These two factors often encourage recordists to develop creative mic-placement strategies.

Obviously, you can place the mics far away from the musicians, but room acoustics might render the sound "wetter" than desirable and could pick up audience noises. In situations where it's impossible to place mics on stage, I've found it's better to position the mics no further than the first few rows of the audience, in a left stage/right stage stereo perspective. Extremely sturdy mic stands with boom attachments are essential. If the mic stands are extended high, it makes sense to secure the legs with sandbags or weights. (Few classic pieces are written to accommodate the sound of a mic stand crashing to the floor.)

My favorite concert miking trick is "flying" the microphones above the audience (**Fig. 1**). At San Francisco's Community Music Center, I've engineered a number of recordings using a pulley system. A Crown stereo PZM microphone is hoisted approximately fifteen feet above the audience's head and secured with clear fishing line, so that the mic doesn't twist around in mid-air. Because the Center's medium-size concert hall accommodates intimate gatherings, this miking system produces a clear and vibrant stereo recording. Basically, the PZM mic emulates the sound heard by the audience. I can't think of a better perspective from which to document a classical concert.

If you *can* place mics on stage, try to position them behind the performers and above their heads. Such discreet positioning allows the audience clean sight lines and doesn't encumber the musicians. In addition, over-the-head placement usually strikes a good sonic



It's safe to assume that most EM readers will not be recording major orchestras such as the San Francisco Symphony. You may, however, be hired to document a performance by a local high school or university orchestra. If so, don't be daunted by the sheer number of instruments; careful stereo miking can produce a master-quality recording.

balance between the natural tone of the instruments and the sound reflections, or room tone, of the concert hall. Always keep a stereo (right stage/left stage) perspective in mind and listen critically to the room acoustics to determine optimum onstage microphone positions.

PERFORMANCE ETIQUETTE

As you're recording the concert or recital, be sure to log the start times of each individual piece and/or movement. Accurate records are critical if the artist desires post-production enhancements, or plans to release certain selections on CD or tape. To log exact timings, make sure your DAT machine is running on ABS mode, so that the display shows the time in hours, minutes, and seconds.

Because few performers own DAT machines, it's a nice gesture to record an analog cassette simultaneously with the DAT version. I haven't met an artist who didn't appreciate a cassette copy at the end of their performance.

POST-PRODUCTION

Most performers think that after the concert is recorded, it's the end of the story. Not so. Remember, you now have a digital recording that can be manipulated in many strange and wonderful ways. The ends of pieces can be faded out and the beginnings edited to start cleanly (*sans* audience rustling and the clicks and clacks of musicians positioning their instruments). And that's just the beginning. Compression can tame less-than-perfect dynamics, unplanned noises can be deleted (or diminished), awkward spaces between movements can be shortened, and room ambience can be toyed with until a small hall sounds like a cathedral. In short, the tools exist to transform a simple sonic document of a performance into a great-sounding, commercial master tape.

Of course, post-production can't save a poor recording or a lackluster concert. A major part of the recordist's job is to put the artists at ease so that they can deliver a transcendent performance. Always keep in mind that the performance is the key, *not* the technology utilized to document the sound on tape.

Neal Brighton *is an independent producer/engineer and co-owner of Sound & Vision studios in San Francisco.*

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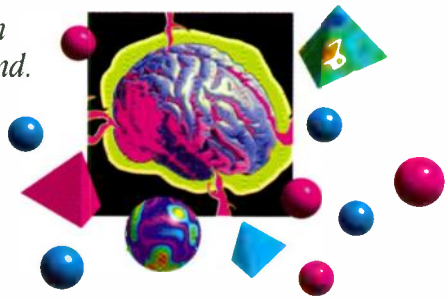

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KAWAI

Questions & Answers

By Alan Gary Campbell

The good doctor offers prescriptions for synth memory loss and LCDs that squeal.

Q. The LCD on my Casio DA-2 portable DAT has started to get little specks, or blotches, in the lower-left corner. What causes this, will it worsen, is it reversible, and should I have it repaired?

A. Occasionally, an LCD substrate will separate, causing specks, or blotches, usually in a corner or near an edge. This may result from impact damage, thermal effects, or a manufacturing defect. The problem is sometimes progressive, but often stops after a point. It is irreversible. If the problem interferes with the function of the unit, or worsens appreciably, the LCD should be replaced. Otherwise, the existing LCD may be left in service.

Q. Is there a remedy for the unnerving squeal emitted by the LCD of the Roland D-70? Roland is aware of the noise, but doesn't see it as a problem. It's driving me crazy!

A. Some LCDs do emit a high-pitched sound (as do monitors), and the emission characteristics vary even among a production run of the same display. You might obtain some improvement by replacing the display, but the new one might be worse! In some cases, applying a bit of silicon sealer or some GC Liquid Tape at strategic points, on the back or at the edges of the display, may effectively damp the emissions. But getting to one of these things often requires quite a bit of disassembly and is not a do-it-yourself project. Placing a towel or some acoustic foam over the display area can block the sound when the unit is idling, or when display access is not required. In any case, I congratulate you on having preserved enough of your hearing to have such a problem.

Q. I have a Digital Music Corp. MX-8 MIDI switcher, which I've used happily for some time. Recently, I tripped over my outlet strip and pulled the AC adapter plug out of my Casio CZ-101 synth. The plug touched the frame of my keyboard stand and made a big spark. Afterward, the program memory in my Roland Super Jupiter was scrambled—it was okay when I reloaded—and the MX-8 locked up. The MX-8 was not near the spark; could it have been damaged? I don't have an address for the manufacturer. Do they have local service centers? Finally, is the adapter safe to use?

A. From the description of the incident, it is certain that when the adapter-plug tip came in contact with the keyboard-stand frame, it briefly shorted to ground, which caused a current surge and produced an arc. Generally, a stand is not directly grounded, but it can be inadvertently connected to the AC line ground by contact with the grounded case components of the keyboards and effects that it supports. The current surge put a significant transient on the AC line, which caused the scrambled memory.

It's likely the MX-8 is undamaged and, like the Super Jupiter, merely has a memory glitch. The MX-8 has a built-in test/reinitialization procedure, activated from the front panel. However, this procedure erases all memory. (It's a good idea to periodically save the internal setups via MIDI SysEx dump.) Unfortunately, if the unit is locked up, there is no way for you to retrieve the setups before the reinitialization procedure.

To reinitialize the MX-8, turn off the power, press and hold both Function and Reset, and turn on the power. Release the buttons when the display shows "TEST MODE (Y/N)?" Press "Yes"; the display will show the ROM

JACK DESROCHER

EASY AS P.I.E.

In the first year of "Service Clinic," I reported on the *Casio Automated Parts Order Entry System*, or *C.A.P.O.E.S.*, an online parts database, and later on Casio's innovative use of microfiche. Casio's concept of computer-based, multilevel, continuously updated, technical information management has achieved a new dimension with the CD-ROM-based *Product Information Environment*, or *P.I.E.*

At the click of a mouse, the service user now has access to extensive service data, product manuals, and accessories lists for a bewildering array of Casio products, from calculators to watches, stereo gear to synths. Moreover, previous innovations have been integrated in the new system, so that *P.I.E.* includes the Master Parts List (MPL) and complete *C.A.P.O.E.S.* routines (as well as a lengthy and illuminating biography of Casio's founder).

The software is user-friendly and menu-driven in a simple click-and-go format. The main screen, for example, allows the user to simply enter a product name or designation (*P.I.E.* will search for a name, if needed), and the system offers an impressive array of menu options, including Spec Sheets/Tips, Instruction Manuals, Programmer's Manuals, Service Manuals, Service Bulletins, Known Problems/Solutions, and Parts Finder.

Relevant for the service environment is the ability to incorporate personal notes and local repair histories for each model name, which are retained along with the factory service data, and the ability to recall and print out portions of owner's and programmer's manuals. All updates and added data files are available online via *C.A.P.O.E.S.*, so there is no need to buy a new CD ROM with every revision. New versions are scheduled for release every six months.

P.I.E. requires a PC (80386 or better) with *Windows* 3.1, 4 MB of RAM, and at least 20 MB of free hard-disk space. *P.I.E.* showed no significant compatibility problems and ran quite smoothly on a Tandy Sensation. Casio had not finished adding the musical-instrument service data files before the release of version 1.0. Electronic musical-instrument repair centers should wait for version 2.0, which will contain these files.

Suggested list for *P.I.E.* is $150 (somewhat less for service centers). It is available from Casio Parts Centers, or directly via *C.A.P.O.E.S.*

version and "GOOD." Press the Function button; the display will self-test, then prompt you to test each panel button. Press the Function button again; the display will show "JUMP IN/OUT." (This test will fail; that's okay.) Press the Function button again, and the display will show "MEMORY TEST"; press "Yes." Press the Function button one last time; the display will show a burn-in timer. Turn the unit off, wait a few seconds, then turn it back on to resume normal use.

Digital Music Corp. performs all service at the factory. The MX-8 carries a 5-year warranty, and the company has a reputation for flexibility with regard to warranty coverage. Contact Digital Music Corporation at 5312-J Derry Ave., Agoura Hills, CA 91301; tel. (818) 991-3881; fax (818) 991-4185.

Q. Why do some AC adapters have a positive-tip polarity and some negative? How can you test to make certain the polarity is correct? Isn't the exposed contact a shock hazard?

A. Different standards have developed, over the years, for plug polarity and

Digital Music Corp. MX-8

plug size: There are over a dozen common sizes and several geometries. The situation is akin to cars: Some use negative ground, some positive; some have one type of battery connector, some another. Yamaha and a few others use positive tip/negative sleeve, but most, including Casio and Roland, use the negative tip/positive sleeve. The latter is somewhat less safe, as most equipment has a "negative ground" that makes case contact with the plug sleeve—the part that is most exposed—which could cause a short circuit.

Of course, simple caution is sufficient to avoid problems, in most cases. Though a sleeve-to-ground short can cause some minor fireworks, brief contact probably will not damage a well-made AC adapter. (Check the plug for arcing damage.) An off-brand unit probably should be discarded. Extended contact can cause damage, even to a well-made unit.

▼ To conserve operating life, adapters should be unplugged when not in use.

A digital multimeter, preferably one with polarity indication (Radio Shack catalog number 22-171, or similar), is sufficient to test adapter polarity. The correct input polarity is usually indicated near the power jack or on the bottom plate of the equipment. If in doubt, contact the manufacturer.

There is no shock hazard with a properly functioning adapter, as the output voltage is comparatively low. Note that to conserve operating life, adapters should be unplugged (if used with an outlet strip, simply turned off) when not in use. It is normal for some adapters to become rather warm, but not hot, during use.

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

Reviews

Yamaha SPX990 Multi-Effects Processor

By Michael Cooper

The popular SPX series steps up to the latest pro standards.

My usual response when a manufacturer claims its effects processors are 20-bit is, "Yeah, but how many bits are the analog-to-digital and digital-to-analog converters?" That's because their lofty specification usually refers to the internal mathematical processing of the unit, not the converters. Not so with the Yamaha SPX990; we're talking clean, 20-bit A/D and D/A conversion. (The internal resolution is 28-bit.)

The 1U rack-mount SPX990 includes reverbs, delays (including multitaps), chorus, flanging, intelligent pitch shifting, autopanning, sampling, compression, distortion, and parametric EQ among its many offerings. It offers true stereo operation but also allows mono in/stereo out. The 80 presets and 100 RAM slots (for storing your own effects) should keep you busy for awhile. If not, a front-panel memory-card slot is provided for use with the optional MCD32 memory card ($75), which provides external data storage for up to 100 effects programs.

Yamaha's SPX990 provides 100 RAM locations and 80 factory presets, which include fine-sounding reverbs, delays, and modulation effects; 3-band parametric EQ; and more. It features 20-bit I/O and true stereo operation and lets you place the EQ, compressor, distortion, and harmonic driver before or after the main effects.

The SPX990's 20-bit conversion yields a typical dynamic range of 106 dB. Aside from the digital distortion algorithms, the unit produced the bare minimum of background noise. The 44.1 kHz sampling frequency provides a 20 Hz to 20 kHz frequency response.

HEY, GOOD LOOKIN'!

The SPX990's front panel is neatly laid out. Concentric pots control the left- and right-channel input levels, and separate 8-segment LED metering is provided for the left and right inputs. The current program number appears on a large LED display, while a 2-line LCD shows the program names, parameter values, and utility information. A power switch and bypass button make life easier. (The bypass routes the signal through the A/D converters and directly to the output DACs.) And, of course, there's the typical assortment of buttons and keys for editing, renaming, and storing programs.

The rear panel sports separate jacks (XLR and ¼-inch phone) for +4 dBm and -10 dBV, left and right inputs and outputs. The inputs are balanced, but I had no problem running unbalanced signals into the beast. In fact, the SPX990 was happy with either line-level signals, or direct input from an electric guitar, thanks to independent -20 dB/+4 dB switches for both the inputs and outputs. Rounding out the rear panel are MIDI In and switchable Out/Thru jacks, as well as footswitch jacks for unit bypass, triggering effects, and incrementing/decrementing through a user-specified range of programs. The unit has an onboard power supply and uses a permanantly attached, 3-conductor power cord.

FIRST DATE

The SPX990 offers limited direct access to its programs. You can assign four of your favorite programs (from factory ROM or user RAM, including

cards) to multifunction soft keys, called "Function keys," located below the LCD screen, for instant recall. But, as with most multi-effects boxes, accessing all other programs necessitates scrolling through the program directory with the data-entry dial. Considering this setup, similar algorithms should have been grouped together in adjacent ROM slots, which for the most part they're not.

The algorithms in the presets serve as mandatory starting points for creating your own custom programs. You can't switch to a different algorithm from within one preset; you must scroll to a preset where the desired algorithm resides, losing all of your current edits in the process.

But the main impediment to carefree programming is the owner's manual, which is written in hilarious, confusing, and frustrating pidgin English. Worse than most manuals, it is quite often misleading, incorrect, vague, or totally incomprehensible.

On a more positive note, the front-panel edit, page, and function keys take you through a logical hierarchy of menus, submenus, and parameters for editing effects and utility functions (such as MIDI, program titling, and memory-card formatting). Parameter values can be changed using the function keys or data-entry dial, and the changes can be stored to internal RAM or a memory card. Happily, the last program used is recalled on power-up, with non-stored edits intact. However, the unit offers no visual indication that a program has been edited.

GETTING INVOLVED

The stereo-linkable, 3-band, parametric EQ; compressor; and harmonic driver (which generates even-order harmonics from the program material) can be placed before or after the main effects. In addition, any of five types of distortion can be placed pre-effect. The distortion algorithms also include the EQ and compressor, which are chained in a predetermined order. The pre-, post-, and main effects can be individually turned off.

My main beef is with the SPX990's buzzy digital distortion, which made my normally creamy-toned 1962 Strat sound like an angry horde of bees trapped in tin foil. Otherwise, most of the effects sounded anywhere from very good to outstanding.

REVERB AND DELAY

The SPX990's four reverb algorithms sound excellent: lush and clear, with smooth decays that exhibit no flutter. The room and plate reverbs sound particularly realistic; the latter is especially impressive on trap drums. Hall and "vocal" reverbs are also provided. The comprehensive offering of editable parameters includes predelay, diffusion, damping, early reflection/reverb ratio, and various types of frequency contouring. Also included is a fairly sophisticated gate that can produce the typical, imploding, Phil Collins drum sounds, as well as more subtle decaying reverbs.

The SPX990 dedicates four algorithms to the sole task of producing stand-alone early reflections (discrete echoes normally heard before the build-up of subsequently dense reverb). Up to nineteen early reflections are at your command. Similar to multitap delays, they thicken up tracks, such as vocals, quite nicely. They can also be programmed to produce coarse-gated and reverse-gated reverb effects.

The SPX990's seven delay and echo algorithms range from hard-panned, multiple delays to 6-tap delays with completely independent panning anywhere in the stereo field. All seven algorithms offer feedback, high- and low-pass filtering, and high-frequency damping on subsequent repetitions. Delay times range as high as 1,480 milliseconds. I found moderate delay times with regeneration useful for producing dense echo trails on lead guitar. By setting all delay times very short and cranking the feedback, I managed to easily transform a smooth-sounding male vocalist into Darth Vader.

Three of the delay and echo algorithms allow you to set delay time by tapping a function key or footswitch in time with your music, or by inputting MIDI Clock messages from a sequencer. The prehistoric method is also available, where you manually enter the numerical value (in milliseconds) with the data-entry dial.

MODULATION EFFECTS

The SPX990 also offers six modulation (flange and chorus) algorithms. The flangers are outstanding. Although subtlety is possible, the wide parameter ranges and programmability of both modulation depth *and* rate happily leave you with enough rope to hang yourself. Although it was no problem getting my electric guitar to "gently weep," I could not get the unit to produce the classic "jet flange" effect.

The SPX990's chorus algorithms include amplitude modulation, in addition to delay time modulation. Tremolo effects immediately come to mind, but by making the left channel decrease in level as the right channel increased (and then vice versa), I could also get a shimmering autopan effect that gave wonderful movement to synth pads and arpeggiated acoustic guitar. Furthermore, a dedicated pan algorithm allows external triggering via MIDI or footswitch.

One of the processor's strongest suits is its pitch-change algorithms. Up to three harmonies can be added to the dry signal. Tracking is excellent: There is no apparent time delay for the processed signal. User-defined, intelligent harmonies (including custom scales) can be specified to avoid non-scalar dissonances. Warbling is effectively eliminated by programming the unit to ignore notes that approach off-key chromatics (due to vocal vibrato, for instance). A feedback parameter with programmable delay time can be used to arpeggiate the input note. Detuning effects are also possible, and they sound absolutely killer on vocals.

MULTI-EFFECTS AND MORE

The SPX990 also provides multi-effects. Algorithms combining either chorus or flange with reverb allow serial or parallel patching of effects combinations. Two individual effects can be chained together in any order, and their volume relative to one another can be adjusted. Other multi-effects options include simultaneous plate and hall reverbs, echo plus reverb, and independent stereo panners for the left and right inputs.

The Freeze program offers a simple, mono sampler, with up to 1.35 seconds of sampling time. You can initiate recording manually (by pressing a Function key), via footswitch, or automatically when the signal level exceeds a set threshold. Sample playback can be prompted manually, with a footswitch, or via a MIDI Note On message. Sample start and end points can be truncated, and the sample can be played in reverse, looped, or transposed up or down two octaves, in semitone increments.

telling *Unisyn* which Modules to address and whether to get an instrument's current patch, internal bank, or both.

CONVENIENCE BANKING

Unisyn Banks are a major form of patch storage that correspond to the way a device holds its internal voices. The size and format of a Bank depend on the target device, e.g., a DX7 Bank holds 32 patches, while a Matrix-6 Bank holds 100 patches. Multitimbral synths have global patches that control subordinate patches. These are called "Parent" and "Child" patches and are handled automatically by *Unisyn* for most Profiles.

Shuffling patches between Banks and moving Banks to and from their target synths is a major user need. *Unisyn* makes this as efficient as possible by supporting several types of shuffling and several means to do them. Banks and patches are sent and received between *Unisyn* and target devices by a single command. Once in memory, single patches, or groups of patches (contiguous or not), can be cut or copied and pasted into a destination Bank. Alternatively, patch selections can be swapped between two Banks, or individual patch selections can be moved within a Bank. These operations can be done through menu commands, keyboard equivalents, or by dragging patch selections with the mouse.

In one respect, *Unisyn* is too smart for its own good. It insists on reminding you if your MIDI interface is not working, even if you don't care. I often just want to customize patch Banks without booting my entire MIDI system, but every patch move triggers another warning dialog box which must be cleared before proceeding. This alert message should be defeatable as a user preference.

Unisyn provides three means to audition patches: mouse, onscreen keyboard, and external MIDI controller. Of these, the mouse is by far the most useful and fun. A combination of control keys and mouse movement lets you play a patch and vary its pitch, Velocity, Pitch Bend, and a controller of your choice, in real time. The pitch range can be specified as fixed notes, or as a glissando over a defined scale and key. This effectively turns the mouse into a virtual instrument and lets you quickly explore nuances of a patch.

The onscreen "virtual" keyboard is similar to that used in other MIDI programs: You click on a note and hear it. Using an external controller is just as simple. In all cases, *Unisyn* automatically adjusts the MIDI channel to match the selected patch. A fourth option is to run *Unisyn* with a companion sequencer, through Apple's *MIDI Manager*, and edit patches while a sequence plays. I'd much rather see *Unisyn* incorporate a simple SMF player and avoid the extra overhead. This capability was built into the IBM version of *X-oR* but never found its way into the Mac version.

Beyond manipulating existing patches, *Unisyn* offers three routines for generating new patches: Blend, Mingle, and Random. Blend takes two Parent patches and creates a new Bank comprising a series of patches that interpolates between the two Parents. Mingle creates a new Bank whose members are made from various permutations of the patch data in two Parents. Random comes up with a Bank of patches whose param-

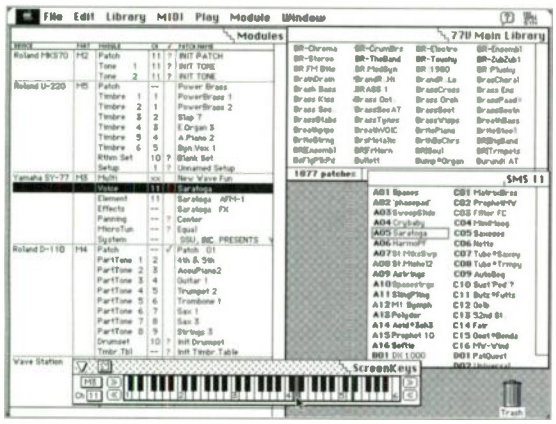

FIG. 1: The Modules window, showing the devices in a sample MIDI setup. Different Modules for each synth correspond to different data types. To the right are windows for a Library and Bank window. The screen keyboard appears at bottom, with the MIDI channel set by *Unisyn* for the selected Module (an SY77 voice).

eters are random variations of a single Parent, with the degree of variability under user control. In all three cases, the routines can work on all patch parameters, or on a user-specified subset of them.

IN THE STACKS

While Banks are fine for getting and sending MIDI data to devices, managing a large quantity of them quickly becomes a problem. Trying to sort through them to find that great distorted bass patch you used last week gets old fast. Libraries offer a much simpler alternative.

A Library is a database containing a set of patches. Each patch may be stamped with identifying keywords, comments, and time and date of creation. Each Module, in turn, can have a Library for its respective data type. For example, with an SY77 you might have a Library of individual patches, another of Multis, and a third of Pan settings. Libraries can also be created for patch-data types that cannot be formed into Banks, such as individual Elements and Filters in the SY77 example. More than one Library can be created for any Module, with one designated as the Main Library. *Unisyn* offers a startup option that automatically opens the

FIG. 2: An overly contrived but still illustrative example of using Boolean operators and keywords to find patches of a desired timbre.

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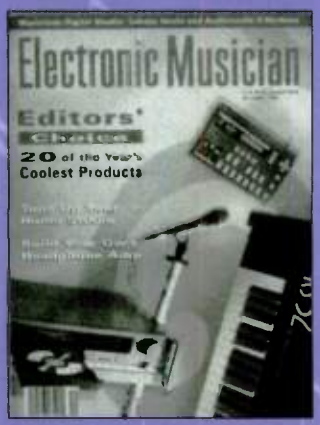

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B40105

Main Library for each Module in the current setup, which is handy when starting an editing session.

Storing patches in a Library would be of little use without a means of ferreting out those of interest. *Unisyn* provides a Find menu command that interrogates all open Library files, using a set of search criteria. These criteria may include a text string in the patch name or comment field and up to eight keywords. You can assign keywords from a 2-tiered index when you enter a patch into the Library. If you enter multiple patches from a Bank at once, keywords can be set as global for the group, or selected individually. You can expand and edit the keyword index at any time; *Unisyn* marks those used by open Libraries to prevent you from deleting keywords in current use.

Rather than simply finding direct keyword matches, *Unisyn* supports Boolean operators (And, Or, and Not) to enhance the search power and specificity. You could request *Unisyn* to find all patches containing the word "piano" in the names that have the keyword "Acoustic" but do not have the keyword "Dark." Much more elaborate search options are also possible (see **Fig. 2**). The program's only missing option is the ability to search on time and date; instead, *Unisyn* allows you to display a Library ordered alphabetically by name or by time and date of creation.

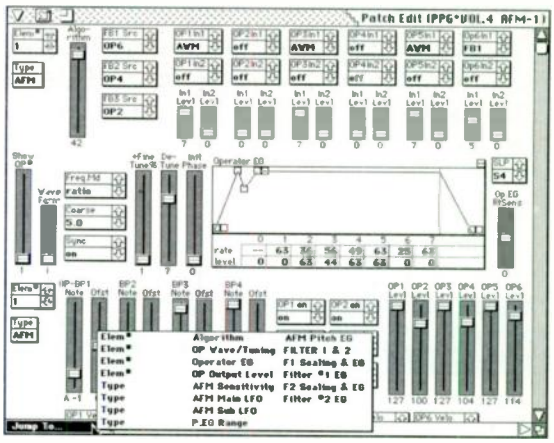


FIG. 3: A typical editing window from the SY77 Profile. The Jump box at the lower left corner is activated. Clicking on one of the parameter subsets would directly move the display area without scrolling through the window.

The Library limit of 32,768 entries is far greater than the number of patches

SUPPORTED DEVICES

The following Profiles ship with the current version of *Unisyn*. All are full editor/librarian Profiles, with the exception of those marked by an asterisk (*), which are librarians only.

360 Systems	MIDI Patcher
Akai	MB-76
Alesis	D4, HR-16, Midiverb III, Quadraverb, Quadraverb GT, Quadraverb Plus, SR-16
A.R.T.	Multiverb, Multiverb II
Casio	CZ-1, CZ-101,CZ-230S, CZ-1000, CZ-3000, CZ-5000, VZ-1, VZ-8m, VZ-10m
DigiTech	DSP-128, DSP-128 Plus
Digital Music Corp.	MX-8
E-mu	Procussion; all models of Proteus, including Proteus/Protologic and Proteus/MPS; Vintage Keys
Ensoniq	DP/4, ESQ-1, ESQ-M, SQ-1, SQ-2, SQ-80, SQ-R, VFX, VFXSD
JLCooper	MSB+
Kawai	K1, K1m, K1II, K3, K3m, K4, K4r, K5*, K5m*
KMX	MIDI Central, 8x8 Patcher
Korg	01/W, 01/WFD, 01R/W, 03R/W, 707, DS-8, DSS-1, DVP-1, DW-6000, DW-8000, EX-8000, M1, M1/EX, M1R, M1R/EX, M3R, P3, Poly-6, Poly-800, Symphony, T1, T2, T3, Wavestation, Wavestation A/D, Wavestation EX, Z3
Kurzweil	K2000, K2000R
Lexicon	LXP-1, LXP-5, LXP-15, PCM70
Mackie	OTTOmix
Oberheim	Matrix-6, Matrix-6R, Matrix-1000, Xpander*
Peavey	DPM 3, DPM V3
Rane	MPE 14, MPE 28, MPE 47
Roland	Alpha Juno 1, Alpha Juno 2, CM-32L, CM-32P, CM-64, D-10, D-20, D-50, D-70, D-110, D-550, DEP-5, GM-70, GP-8, GR-50, JD-800, Juno 106, JV-80, JV-880, JX-8P, MKS-20, MKS-50, MKS-70, MKS-80, MT-32, PAD-80, R-8, R-8M, U-20, U-110, U-220
Sequential	DrumTraks, MAX, Prophet-5, Prophet-600, Six-Trak
Sony	DPS-D7*, DPS-R7
Waldorf	MicroWave
Yamaha	DMP7, DX7, DX7S, DX7II, DX7IIFD, DX21, DX27, DX100, FB-01, KX76, KX88, RX11, SPX90, SPX90II, SY55, SY77, TF1, TG33, TG55, TG77, TG100, TX7, TX81Z, TX216, TX802, TX816, V50

anyone would sanely collect for a given synthesizer. *Unisyn* automatically recognizes and converts older Macintosh *X-oR* Libraries into its new format and upgrades the keyword index with any new entries. All swapping and copying operations between Banks work equally well with Libraries. Annoyingly, there is no keyboard command to delete a Library entry; only a menu command. How about supporting the Delete key for this?

EDITING

Although you can use *Unisyn* simply for cataloging patches, double-clicking on a patch name invokes its respective editing Profile and gets you into the world of patch-editing. The Patch Editor window displays all parameters for a given data type as graphical objects (see **Fig. 3**). Although each Module has a different parameter set, the basic format and operations are similar across all Profiles; learn one, and you've pretty much learned them all. Help information is integrated within the Profile and is displayed by a menu command.

Editing controls are displayed in a single, large window, only part of which may be visible without scrolling. *Unisyn* simplifies this by providing a Jump command that lets you move immediately to major parameter subsets, dependent on the particular Profile. Patch parameters are represented as graphical objects: sliders, text boxes, and envelopes. All of these are easily manipulated with the mouse and provide instant visual feedback.

Wherever possible, clicking on a text box calls up a display of all possible parameter values; simply click to select. Envelopes can be manipulated by changing the numeric values, or by dragging the graphic display points to taste. One future upgrade could be to maintain a shadow graph of the original envelope during editing to better visualize the change.

Unisyn's patch-copying capabilities are state-of-the-art. In addition to supporting simple copy-and-paste of various parameters, you can specify particular parameter subsets by name. These vary from one Profile to another but include groups such as Operator, Pitch Envelope, Amplitude Envelope, Effects, etc. You can copy-and-paste between a Parent patch and any single, group, or even entire Bank of patches, in one step. This is handy when you want to

set an entire Bank to use a common effects or tuning setting.

Surprisingly enough, *Unisyn* lacks the ability to directly compare an edited patch with its original version if you are working straight from the synthesizer's memory. Instead, you can compare the current edit with any patch stored in a Bank or Library. This function allows you to switch between the two patches and show the degree of similarity in their parameters. Although this is useful in many cases, there are still plenty of times when a simple Parent/edit compare would be all that's needed.

My experiences with *Unisyn*'s Profiles were satisfactory in almost all cases. The devices responded flawlessly, and I could edit all patch parameters. The only exception was with the Yamaha SY77; *Unisyn* was unable to receive MIDI data from it, although it had no problems sending data. MOTU is aware of this problem (which is also a bug in Mac *X-oR*) with some SY77s, and a Profile update has already been sent to correct it.

THERE'S MORE AT THE DOOR

Unisyn offers additional capabilities of interest, such as a Panic button, MIDI monitor, and hot links into MOTU's *Performer* sequencer (version 4.1 and later). The Panic button sends an All Notes Off command, followed by all individual Note Off events, along with Sustain and Pitch Bend reset, on all MIDI channels. The MIDI monitor provides a view of SysEx data received or sent by *Unisyn*. Though not a general MIDI data-viewer, it can be valuable when debugging SysEx communication problems.

Performer users should be delighted with *Unisyn*. Running the programs together lets *Performer* pull Modules defined in *Unisyn* into its MIDI Configuration window and identify patches by name in its Set Patch List dialog box. On the flip side, *Unisyn* users can change or edit patches in context, while listening to sequences play through *Performer*.

SHOULD I STAY OR GO?

Should you spring for it? It depends on your situation. Current Mac *X-oR* users covered by existing Profiles have little reason to upgrade at this time. In fact, you'd actually lose ground with *Unisyn*'s copy protection. Similarly, users with mostly Kurzweil gear will find no support except for the K2000. On the other hand, most other Mac

Product Summary

PRODUCT:
Unisyn 1.0 universal editor/librarian

PRICE:
$395

SYSTEM REQUIREMENTS:
Macintosh Plus or better, with System 6.0.5 or later; hard drive; MIDI interface

MANUFACTURER:
Mark of the Unicorn
1280 Massachusetts Ave.
Cambridge, MA 02138
tel. (617) 576-2760
fax (617) 576-3609

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

MIDI users will find *Unisyn* offers a tremendous productivity boost and, with free future Profiles, the most economical investment around. Even current *Galaxy Plus Editors* owners, unless tied into *Vision/Studio Vision*, should be interested, especially given the delivery speed of new *Unisyn* Profiles and continuing cost of new *Galaxy Plus* editors.

In my opinion, *Unisyn* is the premiere universal editor/librarian available today on any computer platform. Yes, MOTU still has room to improve, and other programs may surpass *Unisyn* in individual design or operational areas. But for overall performance, ease of use, and breadth of support there's nothing better.

Jim Pierson-Perry *is a clinical chemist, musician, and semi-regular* **EM** *contributor. He is widely regarded for his expertise in ethnic musical techniques, such as toad strumming and blowing the 'possum pipes.*

Circle #438 on Reader Service Card

Sony DPS-F7 Dynamic Filter

By Peter Freeman

A truly special effects processor ventures beyond traditional ideas.

It's a real treat when a major manufacturer produces interesting, flexible, and unusual effects processors with extensive MIDI control. The latest installment in Sony's DPS series, the DPS-F7, is all of that and more. Billed as a dynamic filter, the F7 can also be a subharmonic synthesizer; percussion synthesizer; monophonic synth, with two oscillators; exciter; compressor/limiter; Saturator; vocoder; and parametric equalizer. I had expected a kind of glorified, MIDI-controlled, MuTron III-in-a-rack, so the F7's tremendous versatility was a pleasant surprise.

Like its DPS-series kin (the DPS-R7, D7, and M7), the DPS-F7 is a 1U rackmount device with both stereo, unbalanced, ¼-inch I/O and balanced, XLR I/O. The unit sports a 40-character × 2-line, backlit, LCD display and a pair of LED level meters that can show input, output, or both. There are also dual-concentric channel 1/channel 2 input-level controls, output level and meter function controls, six function keys (Load, Edit, Bypass, Help, Save, and Enter), and a soft dial.

UNDER THE HOOD

The F7 has the same memory structure as the other DPS devices. There are 100 preset Program memories, with an additional 256 user Program locations. The DPS boxes allow long program names, which lets you include a bit of relevant information in each program's title. In addition to the program name, a 3-letter code is always displayed to the right of each program number, indicating which F7 algorithm is used by the program.

The F7 also employs the same block-oriented architecture and MIDI implementation found in the other DPS devices. The unit's architecture was described in detail the DPS-R7/D7/M7 review (December 1992 **EM**), so I won't go into it here.

DYNAMIC FILTERING

The DPS-F7 presents you with a choice of two basic filtering algorithms: Dynamic Filters 1 and 2. Dynamic Filter 1 consists of two parametric equalizers, a high-frequency booster, and a lowpass filter. The levels of both EQs and the high-frequency booster, the lowpass-filter cutoff frequency, and the lowpass-filter maximum attenuation level are controlled by independent envelope followers, or via MIDI Continuous Controllers.

Dynamic Filter 2 is a variable, dynamic filter whose outputs are controlled by either the onboard envelope generator, or the envelope follower. The filter section consists of a multimode filter and a bandpass filter, both of which are completely variable; a fixed highpass filter; and a Dynamic Crossfader that allows smooth crossfades between the DPS-F7's two discrete input channels (A and B). All of these elements are MIDI-controllable.

The filtering algorithms are the F7's main focus, so its not surprising that they are one of its strongest suits. Through the use of the unit's LFOs in combination with MIDI Continuous Controllers, a complex and powerful range of effects can be created, which sounded good on many different instruments, including synthesizers, guitars, bass, and percussion.

The ability to manually sweep the filters via MIDI means that precise, repeatable effects can be set up and controlled by a MIDI sequencer, a capability that few (if any) filtering devices possess. Although the sound of the F7's filters struck me as a bit clinical, the wide array of modulation possibilities and filter-control parameters tended to override this timbre when processing musical tracks.

EQ AND DYNAMICS

The Fading Parametric Equalizer algorithm contains eight sections. There are two shelving-type equalizers for bass and treble control, which cover the 16 Hz to 6.3 kHz and 400 Hz to 20 kHz ranges, respectively. There is a dedicated, ultra high-frequency adjuster (for what the manual quaintly refers to as "sound quality fine adjustment" of the frequencies *above* 20 kHz!); four independent parametric equalizers that cover the 63 Hz to 18 kHz band; and a Soft Clipper section, which works like a limiter. All of these sections, with the

exception of the Soft Clipper, are MIDI-controllable.

The sound of the parametric EQs is fairly good, and a good amount (12 dB) of boost and cut is available. I found the MIDI-control capabilities to be the most interesting aspect of this algorithm, as it allows the EQ to be used as a dynamic effect, rather than just a static one.

The DPS-F7's Extended Compressor Limiter algorithm can be used either as one stereo compressor/limiter or expander, or as two discrete mono ones. The distinguishing feature here, however, is that each channel has two signal paths (A and B), which can be set independently. Each of these contains separate controls for phase, bass and treble adjustment, parametric EQ, and panning. I found this section of the F7 to have limited usefulness, as it tended to sound less natural than dedicated, studio-quality compressors. Conceivably, it could serve in a pinch, if you've used all your compressors during a mix and require one extra.

BELOW AND BEYOND

I'm a bassist, so the F7's Subharmonic Generator algorithm was one of my favorites. The input signal is divided into eight adjustable frequency bands (discrete subharmonics) and recombined at the output. This is also absolutely brilliant for those subterranean, ultra-low kick drums that never fail to move bodies on dance floors. Programmable, MIDI-addressable, and more controllable than a dbx 120x, this is a mega-useful feature.

Another super-cool aspect of the F7 is its Channel Vocoder algorithm. The input at channel 1 acts as the carrier signal, while channel 2's input becomes the modulator. Four different possible frequency patterns are available. A shift control introduces a preset frequency offset for channel 1, and sixteen adjustable frequency bands shape the character of the vocoded signal. There also is a highpass filter, a treble control, and a very useful distortion section for the input. This is important because a distorted signal, rich in complex harmonics, tends to work better as a vocoder input than a clean one. Very smart, Sony.

I'M SO EXCITED

The remaining two signal-processing algorithms in the F7 are the Exciter and Non-Linear Saturator. The former works by emphasizing the high-frequency content of the input signal through the use of a dynamic controller, which detects the amount of change in the input signal and governs the exciter effect. The effect itself is produced by two independently adjustable highpass filters and fed into a gate (which can be disabled) before the output.

The Non-Linear Saturator is a subtle algorithm that, through the use of its parametric EQ, bass enhancer, Saturator, and highpass-filter blocks, is intended to create an effect similar to the sound of analog tape saturation. In practice, the sound of this algorithm helps fatten up the sound of various instruments. Synthesizers appear to benefit most from its sound.

SYNTHESIS

In addition to all of the effects-processing tasks I've already described, the DPS-F7 contains two synthesis algorithms. The Percussion Synthesizer algorithm produces short-duration sounds (up to about eight seconds, maximum) that are generated by up to twenty sound generators and played via MIDI, as with a normal synthesizer. The sound generators consist of six sine-wave oscillators, three sine-wave/ring-modulator/EQ oscillators, eight noise generators with bandpass filters (one of which is sweepable), a multitap noise generator, and a pulse generator with resonator.

This algorithm is intended to emulate old-style, analog rhythm machines

Product Summary

PRODUCT:
DPS-F7 Dynamic Digital Filter
PRICE:
$1,785
MANUFACTURER:
Sony Corporation of America
3 Paragon Dr.
Montvale, NJ 07645
tel. (201) 930-1000
fax (201) 930-7633

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

and analog synthesizers, and it occasionally comes close. I definitely had fun with this one. A bit of parameter-twiddling, and the DPS-F7 was quickly producing a wide range of funky, Kraftwerk-worthy blips and bleeps, perfect for that techno extravaganza you've been laboring over.

The tenth and final algorithm in the DPS-F7 is the Monophonic Synthesizer, which is a surprisingly sophisticated sound generator with two oscillators (digital, of course), a noise generator, comb filter, one lowpass filter, two bandpass filters, and six envelope generators. It also includes a delay line and soft clipper.

Considering that the F7 isn't billed as a synth, it was nice to discover it tucked away amidst the other features. Although it's not likely to become number 1 in the synth hit parade, I was able to coax a few musically useful sounds from it after some experimentation. It's great for those extra synth overdubs when you've run out of modules, mixer inputs, and ideas, and you're trying to get the mix printed by eight in the morning.

Sony's unique DPS-F7 Dynamic Filter combines a broad assortment of filtering algorithms with a subharmonic synthesizer, exciter, comp/limiter, Saturator, vocoder, and innovative percussion and monophonic synthesizers, all under MIDI control.

CONCLUSIONS

The overall sound quality of the DPS-F7 is excellent, and I had a lot of fun tweaking its parameters in a variety of mixing situations. It proved an unusual, sonic Swiss Army knife, generating many useful sounds and effects. Personal favorites include the Dynamic Filter algorithms (obviously), the Vocoder, Subharmonic Synthesizer, and Percussion Synthesizer. Defining a few graphic faders in a sequencer program provided all the control necessary to make full use of the DPS-F7's real-time capabilities.

While the user-interface takes a bit of getting used to, it becomes fairly easy to use without much effort. That's

● DPS-F7

good because the manual is a nightmare. Don't expect an elegantly designed, easy-to-read, highly informative tome; you get the bare bones (in English and French) and not a whole lot else. The box isn't hideously complicated, however, so the manual isn't an insurmountable problem. Besides, if you are familiar with the design of the other Sony DPS-series devices, you already know most of this one.

If you're looking for something different in an effects processor, and particularly if you're interested in filtering effects, I strongly suggest you have a look at the F7. It's expensive, but there's nothing else quite like it. Kudos to Sony for not producing yet another generic, boil-in-bag effects box.

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.*

Circle #439 on Reader Service Card

Mackie Designs OTTO-1604

By Peter Freeman

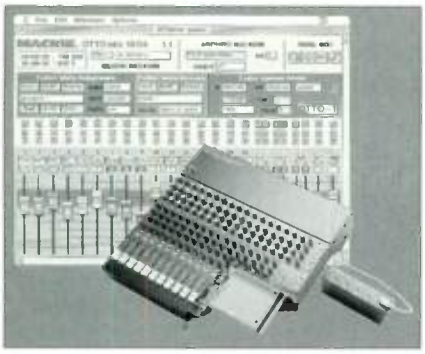
MIDI automation for the Mackie CR-1604 mixer.

Sooner or later, you will run out of hands trying to mix a complex, fast-changing arrangement. Trained giant squid are extremely hard to find and care for, and they tend to slop water all over the console. Furthermore, second engineers are costly and tend to slop coffee all over the console. Under these circumstances, the advantages of mixer fader and mute automation are evident.

Mackie Designs has nothing against squid or second engineers; nevertheless, the manufacturer of the popular CR-1604 mixer has come down firmly on the side of automation. Mackie's OTTO-1604 system for the CR-1604 provides MIDI-controlled automation of levels for the mixer's sixteen input channels, as well as its Alt 3/4 bus, four aux returns, and main outputs. No control over the mixer's EQ, aux sends, or pan controls is provided.

The OTTO-1604 system is comprised of two parts: the Gain Cell board, which must be installed into the CR-1604, and the external Control Module. The Gain Cell board can be self-installed, or installed by an authorized Mackie service center. I installed the review unit into one of my 1604s and found that although the process involves opening the mixer and switching ribbon cables around, installation wasn't difficult. The trickiest part was keeping track of all of the 1604's numerous, different-sized screws. The installation was done inside of an hour, and the unit worked fine. The external Control Module needs no separate power, as it gets its juice from the 1604's power supply via a cable from the module to the Gain Cell board.

The only physical controls in the OTTO system are four buttons on the Control Module that trigger the Learn, Snapshot, Mute, and Bypass functions. Generally, the buttons' functions are self-explanatory, but they also have some special functions, which I'll de-



Mackie Designs's OTTO-1604 for the CR-1604 mixer adds level and mute automation to the channels, aux returns, Alt 3/4 bus, and main outputs.

scribe later. The External Control Module connects to the world through MIDI In, Out, and Thru jacks and to the internal Gain Cell board using a standard Apple Desktop Bus (ADB) cable, which is supplied with the unit.

OTTO CONTROL

The OTTO system can be controlled from any device or software that can send MIDI Continuous Controller messages. The system also comes bundled with Mackie's *OTTOmix* automation software for the Macintosh (see sidebar "OTTOmix Automation Software").

You can quickly configure OTTO by pressing and releasing the Learn key on the Control Module, then sending it the MIDI Continuous Controller you wish to use to control channel 1. Once it sees this data, OTTO automatically assigns the next 23 consecutive Control Change numbers to the remaining fifteen 1604 channels. Aux 1 left and right returns, Aux 2 left and right returns, Aux 3 and Aux 4 returns (one controller per stereo return), and the Alt 3/4 bus. The next sequential Controller after this supports a joystick controller, which is used to fade from the current hardware "snapshot" (discussed shortly) to the previously selected "snapshot."

MIDI mute control is configured similarly; pressing the Learn key and sending OTTO a MIDI Note On message establishes that note as the base key, and the next consecutive 23 Note numbers are used for the remaining mutes. The channels and buses can be unmuted by sending the same note number again. A flashing LED on the External Control box indicates that

one or more mutes are on.

FUN WITH OTTO-MATION

Using the OTTO is a straightforward affair. For my initial tests, I controlled the automation with an Atari 1040STF (with 1 MB of RAM and no hard drive) running Steinberg's *Cubase* sequencer. I synchronized the Atari to a Mac IIci (also running *Cubase*) via MIDI Time Code. Although I could have done everything exclusively on the Mac, this system worked well, as I could dedicate the Atari to automation moves only, using *Cubase*'s handy graphic onscreen faders to send out the proper controller data. This allowed me to leave the faders up on the Atari's screen at all times, while the Mac concentrated solely on musical tasks.

If this setup seems extravagant, keep in mind that when performing a lot of automation moves in conjunction with a large MIDI sequencing setup, it is possible to clog the data stream. I found that having the OTTO-1604 on its own datastream provided optimum performance.

After connecting the Atari's MIDI Out to the OTTO's MIDI In, I was ready to roll. I started building up a complex mix, with many mutes and fader moves, recording the moves for each part of the song into *Cubase* in sections. OTTO handled the data quite well, with no perceptible quantization ("zipper") noise.

SNAPSHOT VS. REAL-TIME

OTTO can automate a mix in two ways:

Product Summary

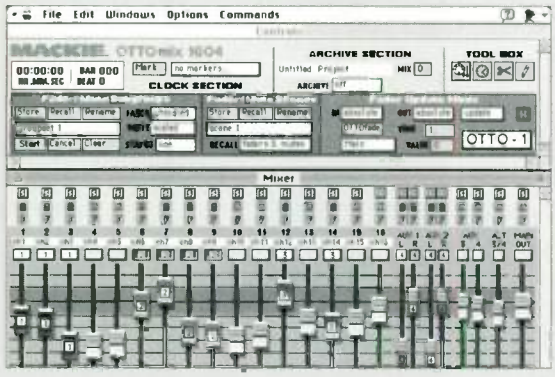
PRODUCT:
OTTO-1604 Automation System
PRICE:
$849
MANUFACTURER:
Mackie Designs, Inc.
12230 Woodinville Dr.
Woodinville, WA 98072
tel. (800) 258-6883
or (206) 487-4333
fax (206) 487-4337
BBS: (206) 488-4586

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

OTTOMIX AUTOMATION SOFTWARE (MAC)

Although I liked the hardware end of the OTTO package, the *OTTOmix* automation software for the Macintosh that is bundled with the system leaves much to be desired. Don't get me wrong; the software is free, so it's by no means a rip-off. It just doesn't work well.

From a conceptual point of view, the software is well designed. It provides fader modes such as Absolute, where fader moves are recorded exactly as performed, and Nulling, where the fader being updated only becomes active when it is moved through its last-recorded position. In addition, the software offers off-line editing, though using this feature is counterintuitive. You also get a variety of mix-archiving options, which let you keep each mix, every other mix, every third mix, etc.



Mackie's *OTTOmix* automation software is a *MAX* patch that provides several fader modes, off-line editing, and mix-archiving.

Unfortunately, *OTTOmix* was written as a "patch" for Opcode's *MAX*, an object-oriented, MIDI development environment. *MAX* is an excellent solution for many MIDI applications, and it's easier and faster to create MIDI software in *MAX* than in a higher-level language such as C++. But *MAX* patches of *OTTOmix*'s complexity heavily burden the Mac's CPU. This manifests itself primarily as very slow screen redrawing, extremely sluggish response to mouse movements, and general instability, particularly when the program is used in conjunction with a sequencer, running in the background under Apple's *MIDI Manager*.

OTTOmix is actually a special, run-time version of *MAX* that has the *OTTOmix* patch installed. Consequently, when you start up *OTTOmix*, *MAX* loads, then *OTTOmix*. The program takes more than 30 seconds to load on a Macintosh IIci and demands an inordinately large amount—minimum 4 MB—of RAM. If you are planning to run your sequencer and *OTTOmix* simultaneously and do complex, real-time mixes (especially on more than one CR-1604), a 33 MHz, 68040-based Macintosh is recommended.

I attempted to use the program in conjunction with Opcode's *Vision* 1.41 and *Studio Vision* 1.45 (without using digital audio) on a IIci with an Apple cache card and 20 MB of RAM, and I encountered nothing but problems. (I wanted to try it with Steinberg's *Cubase*, but Steinberg hasn't finished modifying its sequencer for *OTTOmix* compatibility.) *OTTOmix* crashed repeatedly when I tried to synchronize it to *Vision* using MIDI Clock by way of *MIDI Manager*. In fact, *OTTOmix* was so unstable and sluggish that I had an extremely difficult time just trying to test its features.

On the positive side, Mackie is developing a much more powerful automation-control application, which will be written in C++. It will be able to run on a Mac Classic II, will require less memory than the current software, and will have more features. The program won't be free, but I'd rather pay for a good, professional application than use the current freeware. Meanwhile, you can simply control OTTO with the virtual faders in a sequencer.

real-time automation (dynamic fader moves) or snapshot automation. With the latter approach, up to 80 different "snapshots" of the instantaneous positions of OTTO's faders can be taken, to be recalled using MIDI Program Change commands. OTTO also allows you to set up crossfades between snapshots, with an adjustable crossfade time from one to 30 seconds, in 1-second increments.

The main advantage to snapshots is that they create less MIDI data than real-time moves. The suitability of snapshots or real-time moves depends entirely on what you're mixing. They can be used together, so you're never forced to chose between the two.

▼ Using OTTO-1604 was a pleasure, with the exception of the *OTTOmix* software.

EVALUATION

Using OTTO-1604 was a pleasure, with the exception of the bundled *OTTOmix* software (see sidebar). The manuals accompanying the hardware and software are good, if a bit sparse. Most of the really important stuff, such as the Gain Cell installation procedure, is covered clearly enough.

I noticed one quirk in the way OTTO performs its unmutes via MIDI, though. Instead of instantaneously unmuting a channel, it seemed to do a quick "ramp-up" in volume, which made the unmutes feel sluggish, particularly with percussive material. Although Mackie claims that OTTO unmutes occur within four milliseconds, the review system took much longer (approximately 20 ms). This was by no means disastrous, just mildly inconvenient.

MIDI automation systems face inherent limitations, of which resolution

is the most apparent: Controller messages have a 128-step range, compared to the 4,096 steps found in many high-end, non-MIDI systems. Fortunately, Mackie has largely overcome this with a smoothing algorithm that interpolates between the 128 MIDI steps, letting the VCA ramp through all of its analog resolution. There's no zipper noise; in fact, OTTO may even be smoother than a stock CR-1604 without automation. The only limitation is that when setting a fader to a specific level (e.g., with a snapshot), you still have 128 points to choose from. At this price, I'll gladly accept that minor limitation.

If you do mixes that would benefit from automation and you already own one or more CR-1604s, I strongly suggest you look into OTTO-1604. Although there are other, less-powerful options (such as the Niche ACM and JLCooper MixMaster), the OTTO system suits the 1604 perfectly and can help you obtain polished, professional results with a minimum of hassle. ●

Circle #440 on Reader Service Card

Johnny C's Vintage & Custom Snare Samples

By Charlie Clouser

An amazing audio CD displays a flare for snares.

For some reason, the snare drum is the most scrutinized and sweated-over drum sound in many mixing situations. Engineers and producers are likely to spend as much time tweaking, sampling, and fiddling with the snare sound as they do setting up the rest of the drum mix.

If you want to achieve a realistic snare performance from your sampler, listen to Johnny C. Craviotto's *Vintage & Custom Snare Drum Samples* CD, distributed by KAT Electronic Percussion. This audio CD contains 797 samples of more than 30 different snare drums, from vintage 1920s Ludwigs to hand-made, custom piccolo snares built recently by Johnny C. These digitally recorded, realistic samples include some of the most well-tuned, well-cared-for snare drums you're likely to hear. The samples are in stereo and exhibit an unexaggerated stereo field that is more pronounced on the ambient hits, so most of the samples will sound good on a mono sampler.

The selection of snares includes eleven Ludwigs from the 1920s and 1930s; eight Slingerlands; a couple of WFLs, Gretsches, and Rogers; and eight of Johnny C.'s handmade snare drums. There is good variety here, with snares ranging from sharp piccolos with a nice, metallic "ding," to fat, marching snares with plenty of bottom, suitable for hard rock. What you won't find are heavily processed, drum-machine-like samples, gated snares, or massive stacked samples.

It is immediately apparent that Johnny C. knows how to tune a drum, which is more important in getting a good sample than the number of bits or the

Drum-maker Johnny C. Craviotto's *Vintage & Custom Snare Drum Samples* audio CD contains a stunning variety of well-sampled snare drums, played with an assortment of stick and brush techniques and digitally recorded in dry, natural room-ambience, and choked versions.

sampling rate. Each instrument obviously has been well-maintained by professionals. The samples are clean and quiet, and their volume has not been normalized, so the relative loudness of each sample in a set has been preserved.

The quality of the drum samples is excellent, but what sets this library apart from others is the variety of playing techniques that were recorded. For each drum, there are 24 samples, including hard and medium hits played with both the tip and blunt ends of the stick, brush hit, brush sweep, hit with sweep, rimshot, sidestick, soft hit, flam, and closed and open drum-rolls. In addition, the hard, medium, and flam samples are available in dry, natural room-ambience, and choked versions.

I've often made snare performance programs on my rig with ten or more samples of a single drum being hit different ways, but I've never seen such complete, well-matched sets of drum samples. The samples within each track sound like the same drum, but they each have recognizable characteristics that set them apart from the others.

A lot of care went into preparing and playing the drums and selecting Johnny C.'s snare samples, and with a little judicious mapping on your sampler you should be able to simulate the real thing extremely well. A 16-page booklet provides the history and applications of each drum. If you're after realistic raw material for snare mania, this one should be in your collection.

Charlie Clouser *is a producer and programmer in Los Angeles who already has far too many drum samples.*

Circle #441 on Reader Service Card

Product Summary

PRODUCT:
Johnny C's Vintage & Custom Snare Drum Samples
PRICE:
$179
MANUFACTURER:
KAT Electronic Percussion (distributor)
300 Burnett Rd.
Chicopee, MA 01020
tel. (413) 594-7466

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

BOSS SE-70 Super Effects Processor

By David (Rudy) Trubitt

This jack-of-all trades combines flexibility with quality sound.

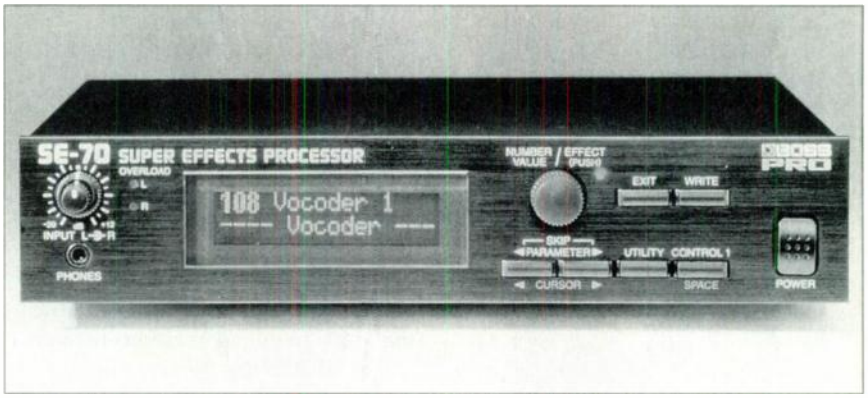
BOSS's SE-70 multi-effects processor is targeted at several applications. It can be used as an instrument-effects processor, plugged in-line between axe and amp, or in conjunction with mixer inserts or aux sends and returns. The true stereo, half-rackspace unit uses a hefty, 12 VAC, lump-in-the-line power supply.

All the expected instrument-oriented effects (and then some) are provided, including reverbs, delays, chorus, phasers, and flangers. You also get

compression; EQ; overdrive; distortion; amp and rotating speaker simulators; and even a non-MIDI, monophonic guitar synthesizer. "Vintage" effects include ring modulation, vocoding, and auto-pan/tremolo. For the recordist or live engineer, the unit also offers pitch-shifting; de-essing; limiting; and a stereo, variable-frequency hum-canceller (notch filter). Add a 2-second sampler, and you'll get an idea of how much this little box does. To top it off, Roland included a built-in tuner and metronome.

In all, the SE-70 delivers a total of 35 different effects and 45 different effect combinations, or algorithms. Some algorithms are simple, such as a stereo reverb followed by an equalizer. Others string together a maximum of sixteen different, simultaneously usable effects. Although the fixed order of effects limits the unit's flexibility, there are enough useful algorithms in the unit to deal with most situations.

You might not need all these features, but if your gear must serve multiple functions, BOSS's new device could prove a major addition to your toolkit.



Roland's BOSS SE-70 not only provides quality delay, reverb, chorus, flange, distortion, and pitch-shifting effects, but has special features such as vocoding, vocal elimination, and hum cancellation. An unusual addition is a pitch follower combined with an internal oscillator that emulates a mono guitar synth.

AUDIO I/O

The SE-70's two inputs and two outputs use ¼-inch connectors, and a single -20/+4 dBm switch regulates the basic input level. A front-panel, ⅛-inch mini-jack, headphone output is provided, along with a dual-concentric, L/R input-level knob and clip LEDs.

Audio input/output routings are determined by the current algorithm. Some algorithms work best connected to mixer channel inserts or plugged in-line with an instrument's output, while others should be connected to effects sends and returns.

The SE-70 can function in mono in/out, mono in/stereo out, dual mono, or true stereo configurations. In addition, some algorithms pair two effects (such as reverb, delay, pitch shift, chorus, etc.), feeding one effect from each mono input. The two effects can be routed to individual mono outputs—giving you two independent effects processors—or mixed to a common, stereo pair.

PRESETS

A generous menu of 145 preset programs is available. The first 100 are in user RAM, and the remaining 45 (one example of each algorithm) can't be overwritten. The unit is shipped with a bank of presets designed for a variety of instruments and recording situations. However, there is an alternate factory bank of all guitar-oriented presets.

The factory presets show off the unit to good advantage, but I quickly dove in and made my own. Any numbered range of factory presets from either bank can be restored, so you don't have to wipe out all your existing patches to recall a few presets.

EDITING SETTINGS

The front panel has only a few buttons for cursor control, storing, exiting, etc., but editing is greatly facilitated by a rotating data-entry knob. In addition to spinning, the knob can be momentarily pushed in. This accesses several shortcuts, such as changing parameters in tens rather than ones, changing letters from lower to upper case, and so on. When you're not editing, the knob toggles the effects bypass.

The SE-70 is easy to program, but any device this flexible requires some effort. Some effects algorithms were deliberately kept simple, but others provide access to many parameters (such as fourteen individual reverb settings). Shortcuts are available, but editing can still take a lot of clicking and twirling.

Two controller jacks grace the rear panel. The Remote/Expression Pedal jack allows you to use a continuous pedal to bypass a specified effect, or to make real-time parameter changes. The units Control 2/3 jack accepts a dual footswitch that allows you to step through patches or change between two parameter values.

In Edit mode, the 2-line, backlit LCD shows the various parameter values; otherwise, a user-definable preset name and its algorithm type are displayed. Using the entire second line for the algorithm seems somewhat wasteful; I'd rather see some parameters of the current preset (e.g., reverb time = 2.6) than just "St Reverb."

With this background in mind, let's look at some of the features of specific effects. Space won't permit a detailed look at all of them, but we'll hit the workhorses.

REVERB AND DELAY

I really like the reverbs. In my critical listening tests, I compared the SE-70's dedicated reverb algorithm to an old standby, the Yamaha SPX90. To my ear, the SE-70 wins that comparison easily. Long reverbs are smooth without the SPX's metallic edge, and small rooms are believable simulations, as opposed to a dense flutter of early reflections. You get a lot of parameters here, including pre-delay, early reflection,

high- and low-frequency damping, high- and lowpass filters, diffusion, density, and more. There also is a gated reverb and an ambient reverb that simulates the effect of a room mic, with independent control over direct and ambient sound.

The delay algorithm provides plenty of flexibility. You can modulate the delay time with an LFO (using a sine or triangle wave), invert the phase, feed the delayed signal back into the other channel, and much more. There's a 20-tap delay algorithm, with control over repetition rate, and Roland even included control over the ducker in one of the guitar multi-effects algorithms.

DISTORTION AND COMPRESSION

As with many of Roland's previous products, the BOSS SE-70 includes two distinct distortion circuits. My clear favorite is overdrive, which is capable of everything from light clipping to as much crunch as I ever use. (Overdrive is the only effect accomplished with analog circuitry.) The distortion setting produces a much buzzier, metallic sound. Maybe you'll like it; distortion is a matter of taste.

I have used BOSS compressors for years, with generally good results. However, my biggest complaint about earlier units (such as the GP-8) was the inability to trim input levels, causing excess compression with hot guitar pickups. The SE-70's front-panel input-level control helps that problem.

Product Summary

PRODUCT:
BOSS SE-70 Super Effects Processor
PRICE:
$895
MANUFACTURER:
Roland Corporation US
7200 Dominion Circle
Los Angeles, CA 90040-3647
tel. (213) 685-5141
fax (213) 722-0911

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

• SE-70

Furthermore, the SE-70 has a true limiter mode, complete with threshold, attack time, release time, and four different ratio settings. Limiter settings must be made by ear, as there is no metering to tell you how much gain-reduction is occurring. (The sampler module displays a VU meter; it's too bad that isn't available here.) That aside, the comp/limiter works well.

EQ AND SPEAKER SIMULATION

The SE-70 has a detailed equalizer in most algorithms. Four bands are available: fixed high shelf, fixed low shelf, and two fully parametric midrange bands, sweepable from 100 Hz to 10 kHz, with variable Q. All offer ±20 dB boost/cut. The only downside is the amount of button-pushing involved, as with most digital equalizers. Unfortunately, the only EQ parameter you can change via MIDI Continuous Controller is the overall output level. But you've got plenty of signal-shaping power, once it's dialed in.

Two amp simulators are provided. The guitar amp simulator offers four response curves simulating different amps, and the bass amp simulator offers three amp emulations. Only one guitar amp sound struck my fancy, but each has a distinctive sound, and they help smooth out the overdrive or distortion when running direct to the mixer.

MODULATION EFFECTS

Nice chorus and flanger sounds abound. Of particular interest is the Band Chorus, which splits the incoming audio into two frequency bands for separate processing. This can give instruments such as bass guitar a nice shimmer on their upper harmonics, with a different effect (or no effect) on the lows.

There is a good rotary-speaker effect. You can program slow and fast rotation rates, as well as the ramp time between the two, and switching between them can be done with MIDI or the rear-panel footswitch control.

The SE-70 has two dedicated pitch-shifting algorithms. The first is capable of adding twelve unique pitches to a mono source, each with separate pitch (±2 octaves), feedback, level, and pan. The second algorithm takes a stereo input and adds up to three new notes per side. Less extensive, but

capable pitch-shifting effects are also available in the multi-effects algorithm; in some cases, you can employ pitch-shifting at two different points in the chain. Pitch-shift quality is generally good, although you can run into particular notes that are shifted slightly out of tune, a common phenomenon.

ESPECIALLY COOL EFFECTS

A novel feature of the SE-70 is a Guitar/Bass Synthesizer effect that can be used with any monophonic pitch source. When you play into the SE-70, a pitch follower triggers the same pitch on an internal oscillator, which is shaped with filter and amplitude envelopes. Although monophonic, the performance is similar to what I've come to expect from typical MIDI guitar controllers. In other words, it's usable, but doesn't track perfectly. There's no way to trigger external MIDI sound generators or sequencers. Notes are not echoed to the SE-70's MIDI Out, and you can't drive the internal sound-generator via MIDI note messages.

Two vocoder algorithms are provided. In both cases, a mic is plugged into one input, your instrument into the other. The amplitude and spectral content of the mic signal is superimposed over your instrument's sound, producing a distinctive vocal effect. Ten- and 21-band versions are provided, the former with EQ, delay, distortion, chorus, and reverb, and the latter with chorus and reverb only.

WAIT! THERE'S MORE

The SE-70 offers some extra goodies worth noting. A vocal eliminator removes audio panned at any point in a stereo mix and outputs a mono mix containing the program material unique to the left and right channels. This works best on older records; on newer mixes with lots of stereo processing, vocals are rarely isolated in the center and can't be removed by this technique. The eliminator includes a 1-octave pitch-transposer.

Another algorithm pairs a stereo hum-canceller with a noise suppressor. The hum (notch) filter defaults to the U.S. standard, 60 Hz AC line frequency, but it can be tuned to remove hum from tapes that play at a slightly different speed, or to deal with non-U.S. line frequencies (i.e., 50 Hz). The filter is effective but to my surprise, it is not included in any of the guitar multi-effects, which seriously undercuts its usefulness.

Two seconds of sound can be sampled by manual or automatic input-signal triggering. The sample can be automatically played back, forward or backward, using a footswitch or MIDI note message. Sampled audio cannot be stored.

A footswitch-controlled Auto-Feedback effect detects the current note and fades in a feedback-like note of the same pitch (or an octave higher). However, the "feedback" has its own LFO-driven vibrato, which virtually negates the already minimal realism of the effect. I'm surprised Roland didn't just implement this idea using the guitar synthesizer, so feedback pitch would change with string vibrato.

MIDI AND REAL-TIME CONTROL

Real-time control of effects is an area of particular interest to me. I find it far more musical to purposely shape the sound of effects, rather than switch something on and walk away. Real-time control offers this capability but is sadly underutilized by most manufacturers.

The SE-70 does an adequate, if limited, job of real-time control. Up to four sources (including continuous or momentary controllers) are available per patch. These can be supplied via MIDI or through an optional CV expression pedal. A good assortment of scaling, polarity, and latching/momentary modifiers are provided. I have no complaints here.

Each real-time source can be routed to one destination. Individual effect levels, on/off status, and master volume are the most common. Turning on or off individual effects (when not changing presets) happens without any audio glitch or interruption. This alone should make you want to use these features. While changing presets, the SE-70 momentarily mutes its output.

Four real-time control inputs proved barely enough for me. (Keep in mind, I'm a control fanatic.) For instance, one source can't be sent to two destinations. At least one algorithm cries out for this: the guitar algorithm with two parallel effect chains, one clean, one dirty. It's an excellent idea, because you can switch or crossfade between the two, but that takes two of the four sources.

Most unfortunate is the SE-70's inability to change settings such as delay or reverb time in real-time. Roland's philosophy seems to be, "If adjusting a parameter in real-time makes a glitch, don't let them do it." This is my single biggest reservation about the unit. I want to be able to change each and every parameter in real-time, and I don't care if it sounds weird.

AUDIO QUALITY

The SE-70 offers very good sound quality, an observation borne out by the published specs. These include 16-bit A/D (64× oversampling) and D/A conversion (8× oversampling), with either a 48 kHz or 32 kHz sampling frequency, depending on the complexity of the algorithm used. Guitar effects are all sampled at 32 kHz, while the dedicated single or dual effects (and one multi-effects preset) are sampled at 48 kHz. Frequency response is rated at 10 Hz to 15 kHz (±3 dB) at the lower sampling rate and extends to 22 kHz at the higher rate.

The dedicated algorithms are clean and quiet. As you might expect, the multi-effect chains are somewhat noisier, especially when using effects like compression, overdrive, and distortion. However, a noise suppressor (downward expander) helps keep a lid on things.

SUMMARY

I would prefer a more robust real-time MIDI implementation and the ability to create my own effect algorithms. But aside from that, I unhesitatingly recommend the SE-70. This box does a huge variety of jobs—for all kinds of instruments—and can proudly sit in live-performance *and* recording rigs.

I'm impressed with the SE-70; it's amazingly compact, easy to use, and sounds very good. On top of that, the SE-70 definitely has the Roland "feel." If you've liked the company's previous efforts, as I have, you won't be disappointed.

David (Rudy) Trubitt *is a freelance writer, jack-of-audio-trades, and acknowledged real-time effects-processing junkie.*

Circle #442 on Reader Service Card

Digidesign Turbosynth SC (Mac)

By Tim Tully

A venerable and unique sound-creation program is reborn.

Digidesign's *Turbosynth SC* for the Macintosh is the latest incarnation of a long-time favorite of sound designers and sampler owners. This ingenious program lets you create new sounds that no other software and few pieces of hardware can even approach.

Turbosynth (previously reviewed in the November 1988 **EM**) is modeled after modular, analog synthesizers, in which you create a sound by patching the output of an oscillator module through modules such as filters and amplifiers. These components are modulated by envelope generators, LFOs, or other voltage sources, until you have the sound you want.

The difference is that the old synths concatenated physical, electronic modules made of wires, resistors, and other hardware, while *Turbosynth* operates entirely in software. It lets you use digital waveforms and sampled sounds, sophisticated software algorithms, and the DSP chips on Digidesign's many sound cards to realize its patches.

The latest version of *Turbosynth* has several new highlights: the ability to record, play, save, and load samples in both stereo and mono; a cool Diffuser module; and an intimate connection to Digidesign's SampleCell. A new memory indicator shows you how full the application's RAM allocation is. The lowlights include copy protection and the fact that *Turbosynth* no longer communicates with external samplers. (Upgrades from the earlier version are $29 for U.S. and Canadian users and $49 for foreign users.)

CENTER STAGE

Turbosynth presents one main window that provides an overview of a patch and a lot of supplemental windows that give you more detailed access to each module (see **Fig. 1**). The main window includes a palette of tools for two different kinds of functions. Four "administrative" tools let you play the sound; get info; and click, drag, and erase icons. However, the real action lies in the remaining tools, which represent sound-source modules, sound-modifying modules, a mixer, and a patch-cord tool with which you connect sources, modifiers, mixer, and output.

To start the process, drag an Oscillator or Sample module into the main window, then drag envelope-controlled Amplitude and Filter modules, Resonance Generators, Pitch Shifters, Delays, Time Stretchers and Compressors, LFO-type modulators, Mixers, and a few more arcane processors, link them all together in any number of configurations with the Patch Cord tool, and connect the whole thing to the Output Jack. You can program each module—to an occasionally bewildering degree—and tweak so deeply as to delight even the most hopelessly studio-bound dweeb.

You can play the resulting sound through the Mac speaker using Apple *Sound Manager* software (not recommended for any serious work, due to the Mac's poor sound quality), or any

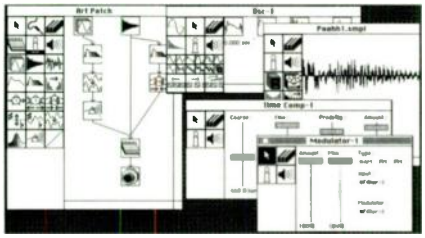


FIG. 1: The modules in the main window (left) can be opened into their own windows (right), providing control and information.

Digidesign sound card, including SampleCell (either version) or the Sound Accelerator. The "output" of your patch can be saved as a *Sound Designer II* or AIFF file and used in any sampler into which you can load these file types (more on this later). I wish it also saved files in MIDI Sample Dump Standard (SDS) format, which would enhance the program's flexibility.

Getting familiar with the modules' many functions is not a trivial chore; they are sophisticated and abstract. Nonetheless, a lot of the concepts involved are no more exotic than envelopes and filters, and anyone with an affinity for synthesizer programming should be able to come up with all sorts of useful patches and sample-enhancements fairly quickly. For those of you who want to dig deep into digital sound-design, though, this is the place to be.

THE MODULES

The Oscillator, Sample, and Noise modules are the three basic sound sources in *Turbosynth*. The Oscillator is extremely flexible. When you open it, you see a time line, with which you can make a sound's duration as long as RAM permits. You then drag waveform icons to any point on the time line. The waveform icons include eleven presets and a file icon that provides access to any custom waveform you have designed and saved (see **Fig. 2**). When you play the Oscillator, it crossfades smoothly from one waveform to the next, at rates determined by where they sit on the time line. However, there is no way to specify other crossfade times and curves.

The preset waveforms vary from simple to fairly complex, and the crossfading can create subtle or obvious changes in harmonics and dynamics. You can even open any waveform icon and substitute other waveforms, or

modify the current waveform with a variety of tools. Any waveform you create, import, or modify can be saved for future use.

The Sample tool is similar to the Oscillator, but instead of using single-cycle waveforms, it lets you import *Sound Designer II* or AIFF files. (I wish SDS files were included here, as well.) You can edit the samples in many ways, including simple looping, crossfade looping, and pitch shifting. A new feature lets you create an Oscillator that generates a series of single-cycle waveforms extracted from the sample. This Oscillator is a rough, synthetic-sounding abstract of the original waveform and provides an excellent way to generate sounds that combine both artificial- and organic-sounding elements (see **Fig. 3**).

The Noise module produces a sine wave you can distort by rapidly varying its amplitude, phase, or any combination of the two. This produces noise with a large spectrum of colors and tonalities, all under your control. Followed by a Filter or Amplitude module, this can become an effective sound element.

Once you've established a sound source, it can be patched through various processors, some familiar and others less common. The envelopes in the Amplitude and (lowpass) Filter modules have eight preset shapes and six tools that globally change the envelope shape. You can manually add as many breakpoints as you like and can even connect two identical Filter modules in series to enhance the effect.

The Delay module acts just like a standard delay unit, with feedback, polarity, wet/dry mix, and coarse and fine delay controls that produce a delay of up to one second, in increments of 0.1 milliseconds. The Pitch Shifter module globally shifts the pitch of its input up or down by as much as two octaves, in cents, and plays any mix of the original and detuned sound. The Pitch Envelope module adds dynamic pitch changes over a total range of two octaves.

The Modulator module can be an LFO that slowly alters a sound's amplitude or pitch, or a high-frequency modulator that performs FM synthesis, rapidly changing a waveform's frequency to alter the timbre. It can use any of the waveforms in the Oscillator module and yields some extremely

complex modulation effects.

The Time Compressor shortens any sound you send to it. The Stretcher resynthesizes and lengthens a sound by looping several small sections in succession. You can set the Stretcher to cause minimal distortion, or really whack the sound out of recognition, depending on your mood. The Resonator acts just like the resonance control in an analog filter, enhancing a small band of frequencies surrounding a specified frequency.

The remaining modules are at the cutting edge of audio adventure. The Spectral Inverter radically shifts the frequencies of a waveform's partials in one of two ways, both of which are much too technical to even think about here. Suffice it to say they can both yield bizarre and wonderful effects. The Waveshaper modifies an input sound with a transfer function that changes the instantaneous level of each sample point according to a curve in the Waveshaper window. The Waveshaper offers eight preset curves, ten shaping algorithms, and a pencil to draw or redraw the curve. Like the Spectral Inverter, you have to hear this to get any sense of it, although it can be thought of as an unusual distortion module.

The new Diffuser lets you create some good-sounding reverbs. This may be the most challenging of the processors, offering a fascinating insight into the creation of digitally generated reverb and requiring serious concentration and critical listening to master. On the other hand, you can use the included reverb examples as easily as adding another Oscillator.

The Mixer accepts up to 32 inputs that are mixed to one output. It sends this combined signal to the Output Jack, which sums all inputs to a mono or stereo sound file.

NEW STUFF

Among the most valuable new features is a set of fourteen example patches with nearly 40 pages of theoretical and practical documentation. The examples and tutorial are the work of Digidesign's Charles Maynes, who has designed some amazingly complex and great-sounding patches. Not only do they provide insight into good uses of the application, but they also give you patches you can use right out of the box by plugging in your own samples

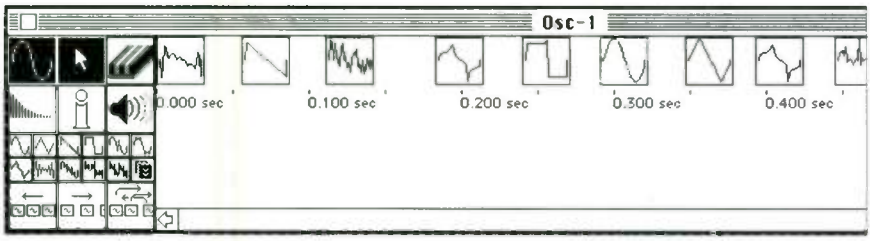


FIG. 2: The Oscillator module crossfades between many standard and custom waveforms.

or otherwise modifying them. The tutorial analyzes the examples and discusses their possible uses, in addition to providing rare insight into the theory of digital reverb and other effects, which can be very useful to sound designers. Check out the Hall Reverb (see **Fig. 4**) and Demented Bells patches for some very chilly sounds.

The other major change in *Turbosynth* is its monogamous relationship with Digidesign's sample-playback card, SampleCell. Previous versions of *Turbosynth* could send files to a number of different samplers, but Digidesign found it untenable to support the ever-growing number of sampler formats and drivers. (This is similar to Passport Designs's experience with *Alchemy*.) As a result, *Turbosynth* saves patches in its own format, or the "output" of its patches as *SD II* or AIFF files. (Of course, people who own *Alchemy* can use it to send these files to the samplers supported by that program, or those that use SMDI or SDS.)

Digidesign also has a positive rationale here: The company is gradually building their product line to form a complete recording studio in a Macintosh. This includes a suite of hardware and software that performs all the functions of a studio that fall between the microphone and MIDI keyboard on one side and the tape deck or hard disk on the other. The new *Turbosynth*/SampleCell integration is just one step toward that all-digital future, and frankly, it works well.

If you have a SampleCell card in your Mac and you run *Turbosynth* and the *SampleCell Editor* simultaneously, you can take advantage of some pretty slick automation. Whenever you save the output of a *Turbosynth* patch, the Mac uses Apple Events to automatically load the file into SampleCell as a new multisampled instrument. You can immediately play the sound from a MIDI keyboard hooked up to SampleCell. *Turbosynth* can also automatically update SampleCell with any subsequent changes you make to the file.

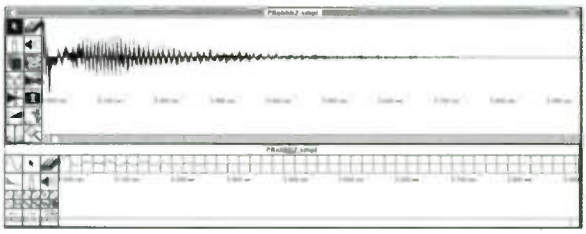


FIG. 3: A sample of the author saying "pa-a-h-h" (above) and the oscillator waveforms extracted from it (below), which sounds like a cartoon robot saying "Bying-ah-ao-ow-wo-ing."

Although I was leery at first, I had no problems working this way. It was

Product Summary

PRODUCT:
Turbosynth SC
PRICE:
$349
SYSTEM REQUIREMENTS:
Mac II; System 7.0 or later; minimum 5 MB RAM; 8 MB RAM and Digidesign sound card highly recommended
MANUFACTURER:
Digidesign
1360 Willow Rd., Suite 101
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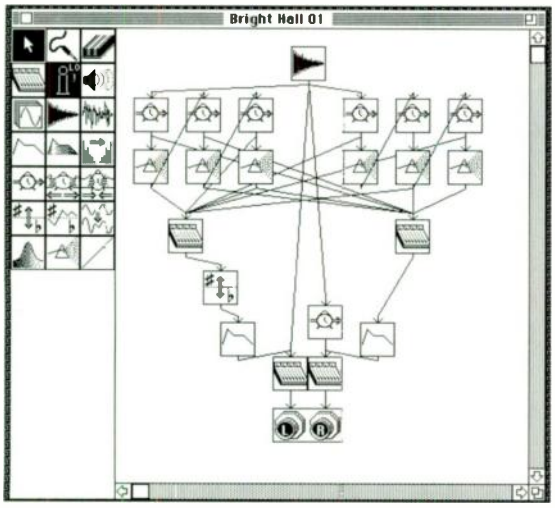

FIG. 4: The Bright Hall example patch. This is why it's so hard to find a digital reverb that sounds good.

quick and easy to set up a SampleCell instrument, and the process gave me excellent aural feedback while programming a patch. Digidesign's use of Apple Events also allows other properly endowed applications, such as Jupiter Systems's *Infinity*, to work with SampleCell in the same manner.

CONS

I found few shortcomings to the application. When you play its sounds through a SampleCell card from the Mac (not from a MIDI keyboard), there's an annoying delay before and after the sound plays. Apparently, this occurs because *Turbosynth* loads the sound into the SampleCell RAM and erases it after it plays. No delay occurs when playing through a Sound Accelerator card from the Mac.

Turbosynth is a real memory hog, because each module in a patch creates its own sound file. Just to load the Demented Bells example file, for instance, I had to quit *Turbosynth* and specify a 6 MB RAM allocation in its Get Info box. I also found that setting the memory allocation was occasionally dicey, and I often had to restart the Mac to make the change stick.

Otherwise, *Turbosynth* works essentially as advertised. It's important to understand one conceptual point: Despite the analogies between many *Turbosynth* modules and time-domain synth/sampler controls—Modulator, Pitch Envelope, etc.—the program leaves real-time processing to your sampler. It only delivers a basic sample, which can include loop points.

Most importantly, the samples it delivers can be unlike those derived from any other source. If you're serious about sound design, creating your own sampler sounds, or even making some unique modifications to your existing sample library, it would be hard to go wrong with *Turbosynth*.

(For *Turbosynth* programming ideas, see "Turbosynth Tips," in the August 1989 **EM**.)

Tim Tully *produces music and designs sounds for multimedia and CD-ROM. He is also the co-author of two new books:* MIDI for the Professional *and* The Audible PC.

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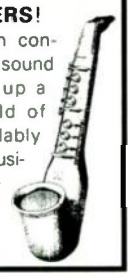

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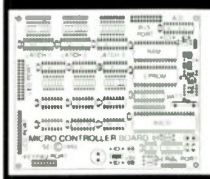

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PRO FILE

Six Strings In Stereo

Alex de Grassi's acoustic alchemy.

By Daniel Levitin

Certain experiences changed the way I would hear music for the rest of my life. The first time I heard The Beatles; the first time I heard a Cannonball Adderley solo; and the first time I heard Alex de Grassi.

As a guitarist, when I hear other guitarists, my attention is usually distracted by thoughts of how they're fingering something or what notes they're playing. But not so with de Grassi. His notes wash over me, flowing in a stream of pure music. De Grassi draws me into his music so completely, I can never stop to ask, "How did he do that?" His facility led one admirer, Tom Wheeler of *Guitar Player*, to note, "His technique is the kind that shoves fellow pickers to the cliff of decision: Should I practice like a madman or chuck it altogether?"

On his latest album, *The World's Getting Loud*, the timbre of de Grassi's guitar is warm and pellucid, his sound built around careful selection of instruments and artful mic placement. His mic techniques have undergone continual refinement throughout fifteen years of recording. One thing that's remained constant, however, is stereo close-miking, in order to record the fullest frequency range possible.

"I use one mic pointed at an angle somewhere at the bridge; the other is near where the neck joins the body, around the 12th or 14th fret. The tail ends of the mics are both facing away from the sound hole," notes de Grassi. "The lower mic picks up the resonance of the guitar; the neck mic tends to get the attack. With more percussive playing, that region becomes more critical." He avoids miking the soundhole to avoid proximity effects and the unpleasant sound of air movement.

De Grassi explains that with proper mic placement and hard stereo panning at the mixdown, "The listener will get a sense of the guitar as having a spatial aspect in which what's coming out of the two speakers represent the ends of the guitar." When the speakers are far apart, the guitar fills the entire room.

On his last two albums, the guitars were miked with B&K 4011 cardioids, which he praises for their full and rich low end. On earlier albums he used AKG 451s and various old Neumann and AKG tube mics. "On 'Doorman Blues' [on *The World's Getting Loud*] I used my old Washburn guitar with light strings, and we recorded with a couple of old tube mics."

Squeaks are often the nemesis of the guitarist and the recording engineer, but they are almost entirely absent from his albums. The secret? "Well, I tried Fingerease 25 years ago but decided I didn't want to put that stuff on my guitar. It's hard to eliminate squeaks completely, but with years of practice, you can reduce them quite a bit. Still, on some pieces I squeak more than others." And the guitarist provides a cautionary note for mixing, "Squeaks that start out little can sound *huge* when you put reverb on them."

Knowing how to mic, manipulate, and tweak your equipment is certainly one way to exercise control over your music, but the one factor *most* responsible for the sound is the player. As Alex de Grassi's success illustrates, practice like a madman or chuck it altogether, but never settle for complacent mediocrity.

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

Alex de Grassi

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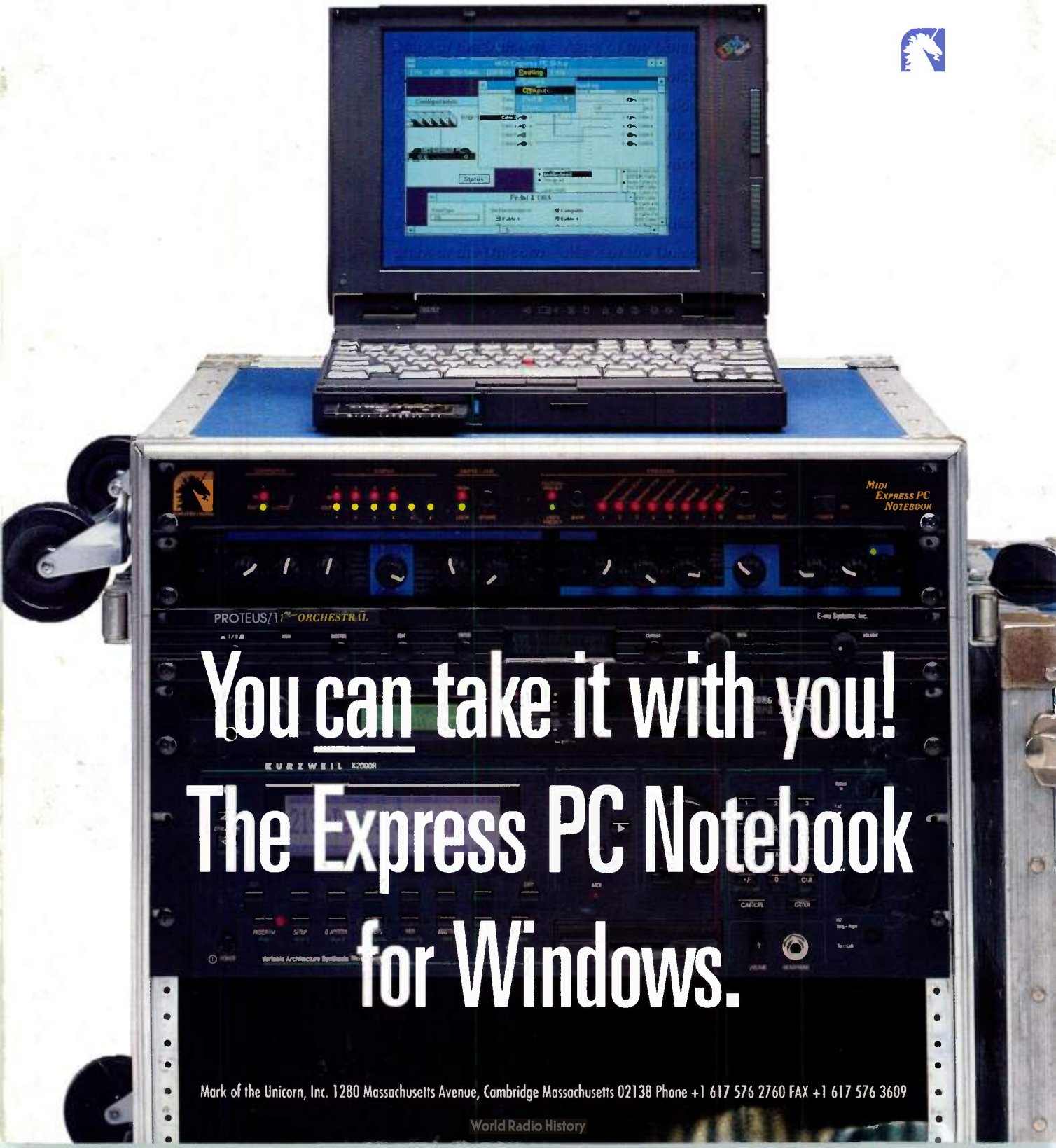

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