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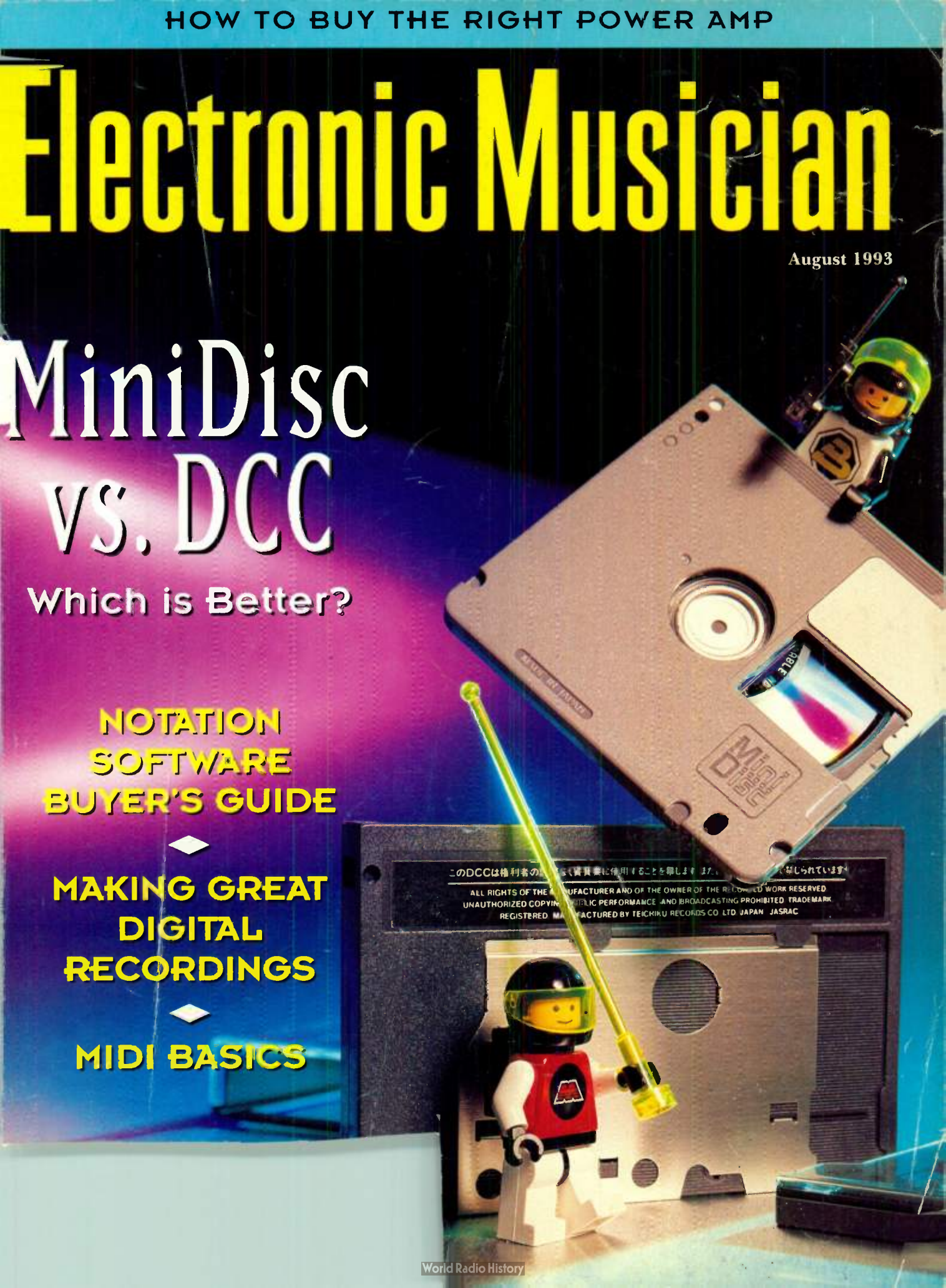
Electronic Musician

August 1993



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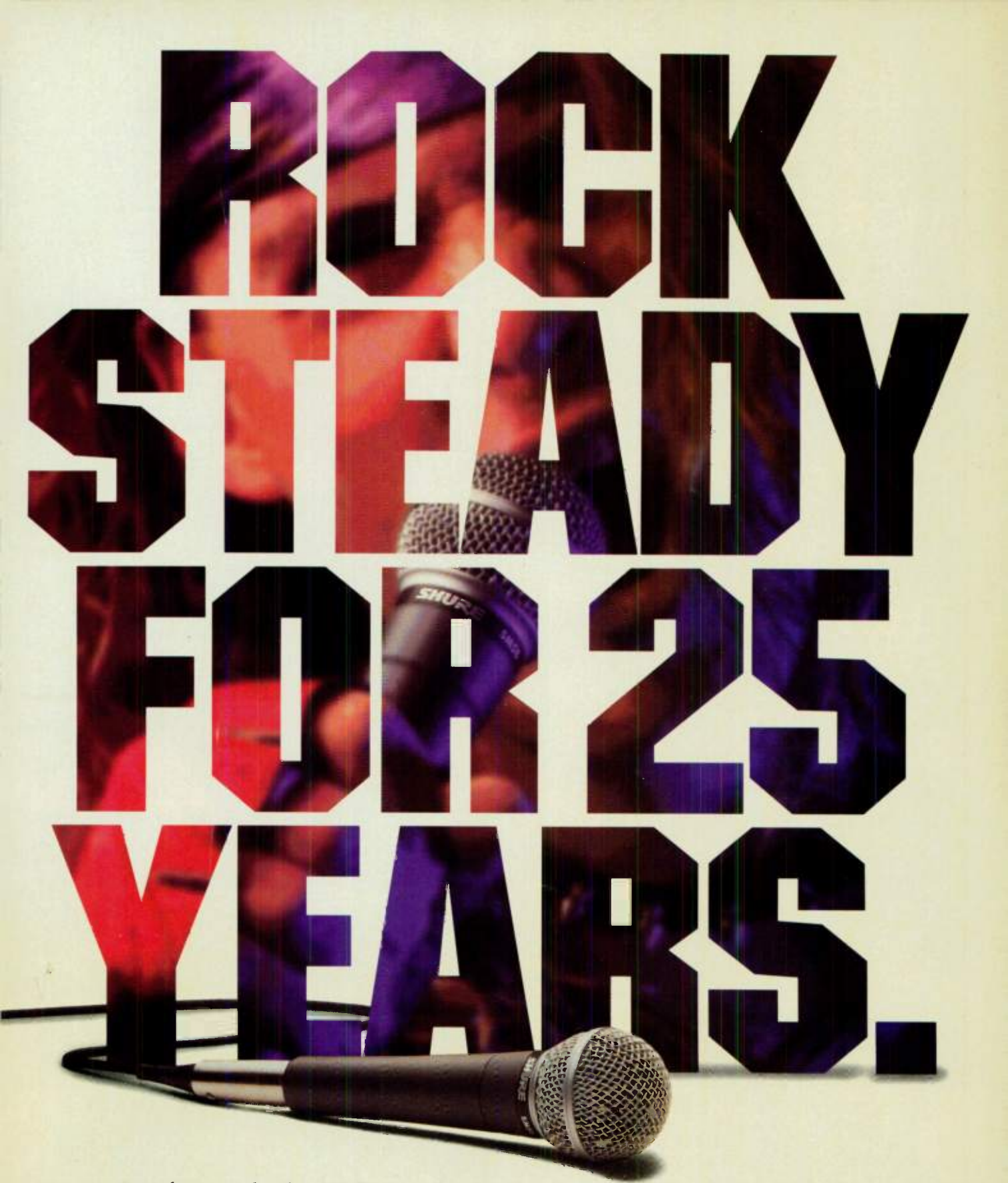

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Cover: Photo by William Zemanek.
Special thanks to Evan FitzGerald.

Computer Notation

Putting notes on the screen isn't easy, but it could be better.

ANNE HAMERSKY

As we proceed further into the computer age, we run into more conflicts between human thinking and computer operation. Initially, people were willing to accept the idiosyncrasies of computers because they recognized the benefits of learning how to operate the new machines. As time went on, however, users demanded more intuitive, human-oriented operation. The results were graphic user interfaces and other refinements that attempt to bridge the gap between how humans think and how computers work.

Music software is an excellent example of this conflict. As a classically trained musician, I generally think in terms of traditional music notation. Consequently, my first encounter with early music software (most of which offered simple sequencing) was fraught with confusion. I did not understand the concept of a sequencer, what it meant to record performance "events," or why the display on the computer screen *wasn't* standard music notation. I wanted to see notes, slurs, ties, and dynamics.

The problem is, although it is a rich language, standard music notation is an inexact, incomplete, distinctly human way of representing musical ideas. Most of its glory is a result of that "inexactness." A printed page of music doesn't come to life until a performer *interprets* the notation, a skill for which the human brain is eminently well-equipped. On the other hand, a MIDI sequence is a very precise, exact representation of a musical performance. It is also typical of the precise language used by computers and software.

The potential for conflict arises when a computer tries to convert the precision of MIDI sequences into the imprecise language of music notation. This conflict is also evident when classically trained musicians try to make the conceptual leap between precise MIDI sequences and music notation. The solution to the problem is a good translator—in this case, a MIDI-based, music-notation program.

Music-notation packages have been around for several years; according to **EM**'s latest reader survey, it's the fastest growing category of music software. There has also been a dramatic increase in the number of products available and the number of manufacturers selling them. Our buyer's guide to notation software (see "Modern Manuscripts" on p. 30) includes 43 programs from 21 manufacturers, as opposed to 31 programs from 19 manufacturers two years ago, and more are in the works. Notation-based editing now appears in most sequencing programs, as well.

These developments have led to a wide variety of sophisticated programs. But notation software is still curiously deficient in some fundamental ways. Many programs lack functions that are essential to create correct music notation. For example, piano music commonly uses cross-staff beaming and cross-staff slurs, yet many programs don't include these capabilities because they are considered "too advanced."

In some instances, it seems that program designers work from spec sheets as opposed to considering real-world applications. Instead of learning what features people need to create popular types of music, they incorporate features designed to impress. For example, a cool chord-analysis feature is of less value if you don't have a complete selection of chord symbols from which to choose.

If you're in the market for notation software, define the type of music you wish to work with, determine the capabilities you need to create that music, and compare the resulting list to the features found in the current crop of products. If you're like me, you'll find this to be an interesting exercise. Good luck, and happy hunting.

Bob O'Donnell

Electronic Musician

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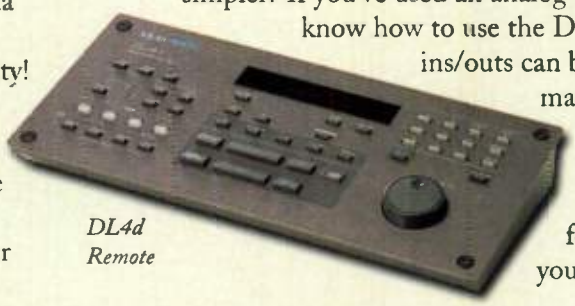
3. JOG/SHUTTLE Another cool DR4d advantage is the ability to offer scrubbing of audio, like "reel-rocking"on analog decks - only with much better quality. Our Jog/Shuttle wheel lets you scrub through the audio at various speeds, forwards or backwards. So finding precise editing points is only as complicated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

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



DL4d Remote

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

ɔse the DR4*d* Hard Disk Recorder

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

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

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

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LETTERS

AURAL THRILLS

In "The Thrill of Adventure" from your June 1993 issue, there was a reference made to *binaural recording*. I mailed for a tape of this technique five or six years ago when it was known as *holophonics*. The effect was unbelievable. It was basically virtual reality in the audio realm. I thought this technique would surface in everything from music to movie production, but I haven't heard it mentioned since. Is binaural recording available to the public yet, and why has it not become the "wave of the future" as I thought it would?

Jeff Hadden
Kansas City, MO

Jeff—I, too, was knocked out when I first heard binaural recording. As you point out, little binaurally recorded material is reaching the marketplace. One reason is that you must listen to binaural recordings on headphones. Playing such recordings on conventional speakers destroys the subtle effect.

Binaural recording is well-suited for acoustic environments such as live concerts and ambient sounds, but it doesn't work well for multitrack studio recording. In this environment, many instruments are recorded without any acoustic sound at all, and others rely on close, multiple mics to achieve a certain sound. Since most commercial music is recorded this way, it is doubtful that binaural recording will become commonplace any time soon.

Although it seems to envelop the listener in a 3-D sound space, binaural recording doesn't qualify as true virtual reality. If you move your head around while listening to sound in an acoustic environment, your perception of the sound changes, allowing you to pinpoint the location of the sound source. If you move your head around while listening to a binaural recording, the sound doesn't change at all.—Scott W.

STRANGE PORK

My recent subscription to your magazine came about for two reasons. First, I want to read about synthesizers, MIDI equipment, and ways to make the best music using them; and second, comparing your magazine to others I've read, yours had the advantage of being consistently cleaner in its language. Also, you have not used your magazine as a political platform to write about the environment, and a minimum amount of space is given to glorifying the philosophies/lifestyles of people who I do not want to think or live like. I appreciate this about your magazine. You *do* use people in the music industry to help your readers understand how to produce professional sounds.

All of this is to preface a small worry that you might be beginning to lean away from this outlook with the last page of your June 1993 issue ("Pro/File") addressing the work of Primus. Why? They are strange, and maybe that is what they really want to be known as. But I think it's because a subculture has developed philosophies to justify strangeness, and people such as those in Primus have taken on this manner of living because of a fear they will not be accepted as anything else but strange. Now with a larger audience willing to actually listen to them, and magazines willing to do write-ups on them, they will be able to allow strangeness to grow to proportions they would have otherwise avoided. *And* make a living doing it.

I want to encourage you to continue with the writing that drew me to subscribe to your magazine in the first place. I do enjoy reading it.

Steven Slaughter
Mountain Home, ID

Steven—I'm glad you appreciate our efforts in making EM *informative and pleasing to read. You are right: We do not try to endorse or glorify any particular philosophy or lifestyle. Reporting on different or "strange" music styles is not the same thing as endorsing them, any more than a newspaper article covering violent crime endorses such acts. Columns such as "Pro/File" and "Working Musician" give us the chance to share different musical perspectives and styles with our readers. It is not our intention to offend, but rather to expose* EM *readers to new ideas.—Mary C.*

ROOM FOR IMPROVEMENT

Jules Ryckebusch's article, "Build the EM Phantom-Power Mic Preamp" (April 1993) was interesting and informative. Please allow me to point out two errors, however. First, the voltage gain of the first stage is 10, not 20. With a maximum second stage voltage gain of 100, the total maximum gain would be 1,000 or 60 dB, not "in excess of 60 dB." The second error is that the output polarities shown in the schematic are reversed, which could lead to phasing problems.

I would also like to make a few suggestions to improve the EM preamp circuit. The input coupling capacitors, C18, 19, 22, and 23 put the low frequency -3 dB point at 37 Hz and with a 20% capacitor tolerance, this could go as high as 45 Hz. Changing to 10 µf caps will lower the -3 dB point to 18 Hz, 21 Hz maximum. I would also recommend placing 470 pF, 5% capacitors in parallel with resistors R10, 11, 25, and 26 to prevent RFI (Radio Frequency Interference) problems. This will drop the maximum gain -3 dB point to 24 kHz, still within the audio band.

Finally, I feel a little uneasy about the 20 kHz, 12-volt signal of the phantom power supply near the low-level audio circuits. If component tolerances drop this down to 17 kHz, my old ears won't hear it, but most of your younger readers will. Changing C9 to 150 pF will raise the switching frequency to about 30 kHz, 26 kHz worst case. Even my dog Corkey won't hear that.

Every month's new EM is enjoyable, so keep those good articles coming.

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

AD McCAULEY

Author Jules Ryckebusch responds: *Thanks for your comments on the project. I agree with all of them except the one about the gain of the first stage. Your calculation would be right if you grounded one of the inputs and used it as an unbalanced amplifier. However, because it is a true differential input, there is an extra gain of two along with the normal gain of ten associated with input and feedback resistors. Regarding your suggestions for the circuit, the 10 µf caps you mention will give the preamp lower frequency response. Typically, electrolytic capacitor values run higher than rated specifications (+80%/-20%). My real tradeoff here is with DC leakage. I wanted to avoid having to trim a DC offset if the input capacitors "leaked" differently. Finally, the neat part of the circuit is the switching power supply. I wasn't sure if this would work at first and was very pleased when it did. The key is that no matter what the switching frequency is, you must prevent it from getting into the audio stage, because it will be amplified. The PC board available from PAiA Electronics is designed with attention to good grounding techniques, so it avoids this problem. My prototype has separate breadboards for the audio and power supply. Also, I haven't noticed an RFI problem, but the capacitors you suggest will prevent it.*

The article on Mac sequencers ("State-Of-The-Art Sequencing," May 1993) was very informative, but neglected an important factor in choosing and using a sequence package. How much power in the Mac itself is needed to run the software efficiently? Not all of us own a Quadra, and an important consideration is how the software runs on various Macs and whether some packages are more effective, responsive, and faster than others on older or entry-level Macs with 68020 processors. Few of us can afford to upgrade our equipment after spending $500 or more on a new software package. Can we get some follow-up on recommended minimum Mac configurations and a comparison of how well they function with various packages?

John Ungaretti
San Francisco CA

John—Believe it or not, all Mac sequencers (with the exception of those that support digital audio) will run fine on Mac Pluses or higher. Of course, there are benefits to running on faster machines—the screen redraws faster, edit operations are performed more quickly, etc.—but for the essential task of recording and playing back MIDI messages, even venerable Pluses, SEs, and Classics will do the job. As far as comparing the performance of each sequencer on various Mac models, that is beyond the scope of the article's intentions (and our testing resources).—Bob O'D

I am writing to you for two reasons. First, in regards to an error that Michael Molenda made in his article "Making A Music Video" (May 1993). Michael referred to a Key Grip as a Props Person. This is far from true. A Key Grip is one whose main task is camera and set rigging, not props. Key Grips, Props People, and film unions would be very upset with that kind of mis-classification.

Second, I would like to voice my opinion in regard to "Computer Musician: Virtual Music" by David Cope in the same issue. Sorry, but there is one negative aspect not explored in the article that may very well

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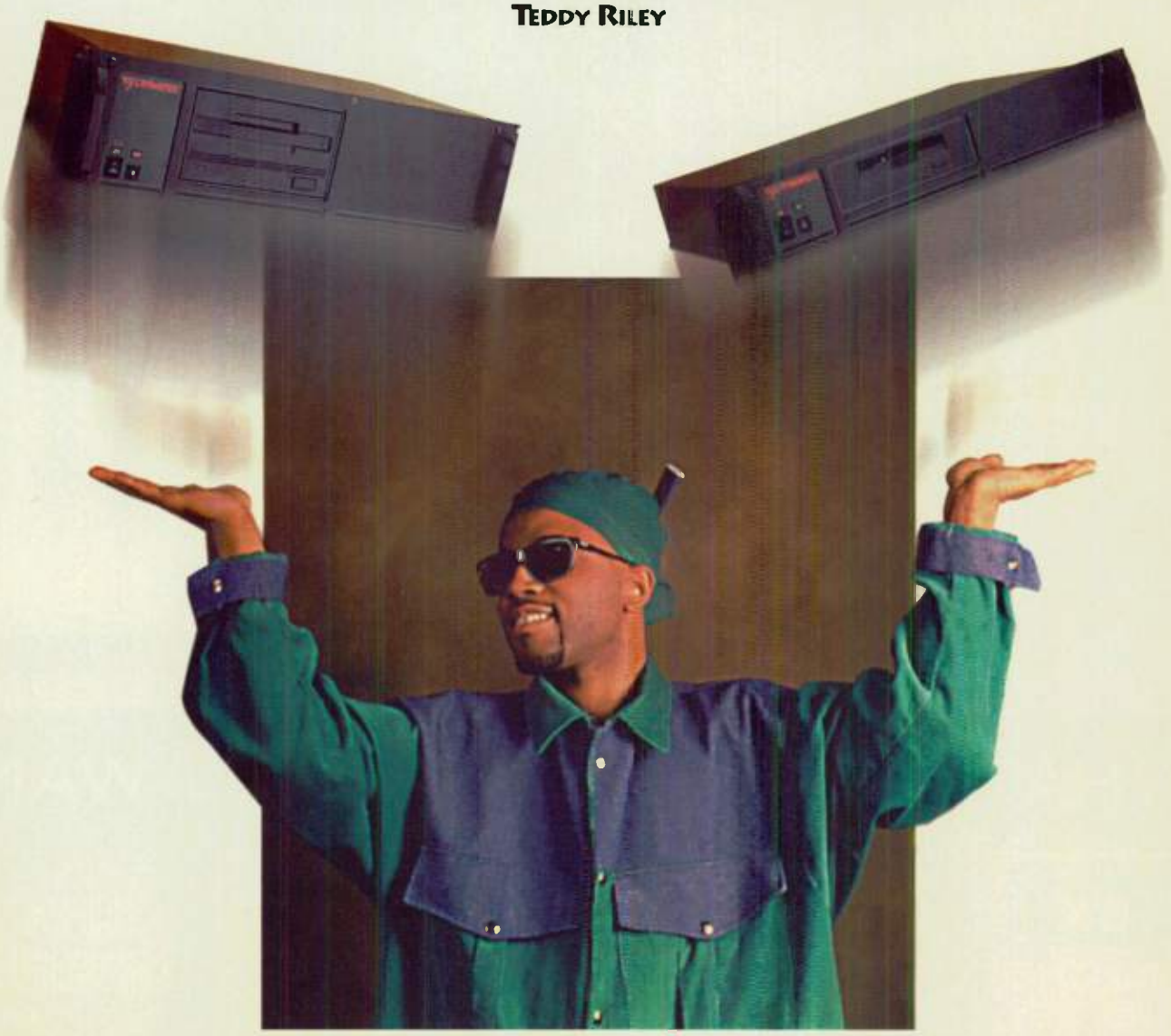

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outweigh the positive. If virtual music becomes readily available, eventually the human composer (good or bad) may become extinct.

Just remember what happened with the calculator. It's now considered acceptable to use one in our schools, and the art of performing calculations in one's head is rare. Have we become so dependent on technology that we lose sight of the whole purpose of composing music, that is, to convey emotions through the use of sound? What next, a "Virtual Lyrics" program?

John A Shaw
Toronto, ON, Canada

THE TV AGE

I am interested in using some of my music material for radio and TV commercials. I am doing a lot of field work and networking trying to find information, and thought that you would have information about this business, and/or direction that you might steer me in.

If you know of some publications that may focus on this area of interest and some associations that I should be aware of, I would greatly appreciate it.

Jon Coble
Tracy, CA

Jon—Unfortunately, as far as I know, no ad industry publications are available that will help you network. My advice is to produce a demo video with brief snippets of your work replacing the original underscores of national and/or local TV ads. (Because this is a personal demo and not a commercial product, you shouldn't have to worry about copyright infringement.) Then, call the ad agencies in your area and try to get a meeting with a creative director. If the director likes your work, he or she might keep you in mind for appropriate commissions. Believe it or not, many of these people are hip and approachable. Good luck!—Michael M.

HERE'S AN IDEA

I continue to be a happy subscriber to **EM**, and I have a thought on how to make it better. Have you considered including a CD with your magazine to give demos of what you discuss in your articles?

It has always seemed to me that a magazine about music without sound would be like reading about a painting without being able to see the picture. Words just don't cut it.

Keep up the good work.

Henry Domke
New Bloomfield, MO

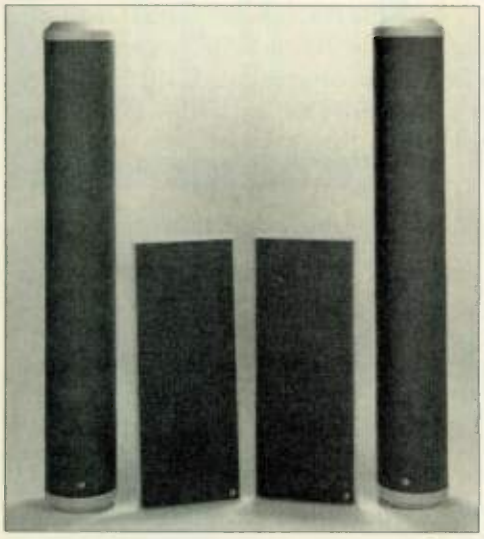
Henry—I, too, would love to see sound incorporated into the magazine, but the economic realities (as well as shipping difficulties) of such an undertaking currently prohibit us from including an audio CD with each issue of **EM**. *Who knows, though? Someday you may receive* **EM** *on CD-ROM, complete with audio and video examples.—Bob O'D.*

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.*

▼ ASC STUDIO TOWER/STUDIO PANEL

Acoustic Sciences Corporation introduced two acoustic control products that can be used together or separately to improve the acoustical characteristics of the small to mid-sized studio. The Studio Tower ($899/set of six) is a 6-foot tall Tube Trap, ten inches in diameter, that controls low-frequency resonance down to 90 Hz. One side is diffusive above 400 Hz, so the amount of absorption versus diffusion can be controlled by rotating the trap. ASC recommends the Studio Towers be placed in the corners of a room, though they can also be centered between monitors to create a distinct stereo image.

The Studio Panel ($299/set of eight) is a flat, 14 x 36-inch wall panel designed to reduce midrange and high-frequency reflections from front and side walls. ASC also offers special monitor stands, in 11-inch ($449) and 16-inch ($599) diameters, which are available in any height up to four feet. The stands are broad-band absorbers designed to clean up mid-bass resonances that develop between the floor and speaker. One side of the stand is a midrange diffusor to improve imaging. ASC provides a free analysis of your studio to ensure correct use and placement of Studio Towers and Panels. Acoustic Sciences Corporation; tel. (800) 272-8823 or (503) 343-9727; fax (503) 343-9245.



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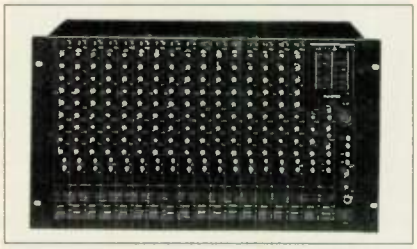
▼ MIDI SOLUTIONS MIDI PROCESSORS

MIDI Solutions is shipping eight specialized, palm-sized MIDI processors. The Router ($59) is a 1 x 2 splitter that routes selected MIDI data types—including notes, Poly and Channel Pressure, Control Change, Program Change, Pitch Bend, SysEx, and System Real-Time—on all or selected channels, to either output. The device stores up to ten routings and can be programmed via SysEx. The Merger ($59) combines two MIDI datastreams, while the All-Notes-Off filter ($49) removes Control Change 123 commands. The Mapper ($59) remaps Control Change, Program Change, Channel Pressure, and Pitch Bend messages, on all or selected MIDI channels. It stores up to ten maps and can be programmed via SysEx.

The Velocity Converter ($59) supplies 40 preset Velocity curves and can assign a different curve to each MIDI channel. A user-definable curve can be sent to the unit as Continuous Controller data from a sequencer, and the unit can be programmed via SysEx. The Relay ($99) controls an electric relay switch (attached with a ¼-inch phone jack) using Note, Control Change, Program Change, or SysEx messages and can be preset on or off for each patch. Up to ten note or Controller messages can be recognized on all or selected MIDI channels. MIDI Solutions also makes a Footswitch Controller ($79) that sends MIDI messages from a momentary footswitch and a 2 x 1 Thru box ($29). MIDI Solutions; tel. (800) 561-6434 or (604) 794-3013.

Circle #410 on Reader Service Card



▲ SAMICK RU-6162

Samick is shipping the RU-6162 16-channel mixer ($1,100). The 6U rack-mount board offers XLR and ¼-inch inputs (switchable) on all channels; defeatable, +48V phantom power; 3-band channel EQ with sweepable mids; PFL monitoring; channel mutes; three aux sends (switchable pre/post-fader), with master level pots; and four stereo aux returns. All aux sends and returns use RCA connectors. TRS ¼-inch insert jacks are provided on all channels and the main L/R bus; RCA inserts are provided for the aux sends. The main L/R output bus uses both XLR and ¼-inch jacks. Signal-to-noise ratio is rated at 65 dB (mic input) and 69 dB (line input); THD at 0.3%; and frequency response at 20 Hz to 20 kHz (-5 dB). Samick; tel. (818) 964-4700; fax (818) 965-5224.

Circle #411 on Reader Service Card

▲ TECH 21 SANSAMP GT2

Tech 21 has added the SansAmp GT2 ($195) to its line of tube-amp emulators. The battery-powered floor device lets you use slider switches to choose guitar-amplifier type (California, British, or Tweed), modification (Hot Wired, Hi Gain, or Clean), and speaker-cabinet mic placement (Off Axis, Center, or Classic). It also offers knobs for level, drive, and high and low shelving EQ. Tech 21; tel. (212) 315-1116; fax (212) 315-0825.

Circle #412 on Reader Service Card

NOW AVAILABLE
The New ASR-10 Rack-Mount

EXPLOSIVE FEATURES!

The ENSONIQ ASR-10 brings the features you've always wanted to a sampling workstation.

Announcing the latest *ENSONIQ boom*–the new ASR-10 Advanced Sampling Recorder. With features like stereo sampling, dynamic effects processing, time compression/expansion, an integrated sequencer and 31-note polyphony, ENSONIQ brings innovation to the world of sampling– *again.*

To start with, the ASR-10 supports up to 16 megabytes of sample memory–eight times the memory of our previous sampler, and uses industry-standard SIMMs for easy expansion.

For on-board effects, the 24-bit digital effects processor has 50 algorithms, many derived from the DP/4 Parallel Effects Processor. Input sampling is easily routed through the effects processor. You can re-sample in stereo through the effects, and even process external signals while you play live.

And for drum loops and other time-based samples, use the ASR-10's time compression/expansion facilities to change the length of a recording without changing the pitch.

The ASR-10 Rack-Mount has all the power of the keyboard version plus eight outputs and a SCSI interface.

The ASR-10's quad-density (HD) disk drive increases storage capacity and speeds load times. Add the optional SP-3 SCSI interface, and you can connect up to seven hard drives and CD-ROMs for easy access to an extensive library of sounds.

Together with a flexible, integrated 16-track sequencer, Poly-Key™ Pressure keyboard and Performance Presets that provide instant recall of sound combinations, you have one powerful workstation.

Harness the power of an ASR-10 for your music. Play one today at your Authorized ENSONIQ Dealer. For the one nearest you, call 1-800-553-5151.

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THE TECHNOLOGY THAT PERFORMS

Please send me more information on the ☐ ENSONIQ ASR-10 Also, please send me information on ☐ ENSONIQ Synthesizer Workstations ☐ DP/4 Parallel Effects Processor

Name Address

City State Zip Phone ( )

Mail to: ENSONIQ, Department E-34, 155 Great Valley Parkway, P.O. Box 3035, Malvern, PA 19355-0735

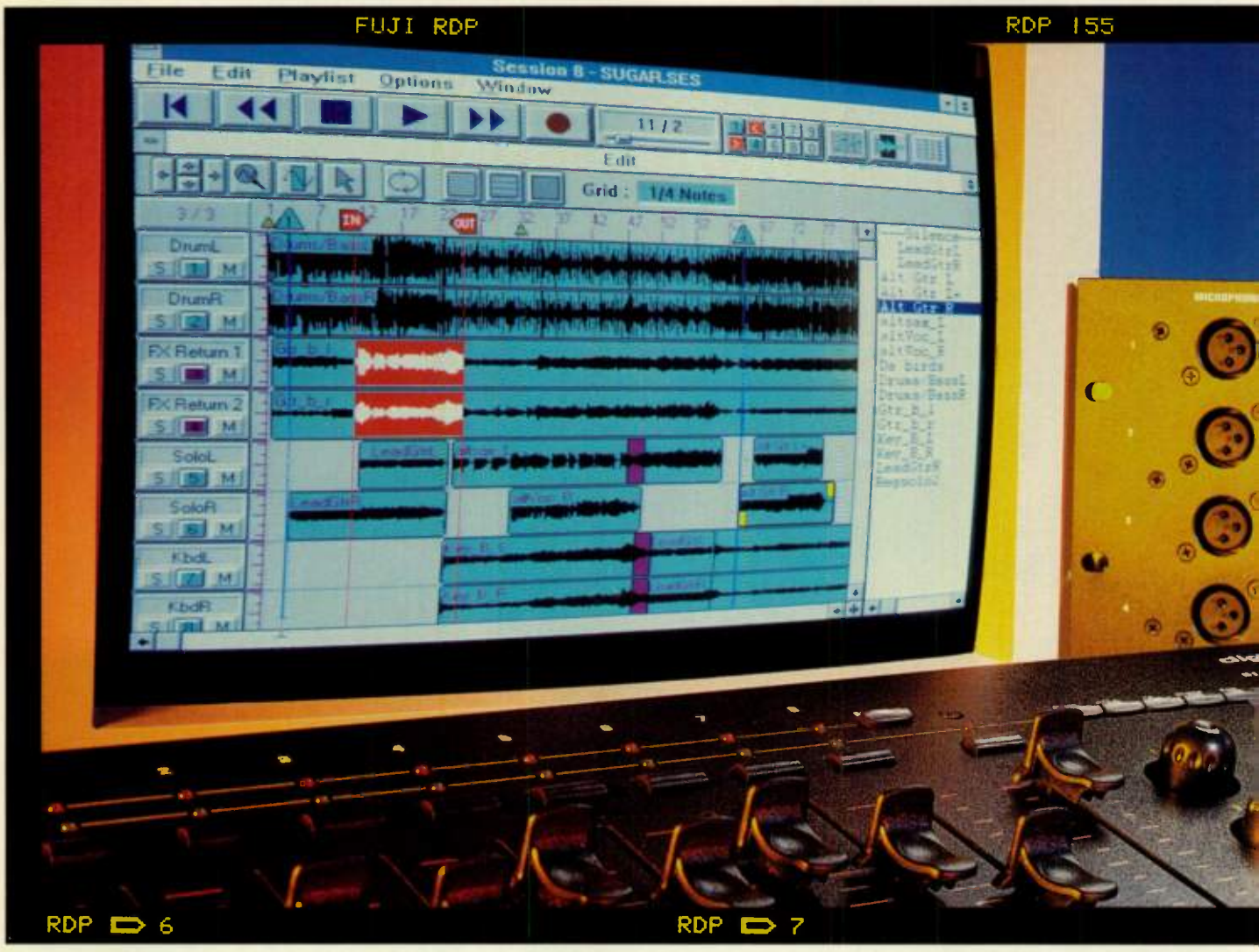
SQ-1 32 Voice Personal Music Studio

SQ-2 32 Voice Personal Music Studio

KS-32 Weighted Action MIDI Studio

DP/4 Parallel Effects Processor

SQ-R PLUS 32 Voice Synthesizer Module



WHY JUST RECORD WI

SESSION 8: PROFESSIONAL-QUALITY MULTIT

AS A SERIOUS MUSICIAN, YOU PUT EVERYTHING INTO YOUR MUSIC. IN YOUR studio, you make the rules. You're the producer, and you know exactly what you want—nothing short of excellence. The ultimate sound. The ultimate take. The ultimate mix. Digidesign Session 8™ was made for you.

Session 8 gives you the kind of sophisticated audio production power you've been seeking to create music that's a cut above the rest. While most of today's multitrack digital recorders do just one thing—digital recording—Session 8 gives you a complete state-of-the-art audio production system featuring direct-to-disk multitrack recording, digital mixing and track bouncing, MIDI sequencer integration, and music's most exciting digital technology: random-access editing. These tools allow you to record, arrange and finesse your music with an unbeatable combination of ease, flexibility and precision, like no tape-based digital recorder can. For professional-quality music production at home, there's only one choice: Session 8 from Digidesign.

FREE WORKSHOPS

See firsthand how Session 8 can put your home studio on the cutting edge of music production. **Call (800) 333-2137 ext. 226** and we'll sign you up for a free Session 8 workshop today.

TN YOU CAN PRODUCE?

CK DIGITAL RECORDING, EDITING & MIXING

SESSION 8 FEATURES

- Eight discrete tracks of digital audio for flawless, CD-quality recording
- Non-destructive cut, copy and paste digital audio editing for creative sequencer-style track composing and arranging
- Unlimited digital track bouncing for recording infinite layers of first-generation-fidelity instruments and vocals
- Automated digital mixdown via Windows-compatible MIDI sequencers for producing precise digital master mixes and submixes
- MIDI sequencer support for synchronized digital audio and MIDI recording and playback
- On-board digital EQ for extremely high-fidelity tonal sculpting
- Non-destructive auto-punch recording for error-free overdubs

Session 8 is being hailed by critics and users alike as the one of the most exciting digital music production systems available today:

"...as a creative tool, Session 8 shines. The power of digital audio can be extremely intoxicating when you create incredible solos, bounce single voices into gigantic choirs, and shift chorus and verse around with a few mouse movements."

Craig Anderton, EQ magazine

digidesign

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B3 IN THE PALM OF YOUR HAND

Frustrated with the less than adequate organ sounds produced by digital synths: don't want to break your back lugging the old "B" around? You crave the B3 sound with all of the sonic imperfections that give it its unique character, but need it in a more convenient and economical package. Sure other synths have sounds that sort of resemble the B3 sound, but none, except for the VOCE DMI-64 Mark II, has ever come close. Until the MICRO B.

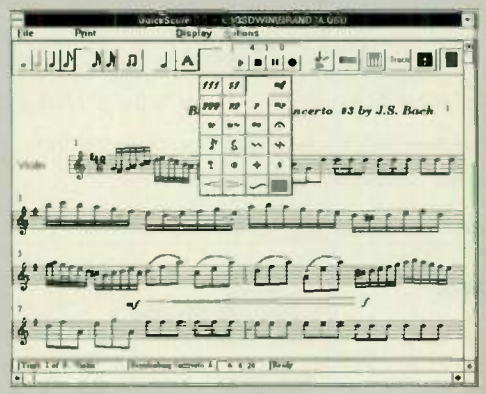
Like the DMI-64 Mark II, the MICRO B was designed with the purist B3 player in mind: unlike its predecessor, the MICRO B is real easy to use. It requires absolutely no programming. There are front panel rotary controls for volume, key click, and overdrive, plus separate controls for percussion volume and decay. Even the original B3 didn't have that. It has a built-in rotating speaker effect (front panel and foot switch controlled) with a simulated upper and lower rotor which speeds up and slows down just like the real thing. The MICRO B lets you select three levels of chorus or vibrato and comes with 36 of the most popular drawbar settings. In addition, the MICRO B can operate in three part multi-timbral mode for any three adjacent channels as well as MIDI OMNI mode. There are high level stereo audio outputs, one of which may be used for headphones. All this makes the MICRO B very easy and intuitive to use, and isn't that the way things ought to be? Visit your Voce dealer and listen to a demo today.

The MICRO B puts the sound of a B3 in the palm of your hand, for under $500.

MICRO B ORGAN MODULE

VOCE, INC. 111 TENTH ST., WOOD-RIDGE, NJ 07075 201-939-0052

REV UP ▲ ▲ ▲ ▲ ▲



▲ DR. T'S MUSIC SOFTWARE

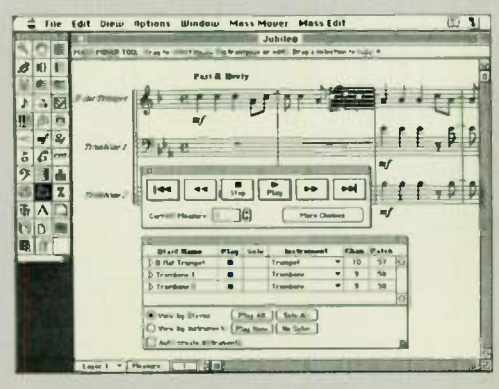
Dr. T's Music Software has released *QuickScore Deluxe for Windows* ($149.95), a *Windows* 3.1 version of the company's user-friendly notation program. Notes can be drawn in with the mouse, or recorded in real or step-time with a MIDI controller. The program displays and edits up to sixteen staves, places text anywhere in the score, and can use any *Windows*-compatible printer that prints TrueType fonts. It supports MPU-401 MIDI interfaces and most *Windows*-compatible sound cards. Dr. T's Music Software; tel. (617) 455-1454; fax (617) 455-1460.

Circle #413 on Reader Service Card

▼ CODA MUSIC TECHNOLOGY

Coda Music Technology announced *Finale* 3.0 for Macintosh ($749; upgrades $99), a major upgrade to the company's flagship notation program. The user interface has been redesigned, with configurable, floating tool palettes; on-line help; more one-step functions; and 28 new score templates for band, choral, church, orchestra, and small instrumental groups. You can open any number of scores at once and any number of views of a single score; see each document window in Page or Scroll view, with separate magnification and measure location; cut, copy, and paste between open windows and multiple documents; select part of a measure for editing; and automatically stack or "tile" open windows on the screen. A new object-oriented drawing program lets you draw and edit your own musical shapes and includes predefined Smart Shapes on a floating palette. Version 3 also offers tape transport-style playback controls. System 7 support has been enhanced: *Finale* is 32-bit clean, supports Apple Events, and includes both TrueType and PostScript Type 1 fonts. The documentation is new. Coda Music Technology; tel. (800) 843-2066 or (612) 937-9611; fax (612) 937-9760.

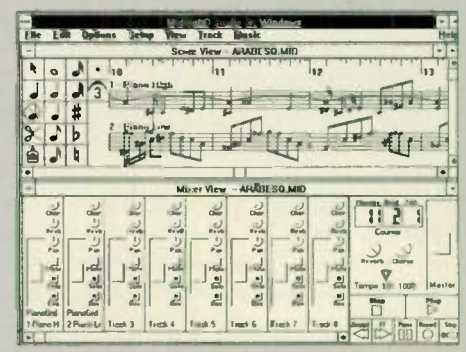
Circle #414 on Reader Service Card



PASSPORT DESIGNS

Passport Designs is shipping *Producer Professional* ($1,495; upgrades free) and has lowered the price of 1.0 to $149. The new version of the Macintosh multimedia production and synchronization program implements a library of user-definable buttons to create interactive links, "go to" commands, and loops, which can be nested. Buttons are transparent, so anything can become a button. The program now provides path-based animation of any object: text files, animation files, *QuickTime* movies, etc. It offers device control for Sony VISCA, Pioneer Laser Disc, and MIDI Machine Control. In addition, version 2.0 can generate and read SMPTE time code. Other new features include support for TIFF files, a collection of over 40 transitions that users can apply to slides and graphics, and enhanced overall performance. Passport Designs; tel. (415) 726-0280; fax (415) 726-2254.

Circle #415 on Reader Service Card



▲ MIDISOFT

Midisoft is offering *Studio for Windows* 3.10 ($249.95; updates free). Version 3.10 adds a Mixer view in which instruments can be assigned to tracks, with control of level, pan, chorus, reverb, solo, and mute, as well as tape transport-style controls. The updated program offers click-and-drag editing in Score view, supports the *Windows* Clipboard, and adds an Undo feature. Time signatures have been expanded to include numerators of 1 to 16 and denominators of 1, 2, 4, 8, or 16. Score resolution has been increased from sixteenth to 64th notes, and triplets are displayed and printed. Up to twelve tracks can be printed per page, and tracks can be auto-transposed in half-step increments. A user-selectable Humanize function can be applied to any quantized region. The context-sensitive, on-line help has been expanded to include introductions to notation and MIDI, including General MIDI. Midisoft; tel. (206) 881-7176; fax (206) 883-1368.

Circle #416 on Reader Service Card

Automatic Accompaniment has arrived – ...and just got better with Version 5

BAND-IN-A-BOX™

INTELLIGENT SOFTWARE FOR IBM (DOS & WINDOWS), MAC & ATARI

Type in the chords to any song, choose the style you'd like and Band-in-a-Box does the rest...

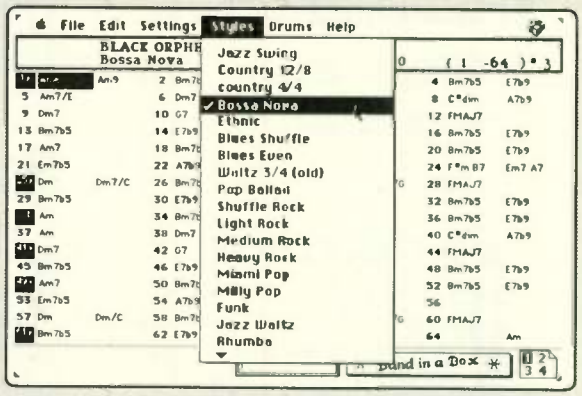
Automatically generating professional quality five instrument accompaniment of bass, drums, piano, guitar & strings in a wide variety of styles

24 Styles built in...

Jazz Swing • Bossa • Country • Ethnic • Blues Shuffle • Blues Straight Waltz
Pop Ballad • Reggae • Shuffle Rock • Light Rock • Medium Rock • Heavy Rock
Miami Sound • Milly Pop • Funk • Jazz Waltz • Rhumba • Cha Cha • Bouncy 12/8
Irish Pop Ballad 12/8 • Country (triplet)

Version 5: 2 more instruments + built-in sequencer...

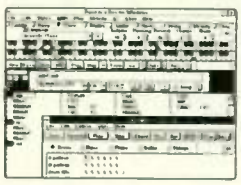
The built-in sequencer lets you record melodies (or buy our MIDI-FAKE-BOOK disks which include chords & melodies). Also make your own 5 instrument styles using the StyleMaker™ section of the program – or edit our styles to your tastes. Now there are 5 accompaniment instruments (including guitar/strings). General MIDI standard implementation (even for old synths). Plus 70 other new features!



NEW! Band-in-a-Box Pro for Windows $88

The award winning Band-in-a-Box automatic accompaniment program is now available for Windows 3.1. All of the features of the DOS version, plus much more including...

- *The "Wizard" (intelligent playalong features)*
- *background playback in other programs*
- *support of all MultiMedia drivers (Roland MPU401, Soundblaster, MultiSound, AdLib, TG100, etc.)*
- *copy MidiFiles to Clipboard to paste into other Windows music programs*
- *onscreen toolbar, full mouse support*
- *fully featured Windows interface*
- *all files fully compatible with DOS, Mac & Atari versions!*



UPGRADE OFFER FOR EXISTING BAND-IN-A-BOX USERS:
Basic upgrade to Band-in-a-Box Pro for Windows – $29
Complete Upgrade including new 5 instrument styles disk #4 – $49

BONUS!! Band-in-a-Box IBM version now includes BOTH the Windows AND DOS version for the same price!!

STYLES DISK #4 (Mac/Atari/IBM) $29

34 Hot new styles for Band-in-a-Box

We've made our best styles disk ever, most utilizing 5 instruments at a time. (bass/drum, piano, guitar and strings) This disk Supercharges your Band-in-a-Box program!!

9 NEW JAZZ STYLES !
(Charleston, Dixieland, Fats Waller, Jazz Quintet, Jazz Fast, Lui Prim Style, Tango, Jaco 5, ChaCha 5)

8 NEW COUNTRY STYLES !
(Chet, Cryin, Country Ballad, Country Contemporary, Floyd Piano, Ozark, Folk, J Cash 5)

7 NEW POP STYLES !
(Breezin, Larry, Grover, Kladrman Piano, St. Elmo, Yesterday, Georgia Style, On BoardWalk)

4 NEW "OLD POP" STYLES
(Supremes, "Sam Cook " Style, J B Goode, Fats D)

6 NEW ETHNIC/MISC. STYLES
(Gumbo, Klezmer1, Klezmer2, March_12, March_16, Mozart)

WE DIDN'T SAY IT... PC MAGAZINE DID!

– FINALIST –
PC Magazine Award for Technical Excellence

AFTER HOURS/ENTERTAINMENT
Band-in-a-Box
PG Music

"This amazing little program from PG MUSIC creates "music-minus-one" accompaniments for virtually any song any style. You simply type in the chords, pick a tempo and one of 24 styles, and the program creates nicely embellished chords, a bass part, and drums to be played on a MIDI synthesizer. Band-in-a-Box understands repeats, choruses and verses, and even varies the accompaniment, just as human musicians would. Peter Gannon, the author of the program makes no claim to artificial intelligence, but Band-in-a-Box is software that repeatedly surprises and delights you, especially in its jazz styles."

PC MAGAZINE Jan. 15, 1991 – Technical Excellence Awards

DownBeat – the #1 Jazz Magazine says...

"Band-in-a-Box is the most significant contribution to Jazz Education since Jamey Abersold Records."

"Band-in-a-Box is an amazing program"
KEYBOARD MAGAZINE Aug. 1992

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

Band-in-a-Box Prices

New customers

Band-in-a-Box Standard Edition (24 styles)	*$59*
Band-in-a-Box PRO version (75 styles)	*$88*

(BONUS!! Band-in-a-Box IBM version now includes BOTH the Windows AND DOS version for the same price!!)

Upgrades & add-ons

Upgrade or Crossgrade (Windows/DOS/MAC/ATARI)	*$29*
("CrossGrades" are for users who need a version for a different type of computer)	
Midi-FakeBook with melodies (100 songs on disk)	*$29*
Styles Disk #2 (25 new styles for Version 5)	*$29*
New! Styles Disk #4	*$29*
Any 2 of Above	*$49*
Any 3 of above	*$59*
(eg. Upgrade to Windows + Styles Disk #4 = $49)	

Requirements:

IBM-DOS: *640K, MIDI interface or soundcard (MPU401 SCC1 Mediator SC 7 TG100 Yamaha C1 Voyetra VAPI, Adlib)*
IBM-Windows 3.1: *2mb memory. Any MIDI interface or soundcard.*
MACINTOSH: *2mb memory, system 6 or 7 (reduced version for 1mb available)*
ATARI: *1040ST/STE/MEGA/TT (reduced version for 520 users available)*

From PG Music... The makers of The Jazz Guitarist, Band-in-a-Box, PowerTracks, The Pianist

☎ *Phone orders:* ***1-800-268-6272*** *or* ***1-416-528-2368*** *VISA/MC/AMEX/cheque/mo/po# Fax 1-416-628-2541*
(to hear recorded demo 1-416-528-2180)

PG Music Inc. 266 Elmwood Avenue Suite 111 Buffalo NY 14222

PG Music announces... The Pianist™

An Exciting New Music Program for Windows & Macintosh!

A MUSIC PROGRAM CONTAINING A HUGE COLLECTION OF OVER 200 OF THE WORLD'S MOST POPULAR CLASSICAL PIANO PIECES, PERFORMED BY WORLD-CLASS CONCERT PIANISTS!

PLUS... Music Trivia Game, "Guess the Song", Program Notes, Biographies, Music Dictionary (all on disk).... and much more.

All the pieces have been recorded "in real time" by concert pianists on an 88 note weighted MIDI piano keyboard. They are never quantized or step recorded. All are complete artistic performances professionally performed, recorded and saved as Standard MIDI files. You'll hear the music playing with CD-quality through your sound card or MIDI system, just as if the pianist was in your home.

ALL YOUR FAVORITE PIECES SUCH AS...
Moonlight Sonata, Sonata Pathetique, Claire de Lune, Liebestraume, Minute Waltz, Mephisto Waltz, Islamey, Hungarian Rhapsody, Flight of the Bumblebee, Nutcracker, Fantasie Impromptu, Military Polonaise... and over 200 more!!!

ALL YOUR FAVORITE COMPOSERS...
Greatest works by Bach, Beethoven, Brahms, Chopin, Debussy, Fauré, Granados, Grainger, Grieg, Haydn, Liszt, Mendelssohn, Mozart, Mussogorsky, Prokofiev, Rachmaninov, Ravel, Satie, Scarlatti, Schumann, Schubert, Scriabin, Tchaikovsky & many more.

SORT & PLAY MUSIC BY:
Composer name, type of piece, historic period, mood, difficulty, title or create your own personal "favorites files".
Play single selections or sets of your favorite pieces or composers.

HAVE SOME FUN!
*Play the **Music Trivia Game** with over 400 Questions about the music, the piano and the composers.*
*Or play the **"Guess That Song" Game** – the program selects and plays a piece at random for you to guess.*

EDUCATE YOURSELF ABOUT THE COMPOSERS AND THEIR MUSIC
Program Notes – Each piece has a memo describing the piece, with descriptive anecdotes & musical points.
Composer Biographies & Pictures describe the lives & times of the composers. On screen Music Dictionary explains the musical terms.

LEARN HOW TO PLAY THE MUSIC
On screen piano keyboard lets you see the music as it's played. Learn the music by watching the on screen keyboard or slowing down the performance. Other functions: Stop/Pause/Rewind/Slow Motion/Tempo Changes/Transposition/Volume/Velocity.

PLAY THE MUSIC WHILE YOU WORK IN OTHER PROGRAMS!
Playback continues in the background of other programs so you can listen to your favorite music while you work.

YOU CAN ALSO USE THE PIECES IN YOUR OTHER MUSIC PROGRAMS OR FOR YOUR PRESENTATIONS
Since the pieces are saved as Standard MIDI files, you can use these fabulous performances in your other music programs or as background music for presentations, music for telephone on-hold, etc.

USE YOUR EXISTING SOUND CARD OR MIDI SYNTHESIZER
Plays the music back through your existing MIDI synthesizer, digital piano or sound module. Windows users can playback through their SoundCard (Roland, SoundBlaster, etc.).

OUR CUSTOMERS LOVE THE PIANIST...
"Incredible... amazing... terrific... masterful... fabulous... love it... my favorite program!"

*Requirements: **MACINTOSH** 2mb RAM memory, system 6 or 7, MIDI interface + synthesizer/module with piano sound, 3.5" high density Floppy Disk, 2mb hard drive space required.*
*Requirements: **Windows (IBM)** 2mb RAM memory, Windows 3.1, SoundCard (Roland, SoundBlaster, etc.) or MIDI system with piano sound, 3.5" or 5.25" high density Floppy Disk, 2mb hard drive space required. **Atari version coming soon!***

All for the amazing price of... **$49** *+ $5 S/H $10 outside USA/Canada*
30 DAY Unconditional MBG

From PG Music
*Phone orders: **1-800-268-6272** or **1-416-528-2368** VISA/MC/AMEX/cheque/mo/po# Fax 1-416-628-2541*
PG Music Inc. 266 Elmwood Avenue Suite 111 Buffalo NY 14222

PG Music announces... An Exciting New Music program for Windows & Macintosh!!

The Jazz Guitarist™

This program makes it "too easy" to learn to be a great jazz guitar player!

A Music Program containing a huge collection of over 60 Jazz Standards, played on MIDI Guitar by top Jazz/Studio Guitarist Oliver Gannon. On-screen guitar fretboard shows you exactly what guitar notes are being played. Play in real time or step through the piece chord by chord.

PLUS... Jazz Trivia Game, "Guess the Song", Memos, Jazz Guitarist Biographies (all on disk)... and much more.

For your PC Soundcard or MIDI system
All for the amazing price of... **$49**
+ $5.00 Shipping & Handling per order ($10 outside USA/Canada)
30 DAY Unconditional MBG

THIS PROGRAM MAKES IT "TOO EASY" TO LEARN TO BE A GREAT JAZZ GUITAR PLAYER!
The on-screen guitar fretboard shows you exactly what notes and chords are being played on the guitar. Slow down the piece, or better still, step through the piece chord by chord, so you can learn every note as it's played. Mute the Guitar track so you can play along with the bass/drums yourself.

PERFORMED BY TOP JAZZ/STUDIO GUITARIST USING MIDI GUITAR CONTROLLER
All the pieces have been recorded "in real time" on a MIDI Guitar Controller. They are never quantized or step recorded. All pieces are complete performances professionally performed, recorded, and saved as Standard MIDI files. Flawless and "glitch-less" guitar performances. You therefore hear the Music playing with CD-quality through your sound card or MIDI system. Most pieces have bass/drums as well as featuring the guitar – so you get a full sounding jazz trio for all of the tunes.

SPECIAL SUPPORT FOR ROLAND GS OR GENERAL MIDI MODULES
Sound Canvas/SCC1 or other General MIDI modules can use the built in mixer to change volumes/patches/panning/reverb/chorus/tuning. Also supports non-General MIDI interfaces with drum kits for over 40 synths built in!

OVER 60 TOP JAZZ STANDARDS WITH COMPLETE GUITAR ARRANGEMENTS

LISTEN TO THE MUSIC WHILE YOU WORK IN OTHER PROGRAMS!
Playback continues in the background of other programs so you can listen to your favorite music while you work.

YOU CAN ALSO USE THE PIECES IN YOUR OTHER MUSIC PROGRAMS OR FOR YOUR PRESENTATIONS
Since the pieces are saved as Standard MIDI files, you can use these fabulous performances in your other music programs or as background music for presentations, etc.

USE YOUR EXISTING SOUND CARD OR MIDI SYNTHESIZER
Plays the music back through your existing MIDI synthesizer, digital piano, or sound module. Windows users can playback through your SoundCard (Roland, SoundBlaster, etc.)

***REQUIREMENTS: MACINTOSH** 2 MB memory, system 6 or 7, MIDI interface + synthesizer/module with guitar, bass, drums sound, 3.5" high density floppy disk, 2mb hard drive space required.*
***Requirements: Windows (IBM)** 2mb RAM memory, Windows 3.1, SoundCard (Roland, SoundBlaster, etc.) or MIDI system with guitar, bass, drums sound, 3.5" or 5.25" high density floppy disk, 2mb hard drive space required.*
Atari version coming soon!

From PG Music... The makers of The Jazz Guitarist, Band-in-a-Box, PowerTracks, The Pianist
*Phone orders: **1-800-268-6272** or **1-416-528-2368** VISA/MC/AMEX/cheque/mo/po# Fax 1-416-628-2541*
PG Music Inc. 266 Elmwood Avenue Suite 111 Buffalo NY 14222

And more... Great Deals on Roland Hardware bundled with lots of MIDI software

Roland SCC1 card (SoundCanvas+interface on a IBM card!!) $389

Roland SC-7 module (General MIDI module with built in serial interface to IBM/MAC) $389

Both of above Roland products come bundled with great software - PowerTracks MIDI sequencer for Windows and DOS, and SC-PRO Sound Canvas Editor/Librarian for Windows)

Virtual Reality Audio, Part 2

The state of the art in 3-D audio simulation is a computational tour-de-force.

By Scott Wilkinson

Last month, we learned that true virtual reality depends on maintaining the relative point of view (POV) of each participant. As you move your head, the image in your eyepieces must shift accordingly, as if you were looking at a real scene through a pair of glasses. The same is true for audio.

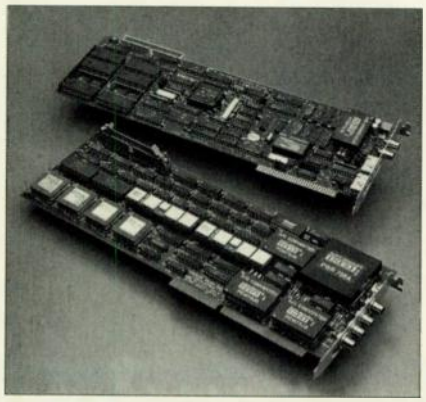
As you move your head, the audio signal must change in a way that maintains the apparent position of any sound sources in the virtual environment.

One of the leading companies in audio for virtual reality is Crystal River Engineering. In conjunction with NASA-Ames Research Center and the University of Wisconsin, Crystal River has performed extensive psychoacoustical research into sound localization and simulation. The results include several products that successfully simulate stationary and moving sound sources over headphones.

HRTFs (head-related transfer functions, used to describe the effect of the head on hearing) are derived by placing a sound source at 265 different locations in anechoic and reverberant chambers and measuring the frequency and phase response within the ear canals of individual subjects. These HRTFs are then used to calculate the coefficients for a series of FIR (finite impulse response) filters, which are combined, or *convolved*, with any audio signal. The output signal can be "placed" at any location around the listener by choosing the appropriate HRTF. The selection is determined by the object's location, the listener's location, and the listener's orientation with respect to the object. Moving sources are simulated by interpolating between the measured locations.

The first product of this research is the Convolvotron ($15,000), a PC-based, high-speed DSP system that uses 128 parallel processors to perform over 300,000,000 multiply-accumulate operations per second. Recently, Crystal River introduced the Beachtron ($1,800), a relatively low-cost 3-D audio system; and the Acoustetron ($50,000 to $60,000), a high-end 3-D audio workstation that achieves a top speed of 2.5 GOPS (giga operations per second).

Even with all this computing power, there are limits to the capabilities of these systems. For example, a reverberant environment can be simulated by storing separate measurements for each combination of positions and orientations, as described earlier. This quickly adds up to an enormous amount of data, severely restricting the capabilities of the system. (Anechoic environments require much less data, making them much easier to simulate; however, they are not nearly as interesting or useful.)



The Convolvotron consists of two circuit cards that install in a PC-compatible computer.

Another approach simulates "image" sources that appear to be directly behind reflective surfaces. The distance between the "image" source and the back of the surface is equal to the distance between the "real" source and the front of the surface. These "image" sources produce signals equivalent to the desired reflections. However, this also requires vast computational resources. At present, the Convolvotron can simulate up to four stationary or moving sound sources in an anechoic environment, or a single source in an environment with up to six user-definable, reflective surfaces. If more simultaneous sources are required, several systems can be combined.

Any inherent delays must be minimized to achieve real-time performance. The Convolvotron has a maximum update interval of 10 to 30 ms, depending on the number of sources and filter coefficients per source. The head tracker introduces a delay of 5 to 50 ms, and the PC host adds another 10 to 50 ms, depending on the complexity of the source geometry. According to recent psychoacoustical research, these delays are acceptable for sources moving at moderate angular velocities up to 360 degrees/second.

Products such as these are on the cutting edge of VR applications, which include flight training, architectural acoustics, telepresence, scientific modeling, and entertainment. (At this writing, Crystal River is installing several Convolvotrons for a VR art project at the Banff Centre for the Arts near Calgary, Alberta.) These applications depend on a complete suspension of disbelief in order to effectively create new worlds of infinite variety and wonder, and 3-D audio systems are as important as stereo eye monitors in the effort to achieve this goal.

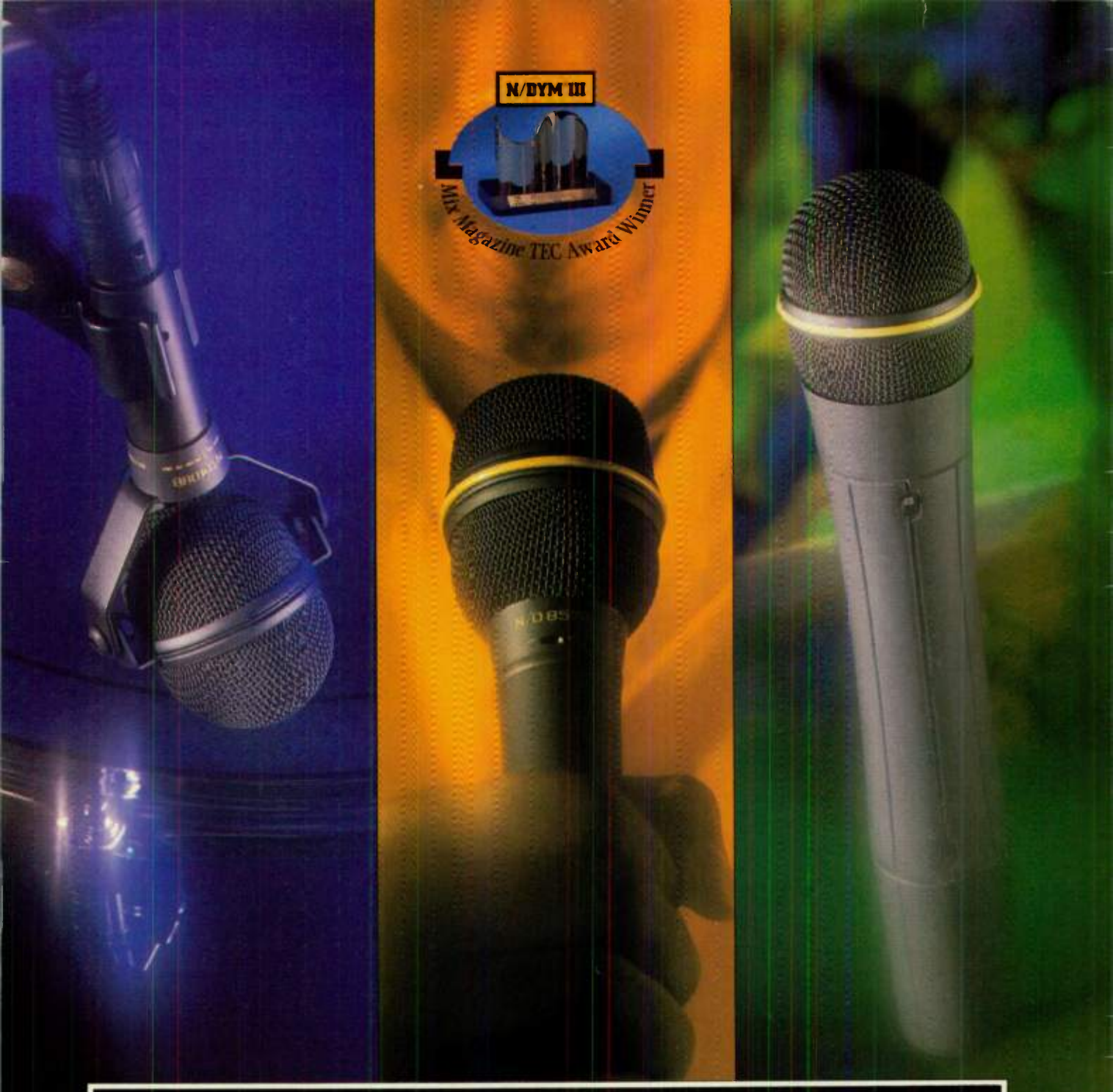


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Illustration by Dave Ember

The EM Guide to Notation Software

MODERN MANUSCRIPTS

AS ANYONE WHO'S EVER PUT PENCIL TO MANUSCRIPT PAPER KNOWS, WRITING MUSIC IS NEITHER A FAST, NOR A PLEASANT TASK. CAREFULLY NOTATING ALL THE ELEMENTS THAT MAKE UP A PAGE OF MUSIC IS SLOW AND PAINSTAKING, PARTICULARLY IF YOU WANT THE PAGE TO LOOK GOOD. IN ADDITION, IT REQUIRES A GREAT DEAL OF KNOWLEDGE ON THE PART OF THE PENCIL-PUSHER.

NOT SURPRISINGLY, MANY COMPANIES AND INDIVIDUALS HAVE RISEN TO THE TASK OF CREATING NOTATION PROGRAMS FOR PERSONAL COMPUTERS. HOWEVER, THE EVOLUTION OF USEFUL, IN-DEPTH PRODUCTS HAS BEEN PARTICULARLY SLOW AND ARDUOUS. EARLY ATTEMPTS OFTEN LACKED ESSENTIAL FUNCTIONS, OR FEATURED USER INTERFACES THAT COULD ONLY BE CALLED OBTUSE.

THE SITUATION TODAY IS MUCH DIFFERENT. AN

By George F. Litterst

EM Guide to Notation Software

Manufacturer/Product	Max. # of Staves/ Voices per Staff/ MIDI Chan. per Staff	Staff Sizes/ Lines per staff	Viewing Modes/ Viewing %	Included Fonts[1]/ Alternative Fonts	User Preferences	Rhythmic Range/ Tuplet Range
Mac						
Ars Nova Songworks 1.3	1/2/3	1/5	page & scroll/100%	Bm, PS/no	yes	32nd to whole/unlimited
Coda Finale 3.0	32,767/8/6	10% to 999%/0-128	page & scroll/5%-1000%	Bm, TT, PS/yes	yes	4,096th to double whole/unlimited
Coda MusicProse 2.1	32/4/1	1/1, 5	page & scroll/5%-1000%	Bm, PS/no	yes	64th to double whole/1-1000
ECS Lime 1.1e	60/unlimited/ unlimited	1/any	page/3 resolutions	Bm, TT, PS/yes	yes	128th to double-whole/unlimited
Emagic Notator Logic 1.6	unlimited/16/16	11/0-8	page & scroll/25%-500%	Bm/no	yes	128th to whole/3
Great Wave Software ConcertWare Plus 1.0	32/4/4	1/1, 5	scroll/100%	Bm, TT, PS/yes	yes	32nd triplet to dotted whole/3-15
Mark of the Unicorn Composer's Mosaic 1.4	unlimited/ unlimited/32	unlimited/0-63	page & scroll/20%-800%	Bm, PS/yes	yes	128th to double whole/1-17
Opcode MusicShop 1.0	16/4/1	1/5	scroll/25%-400%	Bm/no	yes	32nd to dotted whole/3
Passport Encore 3.0	64/8/8	4/1, 4-8	page & scroll/100% (print preview)	Bm, TT, PS/no	yes	64th to whole/3-15
Passport MusicTime 1.2	6/4/4	4	page/100%	Bm, TT, PS/no	yes	64th to whole/3-15
Pygraphics Pyware Music Writer 1.4	40/unlimited/1	3/1, 3, 5	page & scroll/100%	Bm, PS/yes	yes	64th to whole/unlimited
Steinberg Cubase Mac Score 1.0	30/4/4	1/1, 5	page & scroll/50%, 75%, 100%, 120%, 200%	TT, PS/no	yes	64th to whole/3
Temporal Acuity Products Nightingale 1.0	64/31/1	unlimited/1, 4, 5	page/25%-400%	Bm, PS	no	128th to double whole/unlimited
PC						
Coda Finale 2.2 (Win)	32,767/4/4	unlimited/0-128	page & scroll/5%-1000%	Bm, PS/yes	yes	4,096th to double whole/unlimited
Coda MusicProse 2.1 (Win)	32/4/1	1/1, 5	page & scroll/5%-1000%	Bm, PS/no	yes	64th to double whole/1-1000
Dr. T's Copyist Professional DTP 3.0 (DOS)	18/unlimited/na	unlimited/unlimited	page/100%	Bm, PS/no	yes	64th to double whole/unlimited
Dr. T's QuickScore Deluxe 3.0 (DOS)	16/1/16	1/5	page & scroll/100%	Bm, PS/no	no	64th to double whole/3
Dr. T's QuickScore Deluxe 3.1 (Win)	16/1/16	1/5	page & scroll/100%	TT/no	no	64th to double whole/3
Emagic Notator Logic 1.6 (Win)	unlimited/16/16	11/0-8	page & scroll/25%-500%	Bm/no	yes	128th to whole/3
Erato Music Manuscriptor 2.0 (DOS)	99/4/32	6/1, 5	page & scroll/33%, 50%, 71%, 100%, 129%	Bm/no	yes	128th to double whole/unlimited
Grandmaster MusicEase 3.0 (DOS)	unlimited/2/1	10% to 190%/0-5, 1-14 (tab)	page & scroll/20%, 40%, 60%, 80%, 100%	Bm/no	yes	64th to whole/unlimited
Musicator GS 1.0 (DOS)	16/2/1	50-200%/5	scroll/100%	Bm/no	yes	64th to whole/3-15
Musicator GS 1.03 (Win)	16/4/1	50-200%/5	page & scroll/20%-400%	TT, PS/no	yes	64th to whole/3-15
Passport Encore 3.0 (Win)	64/8/8	4/1, 4-8	page & scroll/100% (print preview)	Bm, TT, PS/no	yes	64th to whole/3-15
Passport MusicTime 1.2 (Win)	6/4/4	4	page/100%	Bm, TT, PS/no	yes	64th to whole/3-15
Personal Composer for Windows 1.0 (Win)	128/4/128	10/15	page & scroll/25-2,000%	TT/yes	yes	256th to double whole/ unlimited, nested
Pygraphics Pyware Music Writer 1.0 (DOS)	40/unlimited/1	3/1, 3, 5	page & scroll/100%	Bm/yes	yes	64th to whole/unlimited
San Andreas Press Score 3.1 (DOS)	100+/unlimited/1	unlimited/0-∞	page & scroll/any	PS/no	yes	unlimited/unlimited
SongWright Software SongWright 5.1 (DOS)	unlimited/4/4	1/5, 6	page & scroll/ 50%, 100%, 200%, 250%, 330%, 500%, 1,000%	Bm/no	yes	32nd to whole/2-9
Steinberg Cubase Windows Score 1.0 (Win)	30/4/4	1/1, 5	page & scroll/35%, 50%, 85%, 100%, 150%, 200%	TT, PS/no	yes	64th to whole/3
Teach Services Laser Music Processor 3.3 (DOS)	14+/1/1	unlimited/1-9	scroll/100%	Bm/yes	yes	1/32 to whole/unlimited
Temporal Acuity Products Music Printer Plus 4.1 (DOS)	42/128/2	1/1, 5, 6+	page/25%, 50%, 100%	Bm/no	yes	128th to double whole/3, 5, 6, 7, 9, 10, 12, 14, 15
Theme Software Theme 3.4 (DOS)	40/32/1	2/0-6	page & scroll/100%-800%	Bm/no	no	128th to longa/2-31
thoughtprocessors ShowTune/DOS 1.0 (DOS)	12/8/16	1/1-12	page & scroll/12%, 25%, 50%, 100%	Bm/yes	yes	256th to double whole/3
thoughtprocessors ShowTune/WIN 2.0 (Win)	12/12/16	1/1-6	page & scroll/25%, 50%, 100%, page	TT/no	yes	256th to double-whole/3
thoughtprocessors The Note Processor 2.3 (DOS)	50/∞/16	8/1-12	page & scroll/12%, 25%, 50%, 100%	Bm, PS/yes	yes	128th to longa/unlimited
Apple IIGS						
Pygraphics Pyware Music Writer 2.03	40/unlimited/1	3/1, 3, 5	page & scroll/100%	Bm/yes	yes	64th to whole/unlimited
Atari						
Dr. T's Copyist Apprentice 1.7	16/unlimited/1	1/1, 5	page/100%	Bm/no	yes	64th to double whole/unlimited
Dr. T's Copyist Professional DTP 1.7	16/unlimited/1	1/1, 5	page/100%	Bm, PS/yes	yes	64th to double whole/unlimited
Emagic Notator Logic 1.6	unlimited/16/16	11/0-8	page & scroll/25%-500%	Bm/no	yes	128th to whole/3
Steinberg Cubase Atari Score 3.01	30/4/4	1/1, 5	page & scroll/50%, 75%, 100%, 200%	Bm/no	yes	64th to whole/3
Amiga						
Dr. T's Copyist Apprentice 1.68	16/unlimited/1	1/1, 5	page/100%	Bm/no	yes	64th to double whole/unlimited
Dr. T's Copyist Professional DTP 3.0	16/unlimited/1	1/1, 5	page/100%	Bm, PS/yes	yes	64th to double whole/unlimited

Key: [1] Bm=Bitmapped, TT=TrueType, PS=PostScript
[2] /=Slash, H=Harmonic, D=Diamond, S=Square, T=Triangle, R=Round, X= X, C=Cross, V=V, B=Blank, N=Tablature Numbers, UD=User Defined
[3] m=movable, UD=User Definable

Alternative Noteheads[2]	Clefs[3]	Non-standard Key Signatures/ Complex Meters/ Non-metric Music	Chords Symbols/ Transposition/ MIDI Input/Auto Frets	Cross-staff Beaming/ Cross-measure Beaming	Music Input: Mouse/ Computer Keyboard	MIDI Step Time/ MIDI Real Time/ MIDI File
none	G, G (8va), G (8vb), F, F (8vb), mC	no/yes/yes	yes/yes/yes/no	no/yes	yes/yes	yes/yes/no
any font character, UD	mG, G (8va), G (8vb), mF, F (8vb), mC, bar, perc, UD	yes/yes/yes	yes/yes/yes/yes	yes/yes	yes/yes	yes/yes/yes
/	G, G (8vb), F, F (8vb), alto, tenor, bar, perc	no/no/no	yes/yes/yes/yes	no/no	yes/yes	yes/yes/yes
H, D, S, X, B, UD	G, F, mC, tenor G, perc, ligature, UD	no/yes/yes	yes/yes/yes/no	yes/yes	yes/yes	yes/yes/no
/, D, S, T, R, X, C, B	G, G (8va), G (8vb), F, F (8vb), mC, perc	no/no/no	no/yes/yes/no	no/yes	yes/no	yes/yes/yes
D, S, X	G, G (8vb), F, alto, tenor, perc	yes/no/yes	yes/no/no/yes	no/no	yes/yes	yes/yes/yes
/, S, D, T, S, C, X, B,	G, G (8va), G (8vb), G (15ma), F, F (8va), F (8vb), mC, perc, others	yes/yes/yes	yes/yes/yes/yes	yes/yes	yes/yes	yes/yes/yes
none	G,	no/no/no	no/no/no/no	no/no	yes/no	yes/yes/yes
/, D, S, X, N	G, G (8va), G (8vb), F, F (8vb), alto, tenor, perc	yes/no/no	yes/yes/yes/yes	yes/yes	yes/no	yes/yes/yes
/, D, S, X	G, G (8va), G (8vb), F, F (8vb), alto, tenor, perc	yes/no/no	yes/yes/yes/yes	no/no	yes/no	yes/yes/yes
D, S, R, X	G, F, G (8va), C (8vb), alto, tenor, perc	no/yes/limited	yes/yes/yes/no	no/no	yes/yes	yes/yes/yes
/, D, T, X	G, G (8va), G (15ma), G (8vb), F, F (8vb), F (15ma), mC, perc	no/no/yes	yes/yes/no/no	no/yes	yes/no	yes/yes/yes
D, S, X, B	G, G (8va), G (8vb), F, F (8vb), alto, tenor, perc	yes/yes/yes	yes/yes/no/no	no/yes	yes/no	yes/yes/yes
any font character, UD	mG, G (8va), G (8vb), mF, F (8vb), mC, bar, perc, UD	yes/yes/yes	yes/yes/yes/no	yes/yes	yes/yes	yes/yes/yes
/	G, G (8va), F, F (8vb), alto, tenor, bar, perc	no/no/no	yes/yes/yes/no	no/no	yes/yes	yes/yes/yes
D, X, UD	G, G (8va), F, F (8vb), mC, perc, UD, none	yes/yes/yes	yes/no/no/no	yes/yes	yes/yes	yes/yes/yes
C, X	G, G (8va), F, F (8vb), alto, tenor, perc, none	no/no/no	yes/no/no/no	no/no	yes/no	yes/yes/yes
C, X	G, G (8va), F, F (8vb), alto, tenor, perc, none	no/no/no	yes/no/no/no	no/no	yes/no	yes/yes/yes
/, D, S, T, R, X, C, B	G, G (8va), G (8vb), F, F (8vb), mC, perc	no/no/no	no/yes/yes/no	no/yes	yes/no	yes/yes/yes
/, D, X, O, T, B	mG, G (8va), G (8vb), mF, F (8vb), mC, perc	no/yes/yes	yes/yes/no/no	yes/yes	yes/yes (tablet)	yes/no/yes
X, N	G, F, mC	no/no/no	yes/yes/yes/yes	no/yes	no/yes	yes/yes/yes
X	G, F, alto, tenor, perc	no/no/no	yes/yes/no/no	no/no	no/yes	yes/yes/yes
X	G, F, alto, tenor, perc	no/no/no	yes/yes/no/no	no/no	yes/no	yes/yes/yes
/, D, S, X, N	G, G (8va), G (8vb), F, F (8vb), alto, tenor, perc	yes/no/no	yes/yes/yes/yes	yes/yes	yes/no	yes/yes/yes
/, D, S, X	G, G (8va), G (8vb), F, F (8vb), alto, tenor, perc	yes/no/no	yes/yes/yes/yes	no/no	yes/no	yes/yes/yes
/, D, S, T, R, X, B	G, G (8va), G (8vb), F, F (8va), F (8vb), alto, baritone, tenor, perc	no/yes/yes	yes/no/no/no	yes/yes	yes/yes	yes/yes/yes
D, S, R, X	G, F, G (8va), G (8vb), alto, tenor, perc	no/yes/limited	yes/yes/yes/no	no/no	yes/yes	yes/yes/yes
/, H, D, S, T, F, X, C, V, B, UD	G, F, mC, perc, UD	yes/yes/yes	yes/yes/no/yes	yes/yes	yes/yes	yes/no/no
UD	C, F, mC, UD	no/no/yes	yes/yes/no/no	no/yes	yes/yes	yes/yes/yes
/, D, T, X	G, G (8va), G (15ma), G (8vb), F, F (8vb), F (15ma), mC, perc	no/no/yes	yes/yes/no/no	no/yes	yes/no	yes/yes/yes
none	G, F, alto, tenor	yes/yes/yes	yes/no/no/no	no/yes	yes/yes	yes/yes/yes
C, X	G, F, mC, perc	yes/yes/yes	yes/yes/no/no	yes/yes	yes/yes	yes/yes/yes
/, H, D, X, B	G, G (8va), F, mC, perc	no/yes/yes	yes/no/no/no	no/no	no/yes	yes/no/no
none	mG, mG (8va), mF, mC, mperc	yes/yes/no	yes/no/no/no	yes/yes	yes/no	no/no/yes
UD	mG, mG (8va), mF, mC, mperc	no/no/no	yes/yes/no/no	no/yes	yes/yes	yes/no/yes
D, S, UD	mG, mG (8va), mF, mC, mperc	yes/yes/yes	yes/no/no/yes	yes/yes	yes/yes	no/yes/yes
/, D, S, R, X	G, F, G (8va), G (8vb), alto, tenor, perc	no/yes/limited	yes/yes/yes/no	no/no	yes/yes	yes/yes/yes
C, X	G, F, alto, tenor, perc	yes/yes/yes	yes/no/no/no	no/yes	yes/yes	no/no/yes
D, X, UD	G, F, alto, tenor, perc	yes/yes/yes	yes/no/no/no	yes/yes	yes/yes	no/no/yes
/, D, S, T, R, X, C, B	G, G (8va), G (8vb), F, F (8vb), mC, perc	no/no/no	no/yes/yes/no	no/yes	yes/no	yes/yes/yes
/, D, T, X	G, G (8va), G (15ma), G (8vb), F, F (8vb), F (15ma), mC, perc	no/no/yes	yes/yes/no/no	no/yes	yes/no	yes/yes/yes
D, X	G, F, alto, tenor, perc	yes/yes/yes	yes/no/no/no	no/yes	yes/yes	no/no/yes
D, X	G, F, alto, tenor, perc	yes/yes/yes	yes/no/no/no	no/yes	yes/yes	no/no/yes

EM Guide to Notation Software

Manufacturer/Product	Text: Lyric/ Header & Footers/ Annotative	Engraver Spacing	Output: PostScript Printing/ EPS/Part Extraction	MIDI Files/ MIDI Playback	Transposition[4]	MIDI: Data Capture/ Editing/ Expression Marks	Price
Mac							
Ars Nova Songworks 1.3	yes/no/yes	no	yes/no/no	yes/yes	C, D, E, M	no/no/no	$125
Coda Finale 3.0	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, D, E, M	yes/yes/yes	$749 retail/ $250 academic
Coda MusicProse 2.1	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, D	no/no/no	$249 retail/ $149 academic
ECS Lime 1.1e	yes/yes/yes	yes	yes/no/yes	no/yes	C, E, M	no/yes/yes	$295
Emagic Notator Logic 1.6	yes/no/no	no	no/no/yes	yes/yes	C	yes/yes/no	$699
Great Wave Software ConcertWare Pro 1.0	yes/yes/yes	no	yes/no/yes	yes/yes	C	limited/yes/yes	$339
Mark of the Unicorn Composer's Mosaic 1.4	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, D, E	no/no/yes	$595
Opcode MusicShop 1.0	no/yes/no	no	yes/no/yes	yes/yes	C	yes/yes/no	$149
Passport Encore 3.0	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, E	limited/yes/yes	$595
Passport MusicTime 1.2	yes/no/yes	no	yes/no/no	yes/yes	C, E	limited/yes/yes	$249
Pygraphics Pyware Music Writer 1.4	yes/yes/yes	no	yes/no/yes	yes/yes	C, D, E, M	limited/yes/no	$119-$595
Steinberg Cubase Mac Score 1.0	yes/yes/yes	no	yes/yes/yes	yes/yes	C, D, E, M	yes/yes/yes	$699
Temporal Acuity Products Nightingale 1.0	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, D, E, M	limited/yes/yes	$495
PC							
Coda Finale 2.2 (Win)	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, D, E, M	yes/yes/yes	$749 retail/ $250 academic
Coda MusicProse 2.1 (Win)	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, D	no/no/no	$249 retail/ $149 academic
Dr. T's Copyist Professional DTP 3.0 (DOS)	yes/yes/yes	yes	yes/yes/yes	no/no	C, D, E	yes/no/no	$299
Dr. T's QuickScore Deluxe 3.0 (DOS)	yes/yes/yes	no	yes/no/yes	yes/yes	C, D, E	yes/yes/no	$149
Dr. T's QuickScore Deluxe 3.1 (Win)	yes/yes/yes	no	yes/yes/yes	yes/yes	C, D, E	yes/yes/no	$149
Emagic Notator Logic 1.6 (Win)	yes/no/no	no	no/no/yes	yes/yes	C	yes/yes/no	$699
Erato Music Manuscriptor 2.0 (DOS)	yes/yes/yes	yes	no/no/yes	yes/yes	C, D, E, M	limited/no/no	$700 retail/ $375 academic
Grandmaster MusicEase 3.0 (DOS)	yes/yes/yes	yes	no/no/yes	yes/yes	C, D, E, M	no/no/no	$295
Musicator GS 1.0 (DOS)	yes/yes/yes	yes	no/no/yes	yes/yes	C, E	most/no/no	$299
Musicator GS 1.03 (Win)	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, E	most/no/yes	$299
Passport Encore 3.0 (Win)	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, E	limited/yes/yes	$595
Passport MusicTime 1.2 (Win)	yes/no/yes	no	yes/no/no	yes/yes	C, E	limited/yes/yes	$249
Personal Composer for Windows 1.0 (Win)	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, D, E, M	yes/yes/yes	$440
Pygraphics Pyware Music Writer 1.0 (DOS)	yes/yes/yes	no	yes/no/yes	yes/yes	C, D, E, M	limited/yes/no	$119-$595
San Andreas Press Score 3.1 (DOS)	yes/yes/yes	yes	yes/yes/yes	no/yes	C, D, E, M	no/no/no	$800
SongWright Software SongWright 5.1 (DOS)	yes/yes/yes	yes	no/no/yes	yes/yes	C, D, E	no/yes/yes	$119
Steinberg Cubase Windows Score 1.0 (Win)	yes/yes/yes	no	no/no/yes	yes/yes	C, D, E, M	yes/yes/yes	$549
Teach Services Laser Music Processor 3.3 (DOS)	yes/yes/yes	no	no/no/no	yes/yes	C, E	no/no/no	$129
Temporal Acuity Products Music Printer Plus 4.1 (DOS)	yes/yes/yes	no	no/no/yes	yes/yes	C, D	no/yes/limited	$495
Theme Software Theme 3.4 (DOS)	yes/yes/yes	yes	no/no/yes	yes/yes	C, D, E, M	no/no/yes	$395
thoughtprocessors ShowTune/DOS 1.0 (DOS)	yes/yes/yes	yes	no/no/yes	yes/yes	D	yes/no/no	$79
thoughtprocessors ShowTune/WIN 2.0 (Win)	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, D, E, M	yes/yes/yes	$139
thoughtprocessors The Note Processor 2.3 (DOS)	yes/yes/yes	yes	yes/yes/yes	yes/yes	C, D, M	yes/yes/yes	$295
Apple IIGS							
Pygraphics Pyware Music Writer 2.03	yes/yes/yes	no	no/no/no	no/no	C, D, E, M	limited/yes/no	$119-$595
Atari							
Dr. T's Copyist Apprentice 1.7	yes/yes/yes	no	no/no/yes	yes/no	C	no/no/no	$139
Dr. T's Copyist Professional DTP 1.7	yes/yes/yes	no	yes/yes/yes	yes/no	C	no/no/yes	$349
Emagic Notator Logic 1.6	yes/no/no	no	no/no/yes	yes/yes	C	yes/yes/no	$699
Steinberg Cubase Atari Score 3.01	yes/yes/yes	no	no/no/yes	yes/yes	C, D, E, M	yes/yes/yes	$599
Amiga							
Dr. T's Copyist Apprentice 1.68	yes/yes/yes	no	no/no/yes	no/no	C	no/no/no	$139
Dr. T's Copyist Professional DTP 2.0	yes/yes/yes	no	yes/yes/yes	yes/no	C	no/no/yes	$349

Key:
[4] C=Chromatic, D=Diatonic, E=Enharmonic, M=Modal

screen. This is convenient for entering data, because you don't have to worry about line and page breaks. It's also convenient if the program scrolls the music automatically during playback. If you like to work in Scroll mode, look for a program that lets you display discontiguous staves by hiding the ones in between. For example, this lets you work on the flute and cello parts of your orchestral score simultaneously.

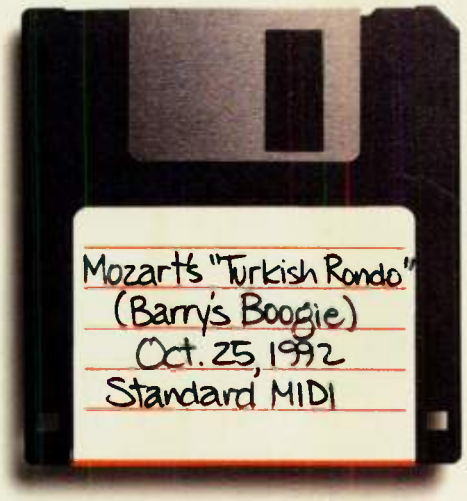
In Page mode, the music appears on the screen as it does on the printed page. Unless you have a large monitor, you won't be able to see the entire full-size page at once. Look for programs that offer multiple viewing resolutions so you can see as much of the page as you want. *Personal Composer* stands out as a program that offers split-screen views.

In addition, don't forget that magnified views are helpful for final layout work when you are polishing the appearance of your score for printing. In fact, many programs require that you manually adjust the placement of

Brush.

Canvas.

1992 MULTIMEDIA WORLD READERS' CHOICE WINNER



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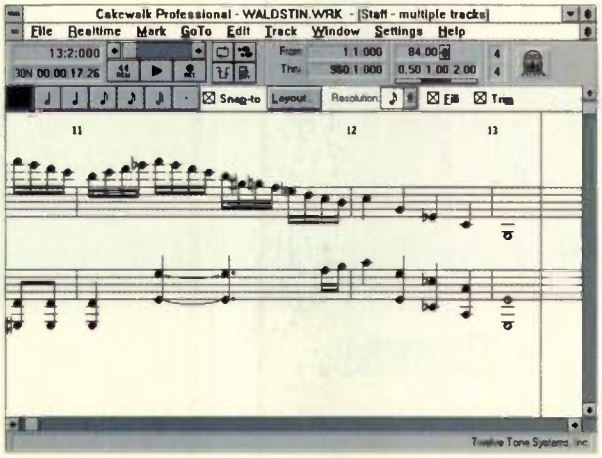
You've been searching for software that will help you turn your musical ideas into polished performances. But the first program you tried wasn't powerful enough. And the other was so complex, you didn't know where to start.

Maybe it's time to see a Professional.

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

Express Yourself

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



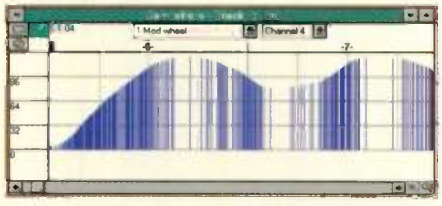
Staff view

Tempo

Take Control

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

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



Controller view

Professional Staff

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

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

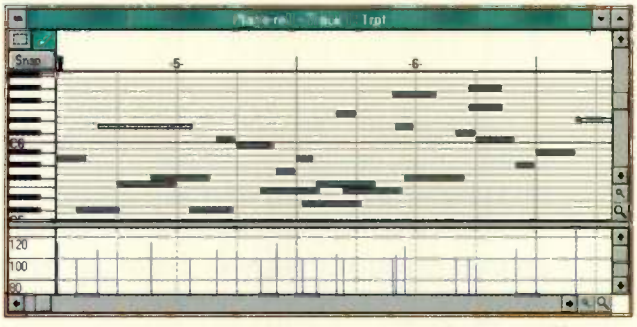
Markers

Get On Track

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

Professional Experience

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



Piano-roll view

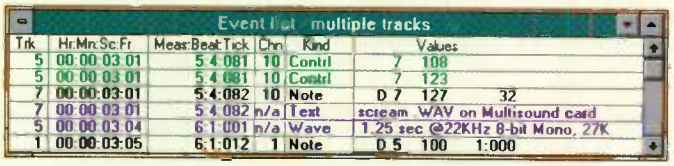
PROFESSIONAL HELP.

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

Faders view

CAL-
SWING 16.CAL

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



Event-list view

Sysx

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

Meter/Key

Get Help Fast

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

Comments

See A Professional Today

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

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

A demo disk is available for $10.

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

Twelve Tone Systems, Inc.
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various symbols to avoid collisions or achieve an "engraved" look.

FONTS

Most notation programs use one or more special music fonts for notes, rests, clefs, and other musical symbols. Bitmapped fonts (BM) are fine for screen display at the installed sizes, but they usually do not yield good results on high-resolution (300 dpi or greater) printers. TrueType (TT) fonts provide impressive results on the screen and printed page. PostScript (PS) fonts also provide good printed results on PostScript printers. Using *Adobe Type Manager* (*ATM*) with PostScript fonts provides good screen display and printed results on a wide variety of printers. If you intend to import musical examples into a page-layout program, you need PostScript fonts to create EPS (Encapsulated PostScript) files.

Some programs, such as Erato's *Music Manuscriptor*, achieve impressive printed results without TrueType or PostScript. In any case, ask for sample printouts from a variety of printers when you evaluate a notation program for your own use.

If you are a professional, you may want a particular look for your scores. In that case, you should consider the use of alternative music fonts. A few programs support this option. (See "Computer Musician: Musical Typography" in the February 1993 **EM**.)

USER PREFERENCES

If you're serious about how your music looks, you should have global control over many aspects of the notation. These aspects include beam angles, beam thickness, spacing, dot offsets, measure numbering, etc. Most programs let you create your own notational look with a variety of user preferences. The exact user preferences vary widely from program to program.

RHYTHMIC RANGE AND TUPLETS

The available rhythmic values and tuplet range are important limiting factors of any program. (Although notation purists may not find the word *tuplet* in their music dictionary, it is a term that is here to stay.) When you contact a manufacturer for more information, find out how flexible their product is regarding tuplets and whether the program supports nested tuplets (see **Fig. 2**).

ALTERNATE NOTEHEADS

If you notate percussion parts, harmonics, or early music, you may need a variety of different notehead styles.

▼

The current programs vary widely in terms of their printed output, ease of use, and suitability to a given task.

Although it is nice to change noteheads on a case-by-case basis, look for programs that let you make global notehead substitutions.

CLEFS

Computers are good at mathematical manipulations, such as transposition. As a result, it's always surprising when a program does not offer a complete choice of clefs, including a movable C clef. Without the right clefs, you may not be able to notate your music properly. Mark of the Unicorn's *Composer's Mosaic* has the most comprehensive set of clefs I have seen. Some programs also let you define your own clefs.

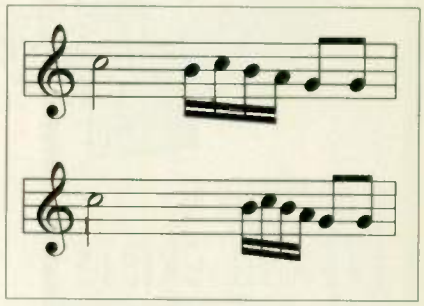

FIG. 3: The lower staff of this example illustrates mathematically correct spacing, otherwise known as linear spacing. The upper staff represents one type of engraver spacing. Note that the engraver spacing is non-linear.

KEYS AND METERS

Do you need to mix sharps and flats in the same key signature, or put them in a non-standard order? Do you need time signatures such as 7+3+2 over 8? If so, apologize immediately to the people who have to play your music, and then look the chart over carefully for the programs that support these items.

In many programs, you can create a piece or a passage within a piece that has no meter by hiding the time signature and bar lines. You may have to think in terms of measures to use such a program, but you can still get the look you want. The ability to create non-metric music is especially important to anyone creating musical examples for instructional books or music-theory tests.

CHORDS

Adding chord symbols to a pop song or lead sheet is one thing; working with chord symbols conveniently is another. In many programs, chord symbols and guitar fretboards are merely text symbols; in others, they have musical intelligence, which means they transpose along with the music.

The manner in which chord symbols are entered also varies among programs. Some allow you to type in chord symbols or choose them from a menu with the mouse. It is more efficient to play simple chords in from a MIDI key-

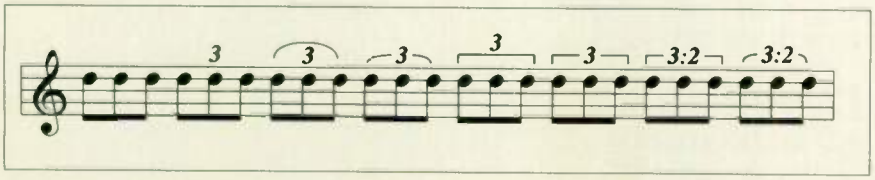

FIG. 2 These are several ways to represent a tuplet (triplets, in this case), including without a tuplet number.

board, however.

Guitar fretboards appear in several programs, but few programs automatically choose the proper chord based on MIDI input. Even if they do, it only works with their limited set of chord fingerings. If you want to notate a chord of your own creation, you may be out of luck. On the other hand, several programs with text-based guitar fonts let you manually construct your own fretboard fingering (although it can be a lot of work). Unfortunately, the world is still waiting for a program that intelligently combines both of these capabilities.

A few programs, such as *Lime*, *Score*, *MusicEase*, *Finale*, and *Encore*, support guitar tablature or other types of fret notation.

BEAMING

Cross-staff beams are so common in

NOTATION SOFTWARE MANUFACTURERS

Ars Nova
PO Box 637
Kirkland, WA 98083-0637
tel. (800) 445-4866
or (206) 889-0927
fax (206) 828-2132

Coda Music Technology
6210 Bury Dr.
Eden Prairie, MN 55346-1718
tel. (800) 843-2066
or (612) 937-9611
fax (612) 937-9760

Dr. T's Music Software
124 Crescent Rd.
Needham, MA 02194
tel. (800) 989-MIDI
or (617) 455-1454
fax (617) 455-1460

Electronic Courseware Systems (ECS)
1210 Lancaster Dr.
Champaign, IL 61821
tel. (800) 832-4965
or (217) 359-7099
fax (217) 359-6578

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

Erato Software
PO Box 526278
Salt Lake City, UT 84152-6278
tel. (801) 328-0500

Grandmaster, Inc.
PO Box 3022
Spokane, WA 99220-3022
tel. (509) 747-6773

Great Wave Software
5353 Scotts Valley Dr.
Scotts Valley, CA 95066
tel. (408) 438-1990
fax (408) 438-7171

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

Musicator A/S
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San Francisco, CA 94141
tel. (916) 756-9807

Opcode Systems Inc.
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Menlo Park, CA 94025
tel. (415) 369-8131
fax (415) 369-1747

Passport Designs, Inc.
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or (415) 726-0280
fax (415) 726-2254

Personal Composer
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Seattle, WA 98199
tel. (800) 446-8088
or (206) 778-9266
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Pygraphics
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Grapevine, TX 76099
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or (817) 481-7536
fax (817) 488-9658

San Andreas Press
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Palo Alto, CA 94306
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Northridge, CA 91325
tel. (818) 993-4091
fax (818) 701-7452

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Donivan Rd.
Brushton, NY 12916
tel. (800) 367-1844
or (518) 358-2125
fax (518) 358-3028

Temporal Acuity Products, Inc.
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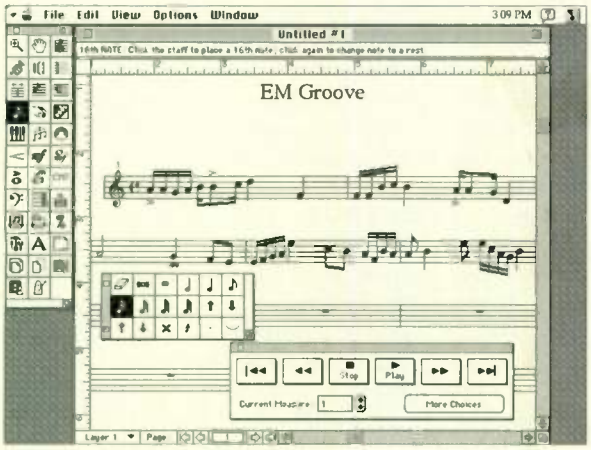
Bldg. 1, Suite 200
Bellevue, WA 98005
tel. (800) 426-2673
or (206) 462-1007
fax (206) 462-1057

Theme Software Company
985 Providence Sq.,
Suite 246
Virginia Beach, VA 23464
tel. (804) 474-9203
fax (804) 495-8740

thoughtprocessors
584 Bergen St.
Brooklyn, NY 11238
tel. (800) 535-8663
or (718) 857-2860
fax (718) 398-8411

keyboard music that it is surprising more programs do not support this feature. A less common but important practice is beaming over the bar line. This feature is not often supported in software, either. Other beaming features to investigate are the ability to change beam angles, control beam groupings, and create secondary beam breaks.



Coda's *Finale* 3.0 for the Macintosh.

MUSIC INPUT

Although you may initially think you need only one or two ways to enter music into a notation program, you will want lots of options once you start using the software. For example, mouse entry is simple, but you may find it to be too slow for anything but editing or simple music entry. Similarly, depending on your typing skills, you may or may not find the computer keyboard to be a good entry device for notes and rests.

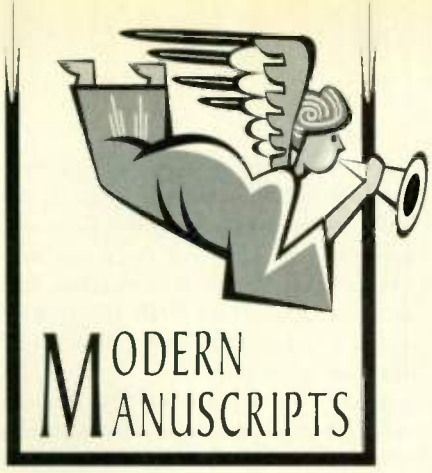
Step-time entry is handy in a wide variety of situations. In this process, you play and hold one or more notes on a MIDI keyboard while typing or otherwise selecting a rhythmic value on the computer. Even people with limited keyboard skills may find that step-time entry is the fastest way to enter music with chords.

For those with keyboard chops, real-time entry is often the way to go. If the music is extremely complex, however, you may need to record the music into a sequencer, edit the performance, and save it as a Standard MIDI File (SMF), which you can then import into your notation program.

Indeed, you may need all five of these entry methods and more. For example, *Music Manuscriptor* has a graphics-tablet entry option that lets you enter notes with an electronic stylus. A few programs also translate from one notation file to another, though the industry could really use a Standard Notation File format. Music scanners are on the horizon, too (see "Technology Page: Scanning the Horizon" in the April 1993 **EM**.) This technology will allow you to convert a scanned TIFF image of printed music into an editable notation file. Some day we may even see digital audio-to-notation conversion.

TEXT

Text in notation programs normally appears in one of three types: lyric,



header/footer, and annotative. Lyric text should be tied to the associated notes; when the page layout changes, the lyric text should move with the music. Unfortunately, some programs do not handle this function properly.

Header/footer text is used for titles, credits, page numbers, and so on. This sort of text is generally specific to the page but independent of the music.

Annotative text includes just about everything else, from stage directions in a musical to an extra verse printed as a paragraph at the end of the score. You may or may not need to tie annotative text to a particular measure.

ENGRAVER SPACING

Perhaps the most poorly understood aspect of music notation is the method by which professional engravers lay out a page. The traditional rules of "casting off"—procedures to determine the horizontal placement of notes and symbols on the page—are known to only a few in the music-publishing industry.

Some simple notation programs give each note a horizontal space on the page that matches its rhythmic value. For example, a half note takes up twice as much horizontal space as a quarter note. This is known as *linear spacing*. On the other hand, music engravers use a variety of tables to determine a non-linear spacing scheme based on the musical context. As a result, a half note usually gets less than twice the space of a quarter note, thus making the music appear more compact (see Fig. 3).

Although engraver spacing might differ from one notation program to another, it is encouraging to note that many programs currently claim to offer it. (The spacing feature may not engage itself automatically, however.) Temporal Acuity Products *Nightingale* stands out as a program that offers a large number of spacing tables.

Laying out a page of music correctly involves many other issues in addition to engraver spacing, such as vertical placement of staves, distances between staves, choice of staff sizes, and intelligent line and page breaks. Leland Smith's *Score* has earned a reputation as the most intelligent music-notation program with respect to these important layout issues.

OUTPUT

All of the programs listed here print music, and many offer PostScript printing. In conjunction with a PostScript printer, this helps characters look good at any size, gives slurs and ties a nice taper, and smooths the edges of a grand-staff brace. Good results are certainly possible without PostScript, but

SEQUENCERS WITH NOTATION

Just as the gap between word processors and dedicated page-layout programs continues to narrow, so does the division between sequencers and notation programs.

The principle functions of a sequencer include recording, editing, and playing MIDI data. The principle functions of a music-notation program include notating and printing music. The current trend among sequencers is to offer notation display and sometimes printing. Similarly, notation programs offer an increasingly large set of options for recording, editing, and playing MIDI data.

Sometimes, the line between these two types of programs is quite blurred, as in the case of *Cubase Score* and *Musicator*. In general, however, sequencing programs do not excel at notation, so many people opt to use both types of programs.

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.

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.

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.

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.

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.

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.

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.

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.

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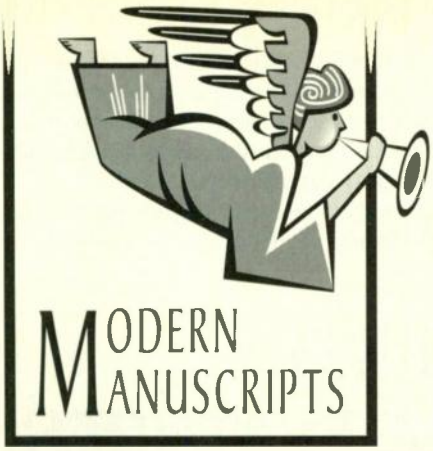


for those with an appropriate printer, PS is the way to go.

If you are working on a music book or music-theory worksheet, you need some way of exporting a graphic image of each musical sample. EPS files are an important, high-resolution graphics format supported by several notation programs.

The Standard MIDI File (SMF) is the only file format that most notation programs and sequencers have in common. With few exceptions, you must have SMF compatibility if you want to send data to and from other music programs. In this case, only note data and some information about key and meter signatures are transferred. Text and purely graphic information are lost in the process.

Another important output option to consider is part extraction, which generates individual parts from a master score. Be forewarned, though: Many programs require you to clean up the layout of the parts once they have been extracted.

TRANSPOSITION

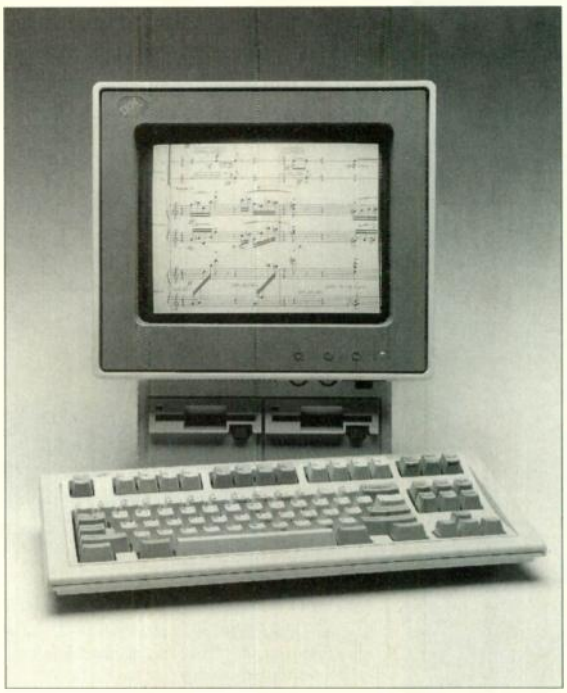
The ability to transpose in conjunction with copy-and-paste can save you a lot of data-entry time. *Chromatic transposition* shifts all selected notes by the same interval (such as a minor third). *Diatonic transposition* shifts all selected notes by the same number of lines and spaces. *Enharmonic transposition* maintains the pitches of the selected notes but changes their names. *Modal transposition* keeps the selected pitches on the same lines and spaces but changes the appropriate accidentals (to go from major to minor, for example).

MIDI

When you transcribe a real-time performance, or import an SMF from a sequencer, the notation program creates a compromised graphic representation of the original performance; the music must be cleaned up and visually quantized for notation display. A feature called *MIDI data capture* records key velocities, controllers (such as pitch-bend wheels and pedals), and the exact note durations and rhythmic placements (regardless of how notes are quantized for display). When this is performed properly, you can end up with well-notated music that plays back with all of the feeling of the original performance. Very few programs, if any, do this well with complex music, but it is a feature on which developers continue to work.

MIDI editing features allow you to change the MIDI playback of your score by adjusting tempo, key velocities, controllers, and the like. Another feature, called *MIDI expression marks*, lets you assign meaning to music symbols for MIDI playback (such as defining *forte* to mean high key velocity). *Finale* is noteworthy for its MIDI capture and editing features.

Passport's *Encore* 3.0 for *Windows*.



Temporal Acuity's *Music Printer Plus* for DOS PCs.

THE BOTTOM LINE

If you have sophisticated notation needs, there may be other features of interest to you that are not included here. These might include features such as the extent of the symbol set, support for *avant-garde* music, and support for early-music notation.

There are also price/performance issues. How long does it take to learn a given program? Once learned, how fast can you work with it? How fast (and how often) is the screen redrawn? How much must you know about the subtleties of music notation to make optimal use of the program? If the program is copy-protected, how much hassle is it? Ultimately, there is no substitute for trying out different programs, working with demo copies if they are available, reading all the reviews you can find, talking with your colleagues, and keeping in mind all of the questions raised at the beginning of this article.

One final word: When it comes to learning a new program, remember that you didn't learn how to play your primary instrument overnight. The best programs should not be ridiculously hard, but there is a price to pay for sophistication.

Once you've chosen the program that best suits your needs and budget, you'll be well on your way to etching out modern manuscripts of your own.

George Litterst *is a classical pianist, teacher, and music technology consultant who has written extensively on music desktop publishing. He specializes in transcribing complex keyboard performances with notation software.*

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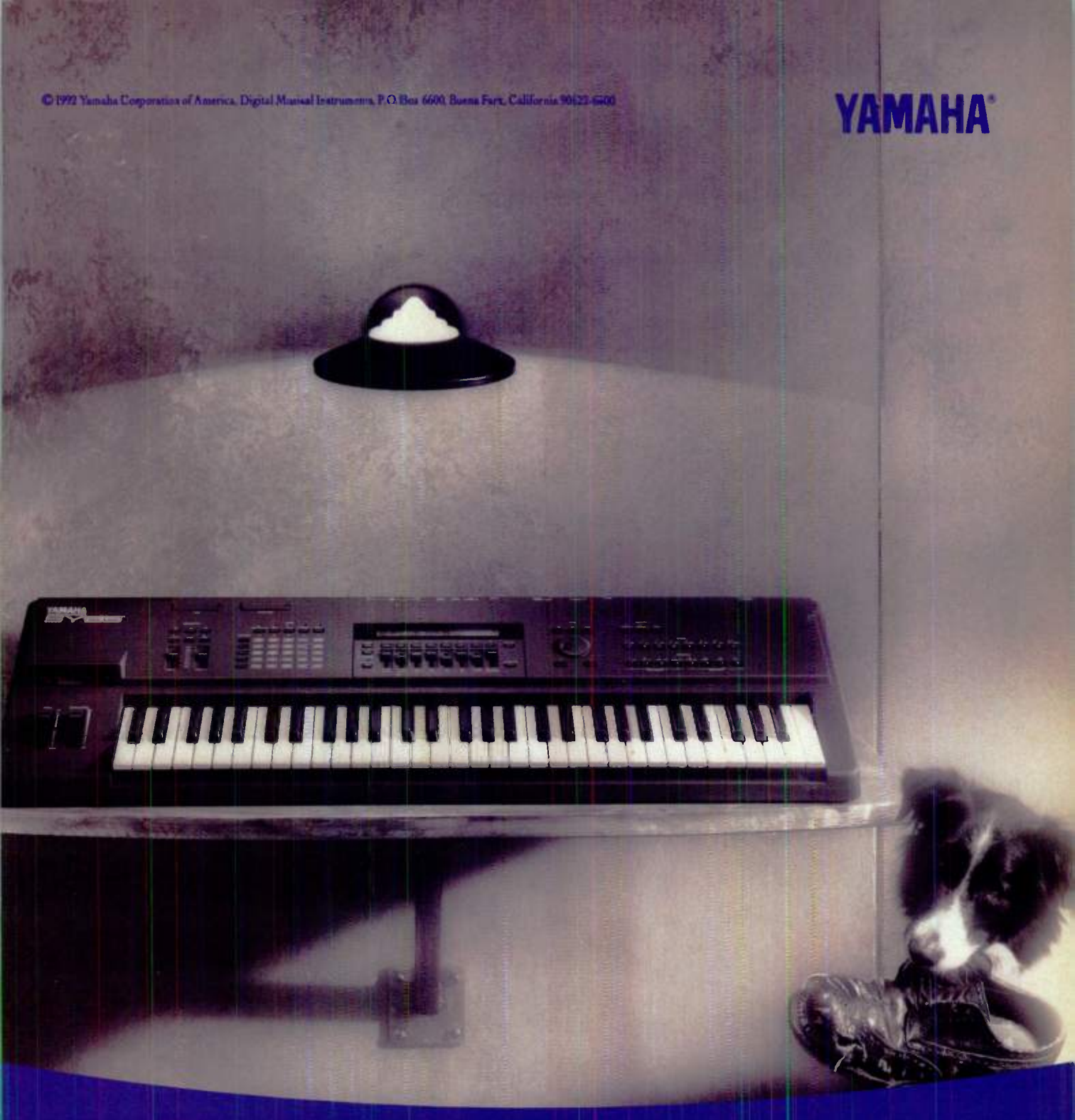

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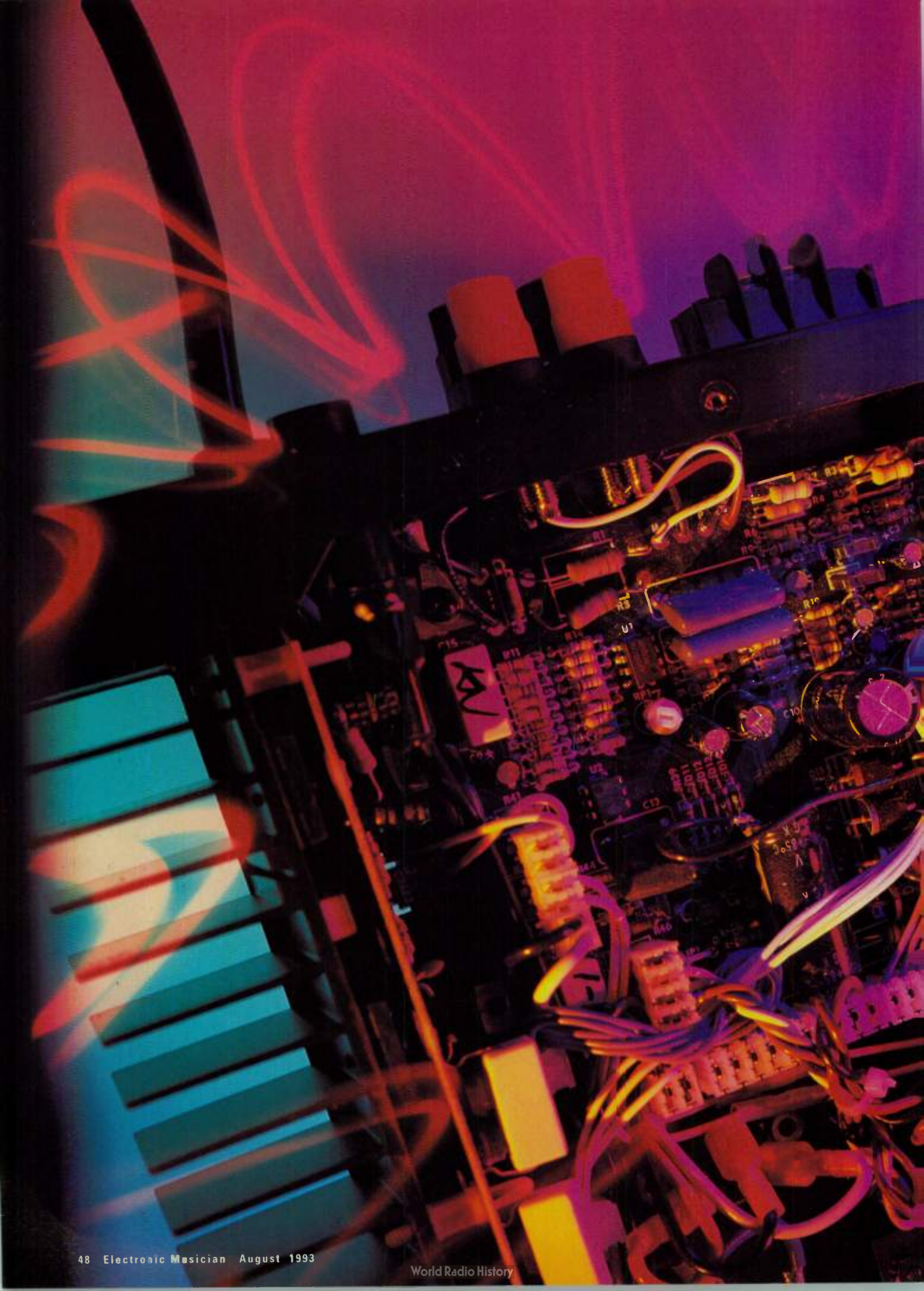

by David (Rudy) Trubitt

The POWER and the Glory

How power amps let electronic musicians be heard.

Making comparisons between most kinds of audio equipment is straightforward. Gear can be evaluated by its user interface and features—how many channels, outputs, etc.—and although "good sound" is subjective, it's simple to audition effects units or sound generators before you buy.

Comparing power amplifiers is more difficult. The sonic differences between reputable models are hard to assess, and even if you know what to listen for, few dealers are set up to perform rigorous listening tests. However, beyond price and spec sheets, certain design variables set one amp apart from another. Learning a bit about how amps work will help you make an informed choice. Power amp issues can be broken down into several overlapping areas: *sound quality; power* in real-world situations; and *weight, reliability,*

PHOTOGRAPH BY PETER OIGGS

POWER Amps

and *heat*, which are closely related.

So let's consider types of amplifier designs, hear how professionals choose their amps, meet some amplifier circuit designers, and consider the basic amplification requirements for studio and stage. As we'll see, choosing the right amp is a study in trade-offs; there is no "best" amp.

THE BASICS

Power amps have two input signals: 120 volts of alternating current (AC) from a wall outlet and an audio-input signal. The internal circuitry of an amplifier is designed to reproduce the shape of the input signal exactly, but at greater voltage and current.

The output of a power amp is ultimately connected to opposite ends of the speaker's voice coil. As the amplifier operates, it delivers a varying voltage. At a given frequency, the speaker's voice coil has a particular impedance (the proper term for resistances that vary depending on frequency, as speakers do). Current flows through the voice coil, causing it to oscillate within the field of a nearby, stationary magnet, moving the cone and producing sound. So, we have a voltage coming out of the amp and current flowing through the impedance of the speaker voice coil. The speakers connected to the amp's output are collectively referred to as the amp's *load*, and their total impedance is the *load impedance*.

THE POWER SUPPLY

At the heart of all amps is a power supply. Incoming 120 VAC power needs to be converted to direct current (DC) as a first step. A typical electrical power supply uses a transformer to decrease (or increase) the incoming AC voltage to a desired level. Power transformers are one of the heaviest parts of an amp.

The AC voltage coming off the transformer is converted into a rough DC voltage by a group of diodes. This is further smoothed by large capacitors, which are electronic components capable of storing a charge. Smooth DC voltage is the result.

For power amps and most audio equipment, two DC voltages are output by the power supply. These are typically voltages of equal potential, but opposite polarity (i.e., ±x volts). These *bi-polar* DC voltages are referred to as the *power-supply rails*. They are used to run the amp's internal circuitry, including the all-important power transistors, the largest consumers of power in an amplifier.

The maximum voltage (and by extension, power; see sidebar "Ohm's Law" below) an amplifier can generate is set by these supply rails. If the rails are plus and minus 50 volts, the amp will be capable of generating outputs up to 100 volts, peak-to-peak. Trying to go beyond that will result in distortion, as audio peaks beyond the rails will be clipped off (see **Fig. 1**).

OHM'S LAW

Amps, ohms, and volts crop up in almost every discussion of power amplifiers. Binding them together is Ohm's law. Nowhere in audio are the effects of this law more apparent than in understanding power amps and loudspeakers.

The three primary properties of electrical circuits are voltage, current, and resistance. German physicist Dr. Georg Ohm laid down the law with a simple equation describing the relationship between the three. It may not look like much, but it will turn up time and time again:

voltage = current x resistance

(We can also express this as current = voltage/resistance, or resistance = voltage/current.)

Current is the flow of electrons within a conductive material, such as copper wire. It is measured in amperes, or amps for short. Voltage is the potential difference that draws electrons through a conductor. Electrical potential is measured in volts. Resistance is the opposition to the flow of current within conductive material and is measured in ohms.

Amplifier specifications vary depending on the connected loudspeaker. Ohm's law says cutting impedance (resistance) in half doubles the current, so changing the impedance of a loudspeaker alters the amount of current drawn from the amp. But a typical spec for a stereo amp might read, "100 watts per channel into 8 ohms, 200 watts per channel into 4 ohms." So what's "watt"? Power, measured in watts, is defined by the equation: power = volts x current. The higher the current and/or voltage, the more power produced, so doubling the current results in twice the output power. One might be tempted to continue down this road, halving the speaker impedance (also called the amp's *load)* and turning a mild-mannered amp into a powerful brute. Why not 800 watts into 1 ohm? At last, math is on our side!

Unfortunately, physics is not. This magical doubling of output power is true only as long as the voltage across the loudspeaker is maintained. If the voltage drops, the power drops.

And the voltage will drop. Nearly all electrical conductors have some amount of resistance. A power amplifier is a bundle of conductors, each with some small, but significant, resistance. Resistance lurks in everything from the amp's AC power cord and internal power transformer to the speaker cables and connectors. As the current through the entire system increases, these little resistances become more significant.

The resistance in any current-carrying conductor creates a voltage drop (following Ohm's law). The little voltage drops developed across the resistances from the AC line cord through the speaker cable waste power, because they reduce the voltage available to the speaker. (This is one reason heavy-gauge wire should be used for speaker connections, never skinny guitar cords.) So cutting the resistance of the loudspeaker won't guarantee proportionally increased wattage. The only sure thing is you'll make your amp run hot.

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POWER Amps

POWER SUPPLY TRADEOFFS

Variations between amps often center around their power-supply design. These tradeoffs typically pit sustained power-handling capacity against size and weight. Pro amps have the ability to drive lower-impedance loads over sustained periods. Musician/semi-pro models are not designed for the heaviest of loads and therefore can use somewhat smaller, lighter, and less-expensive components. (To learn how to calculate speaker-load impedance, see the sidebar "The Ultimate Load" on page 60.)

Circuit designer Steve Selberg, of amp manufacturer BGW, describes one example: "We limited our Performance Series amps to a 4-ohm minimum load. We also aimed our duty cycle [the amount of working vs. idle time] at the 40 to 50% level, which is more typical of musician use than the 75 to 80% duty cycle of our pro touring line. A 2 ohm-capable amplifier would have meant a much larger power transformer and heat [sink] system.

"You probably find one of the largest variations in companies' power transformers," Selberg continues. "When you get into a 2-rackspace box, all you have is about 3.3 inches in height that you can put into a 3.5-inch package. If you don't go to a toroidal transformer, then you really start making compromises in how much copper and iron you can put into that space." (Toroidal transformers use a wire-wound, donut-shaped [toroid-shaped, mathematically speaking] core design that offers low profile and reduced hum emissions, but at a comparatively high cost.)

BGW chose a relatively small transformer for the Performance Series, considering the 4-ohm minimum load. "But," adds Selberg, "because a smaller transformer in a 200-watt product is going to generate a good deal of heat, we chose to go to a much higher-temperature insulation system [in the transformer windings]. It's a little more expensive, but it allows a longer operating time. We have internally inverted the polarity of Channel B to Channel A to get as much as 26% more efficiency from the transformer, but the audio path remains unaffected. The bottom line is to minimize the heat buildup, which maximizes the life expectancy of any electronic component."

Outside the audio industry, designers have sought more efficient types of power-supply designs. *Switching* power supplies start with the same 60 Hz AC power, but convert this power source to much higher frequencies, often over 100 kHz. The advantage gained is due to the changing behavior of transformers over frequency. At high frequencies, the same amount of performance can be gleaned from much smaller and lighter transformers. Long used in computers, switching power supplies can be found in amps by Stewart Electronics, Crest, and several other companies.

Conventional wisdom, for what it's worth, claims that this type of design tends to have a more "open," or clearer, high end, with a little less bottom than conventional designs. Your results may vary, though; a rep for Stewart Electronics notes a number of high-profile bassists now use the company's switching power-supply amps.

Most switching power supplies (and even some conventional supplies) are regulated, which can affect amp performance. Most unregulated amps store enough energy to reproduce musical peaks with much higher power than their average power rating would indicate. (The ratio of this "peak power," or "burst power," to the continuous average power is termed *dynamic headroom.*) In a regulated supply, the supply rails are controlled to stay at the voltage required for producing the specified output power. The positive result of regulation is that such amps may be able to produce their rated power even when the AC line voltage is quite low. The negative effect of regulation is an almost total absence of dynamic headroom; the amp will faithfully hit its rated power ceiling, but will never go higher. Thus, when line conditions are good, an amp with an unregulated power supply will sound considerably louder than a regulated amp of identical continuous average power rating, but it is more dependent upon the quality of its AC line voltage.

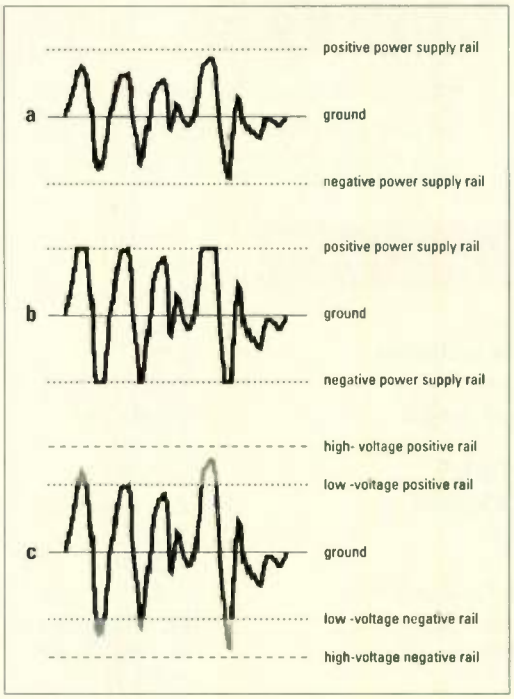

FIG. 1: (a) As long as the peaks of the reproduced audio signal don't exceed the voltage of the power-supply rails, signal peaks are preserved. However, if the signal tries to get above the rails (b), its peaks will be clipped off, resulting in audible distortion. Many amps use multiple-rail power supplies for increased efficiency (c). When the signal falls within the range covered by the lower-voltage rails, only they are connected to the amp's output transistors. When signal peaks appear, the higher-voltage rails are switched into the circuit, providing additional gain without clipping distortion.

BGW Performance Series 2

OUTPUT TOPOLOGY

The interconnection of power-supply rails and output transistors is another difference between amps. These various "output topologies" are referred

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to by letter designations. In Class A circuits, each transistor operates over the entire audio range, including positive and negative peaks. In contrast, Class AB amps use one set of transistors for *just* the positive portions of the output waveform, and *another* set for negative swings.

While it may seem unnecessarily complicated, this "complementary" division of labor makes for *much* more efficient amps, especially when amps are running at low levels. (However, a lot of power is wasted in the output transistors of Class AB amps, especially when the amp is operating at low output levels.) Most power amps use some sort of complementary-transistor output stage. Care must be taken in the design to ensure a minimum of distortion when combining the positive and negative halves of the final waveform. (Purists consider Class A sonically preferable, and Class A circuitry is found in the less power-consuming input stages of some amplifiers, including Ashley.)

Beyond A and AB, there are a number of other schemes. A common alternative is to use two or more pairs of positive and negative supply rails. By switching between a lower-voltage and a higher-voltage pair of rails as the output-signal voltages fluctuate, much greater efficiency is achieved. This doesn't just happen during soft passages; the rate at which the supply rails can switch is almost instantaneous. "If you put a 20 kHz sine wave into our newer amps [which use power MOSFETs]," explains Carver circuit-designer Dennis Griffiths, "the supply will actually go up and come back down in each half-cycle of the sine wave."

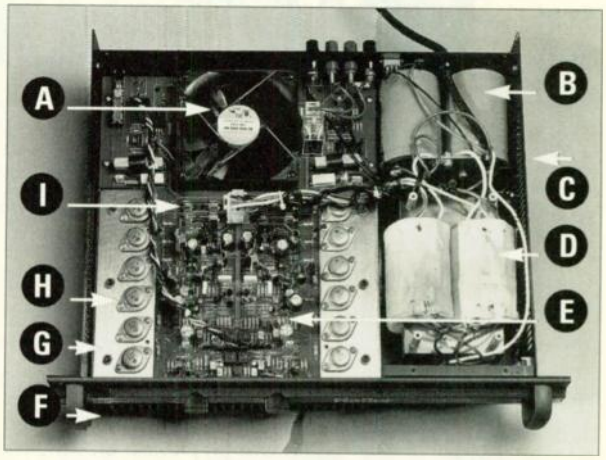

FIG. 2: In this Hafler Pro 5000 power amp, the main power supply is at right, including the power transformer (D) and capacitors (B). The fan (A) pulls air through the front-panel intake and filter (F), below the main circuit board, and vents it out both sides of the case (C). The main circuitry is divided into halves, one for each channel (E). The power transistors (H) are mounted to heat sinks (G), and internal fuses are provided (I).

Refer to **Fig. 1b** for a graphic example of how a multiple-rail amp behaves. An audio waveform is full of peaks and valleys. When the signal is loud enough to require the extra headroom provided by the higher rails, the amp's output circuitry switches the connection between power transistors and rails to use the extra voltage. When the signal drops below the "low rail," the higher-voltage rails are switched back out. Since most music consists primarily of soft sections punctuated by occasional loud peaks, most of the amp's operating time is spent using the low-voltage rails.

(Note that the term "switching" is also used to describe a type of power-supply design mentioned earlier. This is a potential source of confusion, as some amps use both switching power supplies and multiple, "switched" supply rails.)

Within this general class of designs are two variations: Class G and Class H. Class G leaves the rails connected to two or more sets of transistors and switches the output devices themselves in and out of the circuit, while Class H switches the supply rails in and out of a single group of power transistors. In addition to the cautions regarding distortion from complementary output transistors, care must be taken to minimize distortion resulting from the switching of supply rails.

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Crown offers yet another approach. "In a normal amplifier," says Mike Rockwell, Crown's manager of pro amplifier engineering, "when the audio waveform is in the positive half cycle, you're operating off the top rail of the power supply. When you go negative, the top rail idles, and the bottom rail works." Crown's patented Grounded Bridge circuit uses one floating supply that tracks the positive and negative portions of the audio and alternately connects the plus and minus supply rails to ground potential, essentially grounding the bridge.

(A point in a circuit is at *ground potential* when its electrical potential is the same as ground, i.e., zero volts. For more information on the principles of grounding, see "On Solid Ground," in the September and October 1992 **EM**.)

In other words, when the signal is positive, the negative supply rail is tied to ground potential. This doubles the effective voltage of the supply rails, because the voltage difference between rails is twice that from either rail to ground. "The down side is it's potentially much more complicated," says Rockwell, "but especially for large amplifiers, it's the only way to go. It uses all the transformer all the time, so you get more power per rackspace." (For more information on amp variations, see the sidebar on p. 72 of the December 1989 **EM**.)

THE EFFECT OF EFFICIENCY

Up to this point, we've just touched on efficiency. But how does this nebulous measure of performance affect you? It turns out that efficiency completes the circle of the many issues we've discussed so far: heat, weight, and output power.

Efficiency is the ratio between AC wall-outlet power consumed by the amp and the wattage actually delivered to the speakers. Power not delivered to the speakers dissipates as heat within the amp itself. Heat reduces the reliability of electronic components and must be removed to prevent failure of the amp. This is done by firmly connecting heat-generating components (primarily output transistors and power transformers) to metal "heat sinks" (see Fig. 2) that draw heat away from electronic components. However, heat sinks are heavy, which increases amp weight. Fans improve cooling, but they are noisy.

So adding more power generally entails an increase in heat or weight, unless the amp can be made to run more efficiently. Of course, once you have a more efficient amp, the temptation is to make it more powerful. These tradeoffs create an amplifier designer's merry-go-round. Where a particular designer decides to get off depends on the amp's intended application.

PROTECTION

A good amplifier has built-in protection for itself and the speakers to which it is connected. We've already talked

POWER Amps

damage loudspeaker components. You'll need at least 100+ watts per 8-ohm cabinet for a small, vocal-only P.A. system, and you might need a lot more. For those who deal with very large systems, there is another consideration. "I design large systems with as many as 180 power amps," notes Richard Zwiebel, "so for me, computer control also is extremely important."

Because live venues are already noisy, fan noise is of little or no consequence. That's good because delivering high output power makes amps run hot, and effective cooling is essential. Fans that change speed depending on temperature run quieter and draw less dust into the amp over time. This is a plus dust build-up can cause a reliability problem, and reliability is critical in front of an audience. (Some fan-cooled amps use dust filters, but these must be periodically cleaned.)

For instrument rigs, as with P.A. systems, amplifier reliability is paramount. The importance of sound quality here falls between studio and P.A. use. Although the quality of the amp's sound may or may not be perceptible to the audience, you have to listen to it all night, so you should be happy. Instruments that put out a lot of low frequencies (bass, keyboards, electronic drums) need plenty of power—at least 200 watts per 8-ohm cabinet is a good place to start—because reproducing low-frequency sounds requires a lot of speaker cone movement, which in turn demands extra power.

If you're like most gigging musicians, weight is always an issue. I have an effects-heavy (literally!) electric-guitar rig, and the lightweight, half-rackspace Stewart amp scored big points with me on my last gig.

THE ULTIMATE LOAD

When two or more speakers are connected to a power amplifier, their combined resistance goes up or down, depending on how they are interconnected (see **Fig. A**). It's important to understand how this works because the load impedance on an amp affects its total output power.

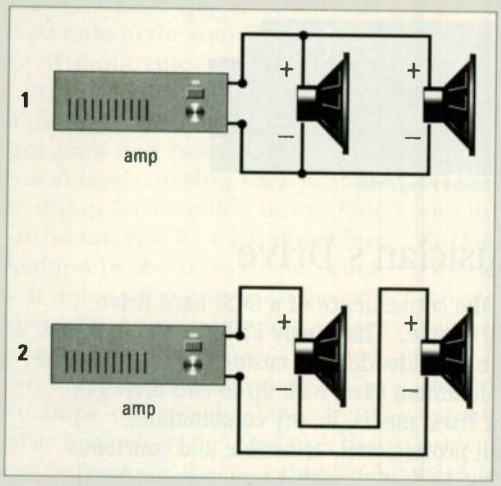

FIG. A: Speakers can be wired in parallel (1), in series (2), or in a combination.

When speakers are connected in series, the resulting impedance goes up, becoming the total of the individual connected speakers. So two 8-ohm speakers connected in series present a 16-ohm load to the amplifier. Note that series connection of loudspeakers is normally only used within the wiring of a single, multi-speaker cabinet.

When speakers are connected in parallel, the total load on the amp they're connected to goes down. This is especially important for live sound systems, because it's common to run two or more cabinets off the same amp. This can result in excessive amp loads; 2 ohms is usually the lowest load recommended for beefy pro amps but is usually too much of a strain on musician and semi-pro models.

Calculating the effective load of several cabinets connected in parallel is straightforward if they are all of the same nominal impedance. Simply divide the impedance of one cabinet by the total number of cabinets. Two 8 ohm cabs: 8 ÷ 2 = 4 ohms. Add a third: 8 ÷ 3 = 2.67.

If the speakers are not the same impedance, the total load will always be less than that of the lowest impedance cabinet. The formula is total impedance = $1/(1/R_1 + 1/R_2 + ... 1/R_7)$. R represents the nominal impedance of each cabinet, and the formula can be expanded to include any number of connected speakers. (R_n would be the last speaker in the parallel group.)

It is possible to combine parallel and series connections in the same loudspeaker system. For instance, 4 x 12-inch guitar cabinets often contain four 8-ohm speakers, configured as two pairs of series-wired speakers (16 ohms per pair). The pairs are wired in parallel, resulting in a system impedance of 8 ohms.

When comparing specifications, use the same yardstick. Compare amp power ratings at 8 ohms, and be sure the specs are for similar levels of distortion.

IN CONCLUSION

Despite rumors to the contrary, power-amp design is not a dark secret. A lot of information is available on the subject, and many manufacturers publish technical papers describing their designs in detail. In addition, "Power Amplifiers," in the December 1989 **EM**, includes a thorough explanation of the specifications used to measure amp performance. Yamaha's *Sound Reinforcement Handbook* is another good source. (**EM** back issues, the Yamaha book, and other books on the subject are available from Mix Bookshelf; tel. [800] 233-9604 or [510] 653-3307.)

Finally, remember that you usually get what you pay for. Manufacturers can cut corners on component quality to reduce cost, but this can compromise performance and reliability. As with so many things, deciding on a power amp is an exercise in evaluating compromises and tradeoffs. But with your newly acquired knowledge, you can apply Ohm's law to figure out why, in the absence of resistance, absolute power corrupts absolutely.

David (Rudy) Trubitt *is the sound-reinforcement editor for* Mix *magazine. He also recently edited* Concert Sound, *available from Mix Bookshelf.*

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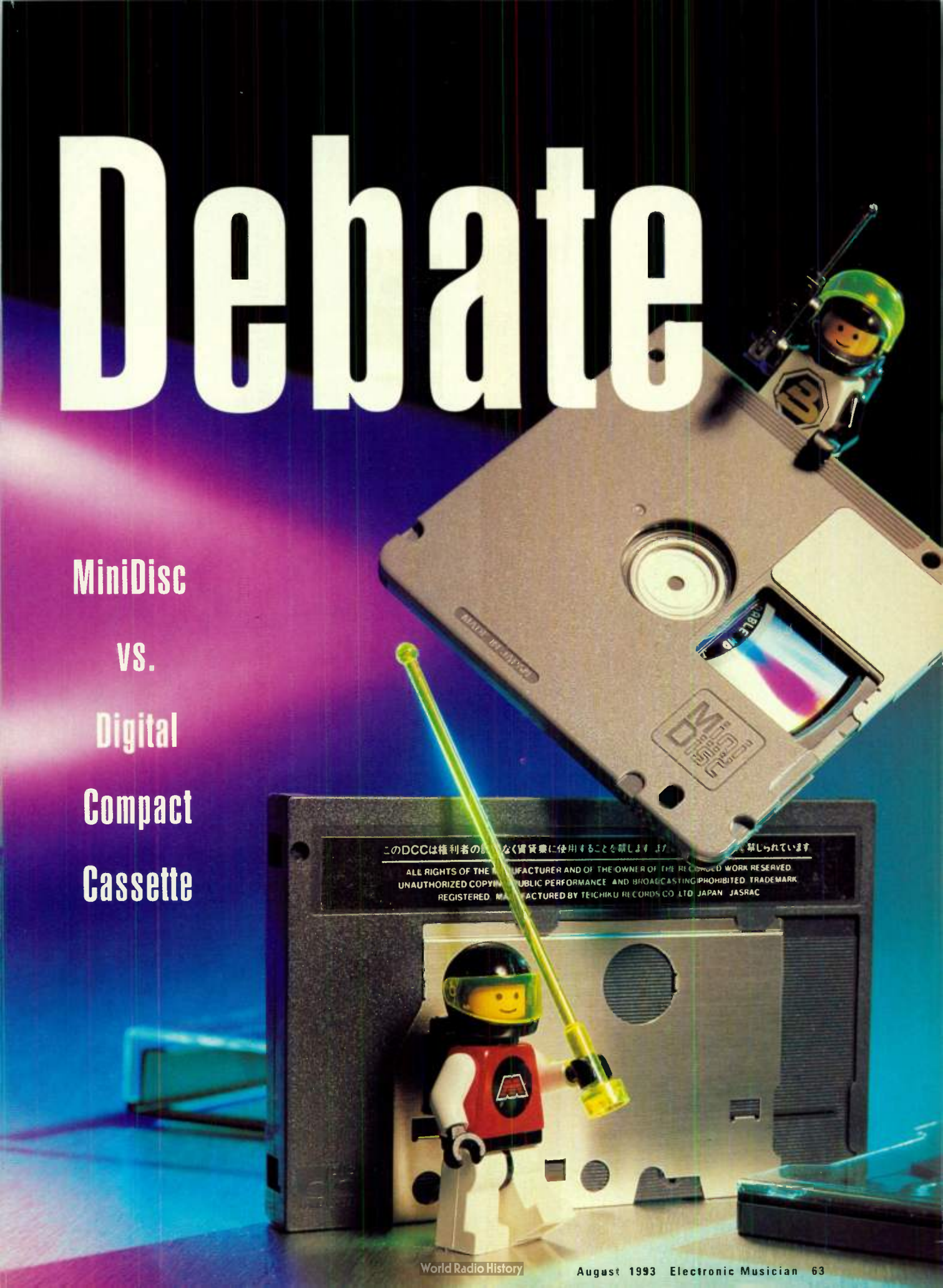
The Digital

By George Dmytryk

The analog cassette is an old and trusted friend, one you've grown up with, sharing triumphs and good times. Even when your interests started going in other directions, you'd still go out for a jog together or take a cruise in the car on a summer's evening. The old cassette proved to be a versatile friend, as well, growing to four and even eight tracks and sparking a revolution in home recording. ◆ But now the powers that be have declared our gracious friend to be a short-timer. In the cold words of corp-speak, it has "entered the final phase of the lifecycle." Its successor must sound better than the cassette, work better, and have new features, such as a digital display for song titles. To satisfy these requirements, the successful candidate must almost certainly be digital. ◆ Currently, two formats are contending to be the consumer's next choice for sound on the go. Philips, the inventor of the original cassette, has weighed in with the Digital Compact Cassette (DCC). As the name implies, DCC is a digital equivalent to the analog cassette, with the addition of intelligent search features and the aforementioned digital display. ◆ Sony's entry is the MiniDisc (MD), a miniature version of the compact disc that comes in a plastic shell like that of a 3.5-inch floppy. Unlike CDs, MiniDiscs can be recorded using magneto-optical technology. A MiniDisc is smaller than a DCC and adds random access and simple editing to the list of features.

Debate

MiniDisc vs. Digital Compact Cassette



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WHAT'S THE CATCH?

Before buying a new car, getting married, or adopting a new audio format, it's wise to ask a few questions, peer under the hood, and solicit the advice of someone you trust. Will the new format truly satisfy your needs, now and in the future? Will it look (and sound) as good on all the mornings after you first met?

Both MD and DCC use data-compression techniques to squeeze digital-audio data into a fraction of the space required by CD or DAT. DCC's Precision Adaptive SubCoding (PASC) achieves slightly better than 4-to-1 compression, while the MiniDisc's Adaptive TRansform Acoustic Coding (ATRAC) betters that at 5-to-1.

That's a lot of compression. The developers of both formats make much of their "psychoacoustically optimized" compression schemes, implying (if not actually stating) that no one will hear the difference between their format and CD or DAT, at least none worth mentioning. But it is clear that these compression techniques do change the audio data in some way. If the new formats have any Achilles heel, this is the place to look.

Much has been written about the technologies of MD and DCC, with various reviews and listening tests. But evaluations of performance have generally been limited to the subjective, or even the projective ("I *think* it wouldn't sound good after a few generations.") Published measurements have been limited to conventional tests, such as tone sweeps, that seem poorly suited to identifying the effects of compression on complex signals.

What we want is hard evidence, something we can hang our hat on and say, "There! That's what happens to the audio signal." We'd also like to compare, at least qualitatively, any differences in the behavior of the two compression schemes.

AUDIO DATA COMPRESSION

ATRAC and PASC encoding differ considerably, but share a common premise. They both perform Fourier analysis on the audio data during short, successive slices of time, then apply common knowledge of human hearing to reduce the data in ways that are (hopefully) inaudible to the listener.

It is well-known that the ear is not equally sensitive to all frequencies. Our hearing is far more acute in the midrange than at the high or low end of the audible spectrum. It's also known that loud sounds can completely mask softer sounds that are close in frequency. These principles are used to eliminate signal components below the threshold of hearing as defined by the frequency content during each time slice.

But this deletion of non-audible components is only part of the story. Equally important, ATRAC and PASC vary the number of bits used to represent each frequency band during each time slice, depending on their masking properties; bands with high-amplitude components are represented with fewer bits. This concentrates quantization noise where it is most effectively masked.

From these two points, we can surmise that the effects of PASC and ATRAC encoding include the removal of some low-level frequency components and an increase in measured quantization noise. Ideally, the effects are so cleverly distributed that no difference between the original and encoded signals is audible.

Admittedly (and by necessity), the foregoing discussion is superficial. For more in-depth information about the MD and DCC formats and data-compression schemes, see *Mix* magazine's March and April 1992 and November 1992 through March 1993 "Insider Audio" columns. Also see the "Technology Page" in the September 1991 and November 1992 issues of EM. (Back issues of both magazines can be ordered from Mix Bookshelf; tel. [800] 233-9604 or [510] 653-3307.)

▼

DAT users would be taking a step backward with either format, although less so with DCC.

THE METHOD

For my tests, I used a Sony MZ-1 MiniDisc portable recorder/player and a Philips DCC900 tabletop DCC recorder/player. These units are very different in form: The MZ-1 unit is roughly the size of a paperback, while the DCC900 is more like a power amp. This made it somewhat difficult to compare product features, but the intent was to test the performance of the media, not the individual products.

I recorded various selections from CD, including test signals and music in a variety of styles, onto a digital audio workstation (DAW). These selections were then transferred to both formats, and the outputs from each were loaded back into the system. All transfers were done digitally. The original, MiniDisc,

Philips DCC900 tabletop Digital Compact Cassette deck.

Digital Debate

and DCC files were then compared for changes in the audio waveforms and frequency content.

One part of the test sequence was to extract a signal representing the changes incurred in recording to either medium. This was accomplished by loading the CD original and MD or DCC output into parallel tracks of an edit list and aligning both tracks to the precise digital sample. The signals were played together and mixed, with one side digitally phase-inverted (see **Fig. 1**).

In effect, the signals are compared sample by sample. If the two files are identical, the output is total silence. If they are not, the output is the difference between them, including both signals added (noise and distortion) and signals removed (filtering). This cancellation testing is a powerful tool for evaluating the effects of various storage and processing techniques.

I also compared the digitally displayed waveforms and their frequency spectra, and subjected both to a certain amount of "abuse testing" to highlight the subtle and cumulative effects of compression. These latter tests included rate-shifting the outputs and creating multiple-generation copies in each format.

Technical tests were supplemented by repeated listening. At the end of testing, I recorded a CD-R with a number of comparison samples and distributed these for additional comments.

THE MADNESS

Initial impressions after listening to both formats were very favorable. Throughout the tests, I was impressed by the technical feat of reducing audio data to the equivalent of 3- or 4-bit resolution while retaining the clarity and punch characteristic of digital recording. Even when testing clearly revealed the technical limits, these effects remained difficult for me to hear except in (deliberately) extreme situations.

After collecting test samples, I went directly to the residual test described previously. A sample of music is shown in **Fig. 2**, along with the residual signals produced from the same passage on both MD and DCC. The level of the residual signal is far lower than that of the original.

What does the residual signal sound like? Both formats' residual signals sound similar, but there are important differences. In each case, it sounds like a whispering "ghost" of the original music. When the sound is amplified, you can clearly hear an "outline" that follows the envelope of the original. Much of the activity appears to be in the upper end of the frequency spectrum with bursts of noise or high harmonics, particularly on high percussion such as bells and cymbals.

The effect of dividing the signal into time slices is heard clearly as a timbral modulation at a few tens of hertz, almost like a complex filter driven by a stepped random source. These amplified residual signals have a distinctive and peculiar quality that could provide interesting samples for synthesis.

Fig. 3 shows the residual signal for each format magnified to show the difference between the two. Note that the level of the DCC's residual is much lower than the MiniDisc's. Consistently, the residual signal from Digital Compact Cassette was 8 to 10 dB lower than that from MiniDisc.

Besides its lower overall level, the DCC residual is more heavily weighted to the high end than the MD's. The attacks of midrange instruments that were nearly inaudible in the DCC residual could be clearly heard in the residual output of the MD.

This difference is demonstrated in **Fig. 4**, which shows spectral analyses of the residual from each format. The MD's residual output is spread across the audio spectrum, while the DCC's residual falls off rapidly below 3 kHz, matching what the ear reveals about these two signals.

Sony MZ-2P MiniDisc player with prerecorded disc.

THE ATTACK

The effects of recording to MD and DCC show up most clearly on attack transients. **Fig. 5** shows a high cowbell sample directly from a CD and as reproduced by MiniDisc and DCC. The MD output shows a clear "porch" ahead of the main attack. This "pre-attack" of the signal starts about 12 milliseconds before the main attack.

Close examination of the DCC's output shows a similar, but far smaller, addition. In either case, I was unable to hear the effects of this transient distortion in the first generation. However, the distortion accumulates through generations of transfer. Published reviews and informal comments indicate that some people, at least, hear this effect on MD in the first generation.

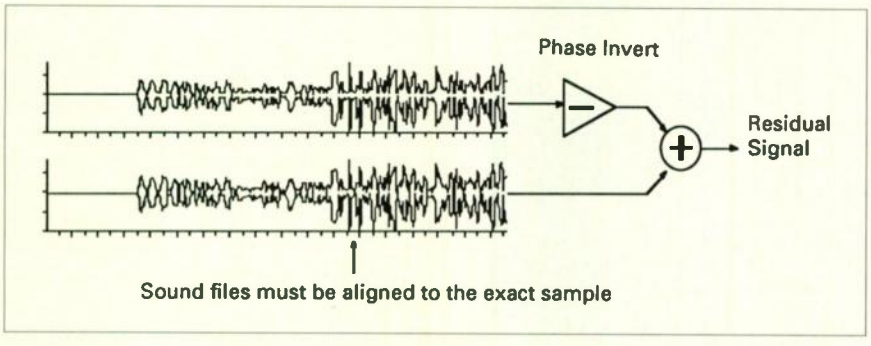

FIG. 1: To analyze performance, 16-bit sound files were loaded to a digital audio workstation, recorded to the subject unit, then read back into the DAW. Phase cancellation extracts the difference between the original and output signals.

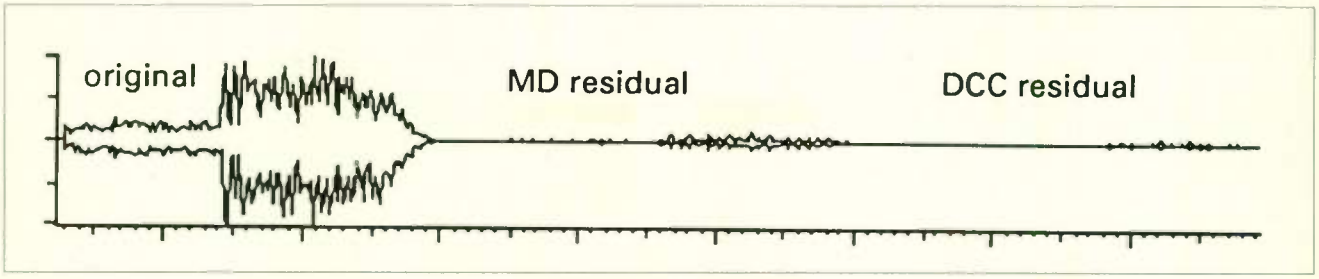

FIG. 2: A short sample of contemporary rock, with the residual signals from cancelling the MD and DCC versions against the original.

Some of the residual signal extracted from each format consists of partials that the compression algorithm deleted from the original. The removal of these partials should be detectable in the decompressed output. A frequency analysis of the cowbell sample is shown in Fig. 6. Both MD and DCC are generally faithful to the original up to about 15 kHz. At that point, the output of the MiniDisc falls off rather abruptly.

In the DCC, much of the content above 15 kHz is also missing, with the exception of two peaks matching prominent partials in the original signal. Apparently, DCC does what we would want, removing signals too low to be heard, while retaining others that are more significant to the perceived tone.

For most music, especially at low levels, analysis of the decompressed output yielded results that were similar for both formats, with almost everything above 15 kHz removed. In signals with greater high-frequency content, DCC preserved the features of the high-end spectrum noticeably better than MD.

GENERATION GAP

To test the effects of signal processing and multigeneration dubbing, I processed the MD and DCC outputs through a variety of filters. I was unable to detect any audible difference between the effects of the filter on the original, MD, and DCC outputs. This test was informal, though, and I did not apply any dynamics or time-based processing.

To alter the masking curves, I lowered the playback rate, shifting the pitch down by an octave. After shifting, there was a clear difference between the original and MiniDisc outputs. The MD's output was rolled off, especially on high percussion sounds. With DCC, the same sounds were preserved well, and I could detect little or no difference in the sound of the pitch-shifted original and DCC signal.

To test the effects of dubbing, a single source sample was bounced back and forth five times from the workstation hard disk, through each medium, and back again. I did not bounce from one medium to the other. After the first two or three bounces, percussive attacks on the MiniDisc began to smear audibly. On the fifth bounce, these attacks were quite evidently distorted; the high bells sounded as though struck by stiff brushes rather than sticks. Pumping quantization noise could also be heard.

▼

Initial impressions after listening to both formats were very favorable.

Similar effects were heard on the DCC, but to a far lesser degree; it took two, three, or even four passes before the effects became audible. Deterioration of the DCC on the fifth pass seemed about equivalent to the second generation on MD.

TESTING THE LIMITS

As mentioned earlier, all signals were transferred digitally, eliminating the effects of the analog electronics in either unit. Although it was my intention to evaluate only the formats, 16-bit CD may not be the best possible source. It appears that the input to these digital-audio data-compression schemes is not limited to 16 bits. Marantz has a pair of DCC decks on the market, the DD-82 and DD-92, that sport 18-bit A/D conversion with 20-bit output. The combination is said to realize the full 105 dB dynamic range specified for DCC.

We might also ask whether the implementations of encoding vary with model, and whether performance is fixed or subject to evolution over time. For PASC, the specification clearly defines both the encoding and decoding processes. There seems to be little room for change or variation between models. It's a little less clear in the case of ATRAC. It may be possible to improve the encoding side to achieve better overall performance. (*According to Sony, the ATRAC encoder in the MZ-1 is a first-generation design specifically intended for portable applications. They*

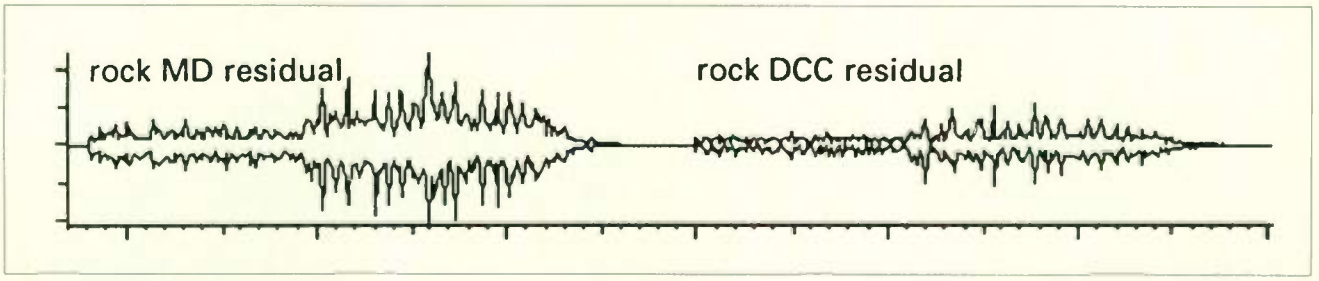

FIG. 3: A close-up comparing residuals from MiniDisc and DCC. The DCC's residual is consistently lower than that from MiniDisc.

Digital Debate

are currently working on second-generation encoders with the goal of improving frequency response, power-consumption efficiency, signal-to-noise ratio, and total harmonic distortion.—Ed.)

THE RESULTS

Throughout my tests, I remained impressed by the performance of both audio-compression technologies, as well as the MD and DCC decks themselves. Both sound excellent, if not perfect, and far better than analog cassette. Neither medium can be copied without loss, but the sound holds up well through a reasonable number of generations. Processing functions such as filtering and pitch- or rate-shifting affect the outputs, but to a lesser degree than I expected.

I was also surprised by the degree of difference I found between the two formats. In all tests, the DCC's PASC encoding appeared to outperform the MD's ATRAC. Both techniques are impressive, but PASC seems truly extraordinary in its performance.

Does this mean that DCC will win the battle for the consumer's heart? Not necessarily. I believe the MiniDisc package is more attractive to the consumer. The tiny, floppy diskette-like sleeve has the right combination of small size and apparent durability, while the sharp-edged DCC cassette seems a bit clunky by comparison.

The MiniDisc's random-access features are attractive, as well. To record on a partially full disc, simply hit Record, with no concern for cueing. Recording starts immediately, and the new material is added as a new track. It is also simple to remove dead air and unwanted material. The deleted time is added to the total time remaining on the disc.

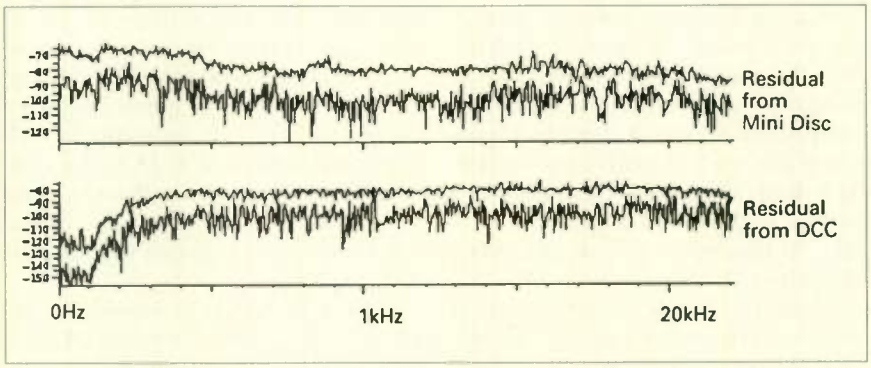

FIG. 4: Frequency analysis of residuals from MiniDisc and DCC. The MiniDisc indicates more effect on the input signal below 3 kHz.

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DCC boasts compatibility with analog cassette, but it isn't clear that this is a major plus. Of the people I spoke with, no one regarded it as a strong incentive in favor of the format. Most people seem to treat cassettes as a transient medium and do not treasure their collections as they do CDs and LPs. However, people with libraries of material on cassette may find this aspect of DCC attractive.

In addition, MiniDisc is likely to gain support from manufacturers who want to use its compact, rewritable data storage in notebook computers and game machines. They are also well-suited to replace tape cartridges in broadcast and theme park applications. DCC is still tape and is less applicable to general-purpose data storage/retrieval.

WHAT'S IN IT FOR US?

As musicians and recordists, **EM** readers want to know how MD or DCC will benefit them. In my experience, either format is less of a compromise than cassette or low-cost reel-to-reel as a mixdown medium, especially if bouncing is avoided. Of the two, DCC offers greater fidelity and robustness.

DAT users would be taking a step backward with either format, although less so with DCC. Immediate fidelity issues aside, both formats demonstrably alter the input, losing information and suffering generation loss as a result. If you are creating stereo masters for duplication, I believe it is best to use a "literal" format, such as DAT, that can be copied without loss.

If prices drop a bit, these devices will be attractive for both entertainment and home recording. Either format would serve well as a way to distribute demos, but that depends on one or the other becoming well-established first.

Portable MDs or DCCs could also make effective field recorders, but I would not use MiniDiscs for collecting samples to be transposed in playback. Changes in high-frequency response become clearly audible when the signal is shifted downward.

What about multitracking? The analog cassette's greatest gift to many of us was the advent of truly low-cost multitrack recorder/mixers. Will MiniDisc or DCC give rise to digital equivalents? For MD, basic engineering defines the rate at which data flows to and from the disc. However, we don't know what enhancements might be possible in the future. With DCC, head design appears to be the limiting factor. Thin-film digital heads are expensive to design and tool, and it might not be worthwhile to go to the expense of designing heads for 4-channel digital recording.

The technology of audio data compression could be applied to other storage media. In particular, PASC coding sounds good enough for a broad range of applications. This technology might be used in low-cost, and perhaps portable, hard-disk recorders. A 4:1 compression ratio could translate into a similar expansion in channels and disk space.

The analog cassette gave rise to an entire culture of experimental and speciality music releases fed by the low cost of media and setup for short-run duplication. If MD and DCC are to provide similar benefits, the cost of the recordable media and (in the case of MD) the setup cost for mass duplication must drop substantially.

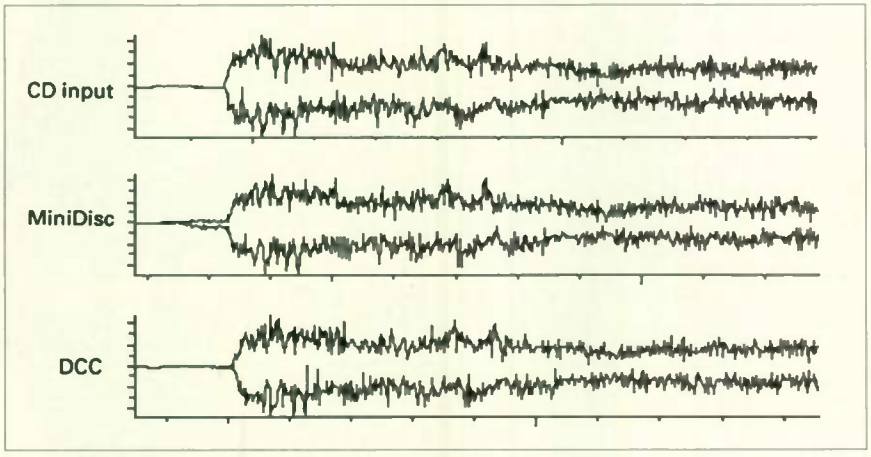

FIG. 5: A cowbell sample in original, MD, and DCC versions.

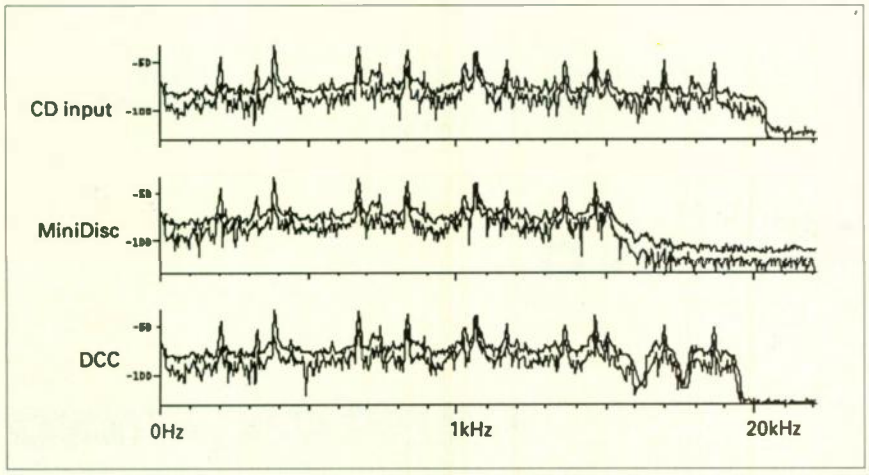

FIG. 6: Frequency analysis of original, MiniDisc, and DCC versions.

CONCLUSION

The tests I performed were meant to evaluate the effects of data compression in at least qualitative terms and provide a basis for comparing the performance of different compression schemes. The results appear to be valid and consistent with one another and with subjective judgments. I hope this information becomes a starting point for clearer, more detailed understanding of these new audio technologies.

George Dmytryk *lives in Wolf Hole, Arizona. His latest musical interest is Indo-tech rave remixes from the Punjab.*

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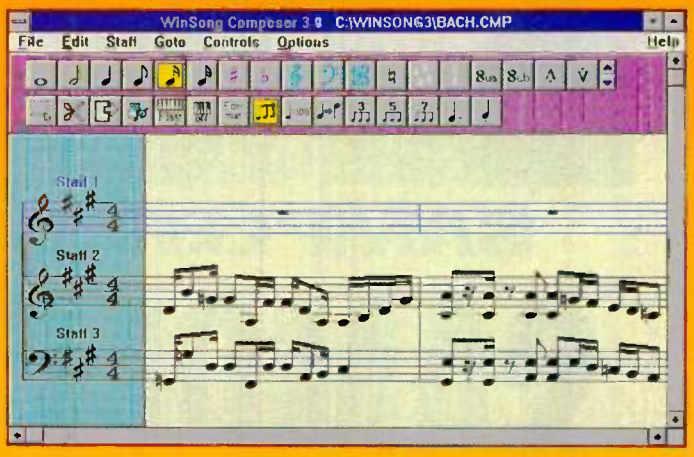

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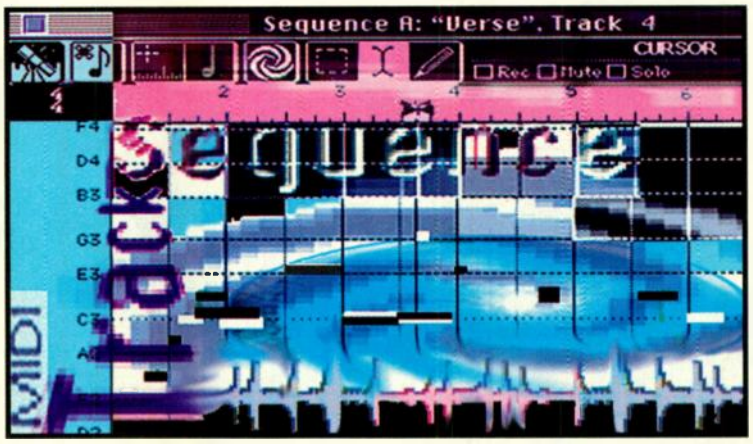
The Best of Both Worlds

By Joey Bargsten

Sequencers that integrate MIDI and digital audio offer tremendous creative potential.



If you're getting into software applications that combine MIDI with digital-audio recording and editing, you're probably elated about the quantum leap in musical possibilities. Software such as Opcode's *Studio Vision* (Mac), Mark of the Unicorn's *Digital Performer* (Mac), Steinberg's *Cubase Audio* (Atari, Mac, PC), and Twelve Tone's *Cakewalk Pro* (PC) provide a level of editing precision and flexibility that many recording engineers and composers only dream of.

The biggest challenges are determining what your particular system does best and coaxing it to do what you want. The following tips and techniques should help you squeeze the most from your MIDI/digital-audio system.

MUSICALLY INTEGRATED DIGITAL INSTRUMENTS

Replacing or supplementing a sampler with a hard-disk recorder is one of the most powerful, but often overlooked, applications for a MIDI/digital-audio system. Most people think of the digital audio tracks in these programs as simple replacements of analog tape tracks. However, you can replace MIDI-triggered samples by recording small sections of audio and placing them at appropriate times in the sequence.

Using digital audio programs such as Passport's *Alchemy* (Mac), Digidesign's *Sound Designer II* (Mac), and Turtle Beach's *Wave for Windows* (PC), you can create or assemble discrete sonic events (e.g., sound effects, individual drum hits, special musical events) and import them into the sequencer. Even if you own a sampler, you can free up its memory by placing discrete events in the body of the sequence.

You can also create dynamic, evolving timbres. For example, take a number of individual sounds (including those from any ancient, non-MIDI synths you may have lying around), normalize the levels of each fragment, and apply crossfades or smoothing between them. By placing these sounds within the sequencer instead of a sampler, you can precisely control where the transitions occur.

Digital audio tracks let you squeeze more voices from your MIDI synthesizers. If you want 16-voice polyphony from an 8-voice ESQ-1, digitally record eight sequenced voices, drop the audio into the sequence, and let the sequencer play the remaining eight voices. Keep the MIDI information for the first eight voices muted or in a separate sequence; you might want to edit and re-record the material later.

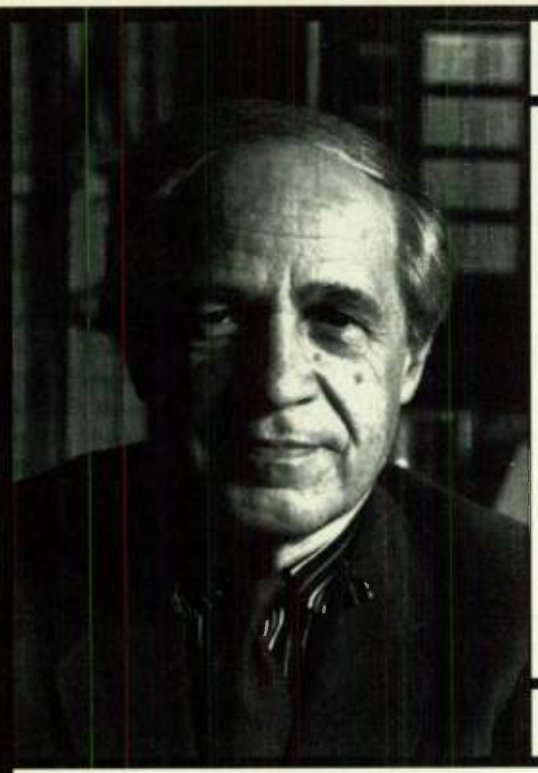
MIDI/digital-audio systems also enhance your sound-processing equipment. You can insert differently processed versions of the same take in the sequencer for auditioning, intersplicing, or mixing with the MIDI material. This is a useful option when you have a limited number of simultaneous effects. If you have only one effects send and return, you might record wet backup vocals directly to disk, then add a gate to the drum tracks and keep the MIDI tracks dry and clean during the mix.

Another effects application is real-time MIDI control. Any MIDI controller messages used to adjust effects parameters can be locked to the audio once it's imported into the sequencer. Result: Baby's first quasi-automated mix.

STEREO FROM MONO FILES

Stereo digital audio gobbles up hard-drive space twice as fast as mono. However, you can approximate stereo effects (including panning) by manipulating mono files. If you have each audio out-

DMITRY PANICH



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NOVEMBER 11-12, 1993

Conductor and composer Pierre Boulez and his Ensemble InterContemporain/IRCAM make their first visit to Carnegie Hall for a unique workshop and performance. This two-day workshop includes a lecture/demonstration, an open rehearsal, and a performance by the Ensemble InterContemporain/IRCAM with Mr. Boulez. The concert program includes Mr. Boulez' *...explosante fixe...* and *The Score of the Sky and the Inferno* by Philippe Manoury, both U.S. premieres.

It is during the two-hour lecture/demonstration that Mr. Boulez will present to the Workshop Auditors the new IRCAM Musical Workstation, better known as the IRCAM Signal Processing Workstation. The IRCAM Musical Workstation is a NeXT computer that includes a digital signal processing board designed at IRCAM between 1989 and 1992. It replaces the 4X computer, also developed by IRCAM. The Workstation allows sound transformation and synthesis in real time, as well as sound diffusion in space. As an example of its abilities, Mr. Boulez will use *...explosante fixe...* to demonstrate it.

SEEKING: 100 Workshop Auditors who are composers, conductors, sound technicians, or workstation programmers.

RÉSUMÉ and REPERTOIRE LIST: Please send a current, brief résumé, and a repertoire list of works either composed or conducted (if applicable). All materials must be typed.

APPLICATION FEE: A non-refundable application fee of thirty-five U.S. dollars ($35) must accompany this application. Please make check payable to The Carnegie Hall Corporation.

NOTIFICATION: Applicants will be notified of the status of their application by letter postmarked no later than Friday, September 17, 1993.

IF ACCEPTED: The fee for auditing the workshop is $150. (Concert ticket is included in this fee.)

TRAVEL and HOTEL: Auditors will be responsible for making and paying for their own round-trip travel arrangements to New York City. Carnegie Hall will make available discounted rates at a nearby hotel for workshop attendees (some restrictions apply). Hotel information will be included in the notification mailing.

WORKSHOP SCHEDULE: Thursday, November 11, 1993: afternoon open rehearsal and evening performance given by Pierre Boulez and Ensemble InterContemporain/IRCAM. Friday, November 12, 1993: 11:00AM-1:00PM, lecture/demonstration by Mr. Boulez and Ensemble InterContemporain/IRCAM. All events take place at Carnegie Hall. Schedule subject to change.

APPLICATION: Mail application, résumé, and application fee **postmarked no later than Monday, August 30, 1993,** to: Education Department, Carnegie Hall Corporation, 881 Seventh Avenue, New York, NY 10019. Inquiries may be directed to: (212) 903-9670.

Photo By Jacqueline Bossard

put from your sound board assigned to the right and left channels of your mixer, the spatial placement of audio segments change as you alter the *velocities* of identical, simultaneous mono files. This is particularly effective in *Studio Vision*. For example:

Import a mono audio file into a sequence as Audio Instrument 1. Then, copy this file to Audio Instrument 2. With the Key Velocity Strip Chart visible, drag the audio portions apart slightly (see **Fig. 1**) so you can see both velocities. Adjust the velocities of each segment to the desired spatial placement (see **Fig. 2**), and drag the segments together once again. You can cut and paste the second segment at an identical clock position to the first, or quantize both segments to ensure they coincide.

Although it's not strictly possible except in true stereo files, panning can be suggested with short mono files played in succession. Import a playlist into both audio tracks and gradually increase the velocities of one instrument while decreasing the other. Use the straight line tool in the strip chart for gradual velocity changes and the parabola tool for more dramatic spatial shifts.

TEMPO MAP TRAUMA

Although we are all accustomed to recording live audio to pre-existing click or MIDI tracks, some of us would prefer to record an audio track first—perhaps the guitar or bass—and embroider it with MIDI parts later. If this is your working procedure, or if you're asked to make a MIDI landscape that synchs to a rather extensive quote of original music from a *Leave it to Beaver* episode, you need a tempo map.

Most MIDI/digital-audio packages let you create a click track during audio playback; examples include the "user sync" feature of *Cubase Audio*, and *Studio Vision's* Tap Tempo. If your system does not provide this feature, you can create a tempo map as follows:

1. Import audio into the beginning of a new sequence, or a convenient cue point.

2. If the meter changes from bar to bar, transcribe the meter scheme and create a corresponding meter track. This procedure may require the time-honored method of rhythmic dictation and a #2 pencil.

3. Find the starting tempo and note any changes in the overall tempo scheme. (For instance, are phrases articulated by slowing down before important downbeats?) In the tempo track, enter the tempo for each measure, or each beat in measures with dramatic tempo shifts.

4. If your system displays a visual representation of the audio tracks in relation to MIDI events, notice where strong pulses occur and how closely the tempo grid lines correspond to the visual representation of the audio. Change the tempo for each bar until the visual pulses and grid lines coincide. This can be done in an event list or on a visual editing page.

5. Play the sequence, notice discrepancies, and fix them.

Although this is not the ulti-

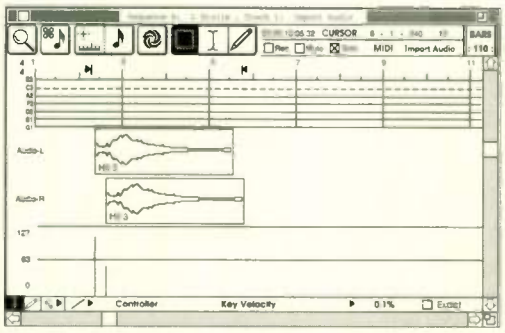

FIG. 1: Identical mono audio segments imported into *Studio Vision*, dragged apart to show velocities.

SMFs WITH DIGITAL AUDIO

Now that several programs offer the ability to work with MIDI and digital audio together, users are interested in a file format that lets them save their work in a single file and use it in different programs. As a result, sequencer developers have started working on an extension to the Standard MIDI File (SMF) specification that would allow sequences with digital audio to be saved in a standard, transferable format. The spec may take some time to finish, and the manufacturers will need additional time to add support for it to their programs, but it's encouraging to see that the issue is finally being addressed.—*Bob O'Donnell*

mate hi-tech approach to tempo maps, the result is more musical because you build the tempo according to your own perceptions of audible changes. There's no technological substitute for a good ear.

SMALL IS BEAUTIFUL

Digital Performer and *Studio Vision* include a Silence Threshold command, which erases the audio below a specified level and leaves the remaining audio segments separated by silence. These segments can then be quantized, which aligns the beginning of each audio segment with specific MIDI clocks. Solo vocal or instrumental lines respond to this process better than dense, complex textures. You may have to try several different threshold levels to find the best setting. Keep a backup copy of your sound file as a source for the ambience or room tone that is eliminated when you apply this process; ambience can always be added later.

Unless the material is a seamless, neo-Wagnerian fabric or a continuous, sanitary, new age landfill without perceptible articulation points, it's helpful to break large audio files into smaller files. Simply copy the entire file and cut all but one segment from it. Be sure you do this *before* you capture regions or make any links to MIDI sequences, otherwise the pointers to your digital audio will not match up.

▼

Digital audio tracks let you squeeze more voices from your MIDI synthesizers.

In the PC world, this procedure gives you more flexibility when placing .WAV files into a MIDI sequence. The more RAM you have and the greater your processor's speed, the faster your files will open and play. Audio files in *Master Tracks Pro 4* are sometimes sluggish, especially on a 20 MHz 80386 system, which has a rather glacial outlook on processing time. As a result, the digital audio may be out of sync with MIDI material. SMPTE sync improves the situation radically.

Small files also make it easier to apply

Pan Position (approximate)

Audio L velocity	127	95	63	31	(no audio imported)
Audio R velocity	(no audio imported)	31	63	95	127

FIG. 2: Pan as function of the velocity of identical mono audio segments (*Sound Designer II* audio imported into *Studio Vision*).

digital signal processing (DSP), which usually is destructive (not undo-able), or impacts a file globally. With shorter files, processing time for these operations is faster, and it's easier to create and audition multiple versions.

HARD DRIVES, SOFT WALLETS

Although it isn't always a pleasant thought, you have to think about storing your files once a project is complete. Small sound files—under twelve seconds in 16-bit mono—can be easily archived, without compression, onto high-density floppy disks. But audio files get very big very fast, and it's impractical to create an audio file larger than your current capacity to back it up.

Removable hard disks are one alternative to huge hard drives. SyQuest 88 MB or Bernoulli 90 MB drives offer a capacity of about sixteen minutes of mono or eight minutes of stereo audio per cartridge (at $80 to $100 a pop). However, removable cartridges are expensive as an archival medium.

DAT is well-positioned as an archival medium. If your DAT deck has S/PDIF (Sony/Philips Digital Interface), and you're working on a Mac, Digidesign's *DATa* can turn your DAT into an archival storehouse. Available free with the purchase of Audiomedia II, Sound Tools, and Pro Tools, *DATa* performs data and digital audio backup.

Another archival alternative is the 128 MB magneto-optical (MO) format. Disks are around $50, and although most MOs are not fast enough to serve as the recording drive (operating in the 35 to 40 ms range), they are getting faster every day.

THE END

The MIDI/digital-audio environment is extremely flexible and constantly expanding, which lets you explore sound in remarkable ways. Several of the major sequencing programs—including *Cubase*, *Vision*, and *Performer*—offer upgrade paths to versions with digital audio capabilities. These tools are going to be around for a long time, so now is the time to build a system that offers such rich potential for the composer and home-studio musician.

Orchestral/electronic composer **Joey Bargsten** *works as a graphic artist for The Coca-Cola Company in Atlanta and remembers when Tab Clear was only a key on the typewriter.*

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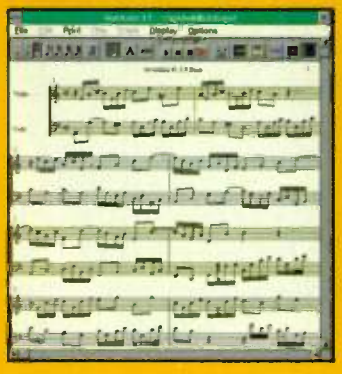

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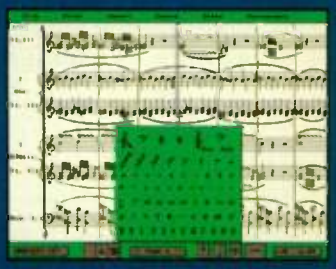

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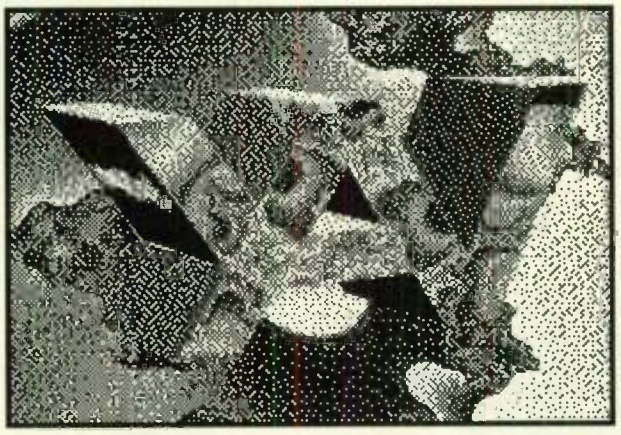
QuickTime Movie Sound

By Christopher Yavelow

Audio for digital movies is finally getting the respect it deserves.



Rodney Dangerfield isn't the only one who has trouble getting respect. In the realm of multimedia, music and audio are often tossed aside in favor of the picture. All the hottest programs, all the coolest technology, and all the greatest features revolve around video. The audio implementation in many multimedia products seems like an afterthought.

When Apple's *QuickTime* digital movie technology for personal computers was first released (see "Computer Musician: Computer Movies" in the November 1991 **EM**), most of the attention it received focused on its video features. In this case, the emphasis was justified. The audio capabilities were limited, and the video playback was an undeniably sexy display of technology. (Audio-only movies that could play sound files from disk instead of RAM is a nice, often-overlooked, feature of *QuickTime* 1.0, however.)

Having lived with *QuickTime* for nearly two years, though, it's clear that the audio support is lacking. Apple obviously feels the same way, because the recent release of *QuickTime* 1.6 and *Sound Manager* 3.0 have significantly upgraded the audio impact you can add to your movies.

HOW IT WORKS: HARDWARE

Before you can start creating soundtracks, you need to understand the capabilities of the various components involved in the process. The Macintosh has supported 8-bit, 22 kHz, mono digital-audio playback since its introduction in 1984. All current Macintoshes support 8-bit mono recording and playback at 22 kHz. The internal speaker, usable for only up to 11 kHz sampling rates, plays the left channel, or a mix of the left and right. The external audio port provides 22 kHz, stereo audio output, except on some of the less-expensive models (Performas, Classics, etc.), where it outputs only the left channel.

At the time of this writing, Apple is developing Macintoshes that will support 16-bit, 44.1 kHz digital recording straight out of the box. Many Mac owners already have this capability with the help of a third-party 16-bit sound card (such as a Digidesign board). To take advantage of the added audio horsepower these options offer, Apple has upgraded the *Sound Manager* portion of its System software to version 3.0. This upgrade allows users to fully integrate 16-bit, 44.1 kHz audio into *QuickTime* movies and throughout their computing environment. Many *QuickTime* programs already offer recording and storage of 16-bit soundtracks in anticipation of these developments.

HOW IT WORKS: SOFTWARE

Despite its video emphasis, *QuickTime* has several important audio features. First and foremost, it gives continuity priority to audio. In other words, it drops video frames before it drops audio data to avoid glitching the soundtrack during movie playback. *QuickTime* 1.5 supports four sound formats: Audio Interchange File Format (AIFF), Audio Interchange File Format-Compressed (AIFF-C), snd (a sound resource used by *Hypercard*), and sfil (System 7 soundfile). (Note that "sfil" is in lower-case letters; *Sound Designer* SFIL files are not directly supported by *QuickTime*.)

QuickTime offers unlimited soundtracks that consist of any mixture of 8-bit and 16-bit mono or stereo soundfiles at sampling rates up to 64 kHz. Theoretically, this allows for multiple-language versions or alternate soundtracks. However, in version 1.5, all soundtracks are

SOUND MANAGER FOR MUSIC

With the introduction of version 3.0 of Apple's *Sound Manager*, owners of 16-bit digital audio cards, such as Audiomedia, Sound Tools, and Pro Tools, will be able to use their excellent output quality for all aspects of the computing experience, including system beeps, game sounds, and other silly stuff. The new version will also allow any music applications that normally support playback over the Mac's speaker, such as sample-editing programs and some notation programs, to take advantage of the high-quality sound offered by the sound boards.

Note that these input and output capabilities do not affect hard-disk recording programs, such as *Sound Designer II, Studio Vision,* and *Cubase Audio.* These programs use another piece of Digidesign-developed software called the *Digidesign Audio Engine,* which supercedes the *Sound Manager* for these applications.

Digidesign has also developed a new version of the *Audio Engine* that will allow all of their existing cards to support up to four tracks of recording and playback within hard-disk recording applications.

mixed to 8-bit, 22 kHz stereo during playback (unless designated as inactive). *Sound Manager* 2.0 performs this conversion by dropping every other sample and the low bytes from the resulting 16-bit sample words. The CPU cycles used up during this conversion process significantly reduce the playback video frame rate. Decompressing MACE (Macintosh Audio Compression/Expansion) files places a similar load on your CPU, resulting in less video bandwidth. Mixing the tracks also slows the frame rates, but many *QuickTime* programs let you "flatten" a movie to merge all its soundtracks in advance.

QuickTime streams audio and video off your hard drive, so you must take your drive's data-transfer rate into consideration when choosing a sample rate for your audio (and deciding between mono and stereo sound). Extra precautions need to be taken with *QuickTime* movies destined for CD-ROM playback. Although newer CD-ROM drives offer higher transfer rates, there is a large installed base of drives that cannot achieve better than 100 KB per second for *QuickTime* playback. If you use a 22 kHz sample rate, with 8-bit mono samples (i.e., one byte), you only have 78 KB per second of bandwidth left for the video; 56 KB if your file is stereo. Using 8-bit mono sound at 11 kHz will leave a whopping 99 KB per second of the data rate available to the video (see **Table 1**).

This is not to imply that you need to avoid 22 kHz sound for CD-ROM playback. *QuickTime* movies with lower frame rates or those that use *QuickTime*'s animation compressor often leave enough room in the 100 KB/sec bandwidth to store 22 kHz audio. Furthermore, Apple's *MovieShop* utility or their Compact Video CODEC (compressor/decompressor) reduces the data rate of any *QuickTime* movie to CD-ROM-acceptable limits.

QUICKTIME SOUND STORAGE

Most *QuickTime* editing software offers two ways to store sound in a *QuickTime*

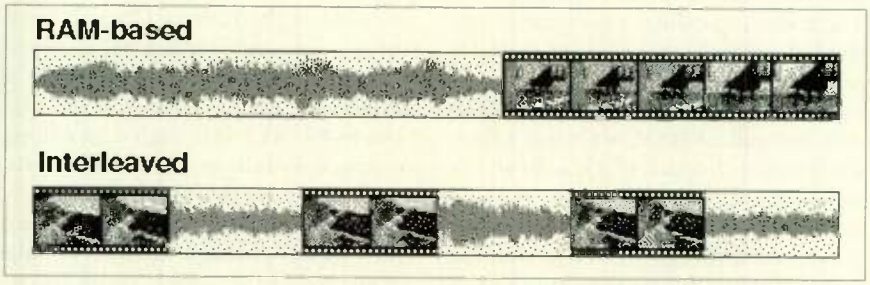


FIG. 1: Movies with RAM-based soundtracks store and load their audio data in a single chunk, whereas those with interleaved sound continually stream the video and audio data directly from hard disk.

movie: RAM-based or interleaved. The former loads all the sound into RAM before commencing video playback, at which point the CPU can devote itself entirely to the video. This implies that your soundtrack must fit into the available RAM, which places distinct limitations on file size. The latter approach interleaves the audio data with the video data (see **Fig. 1**). This is useful for longer movies where the sound will not fit into RAM, though it puts additional computing requirements on the CPU.

Another choice you need to make for *QuickTime* movies is how to store the audio. Self-contained movies store the sound data with the video data. Referenced movies, on the other hand, merely store a pointer to their associated external soundtrack file or files. Using the latter approach lets you easily edit or replace the soundtrack, but it also requires that you distribute the necessary soundfiles (in AIFF format) with your movies. Unfortunately, referenced audio will not work off a CD-ROM; it must be interleaved. Popular *QuickTime* editing programs, such as Adobe's *Premiere* (see **Fig. 2**), allow you to choose the storage method you prefer.

THE SOUND MANAGER

QuickTime audio is inherently bound up with Apple's *Sound Manager*, a collection of routines responsible for digital audio recording, playback, and file management. *Sound Manager* 2.0 has problems with multichannel *QuickTime* soundtracks. During the on-the-fly mixdown, each channel's volume is reduced to

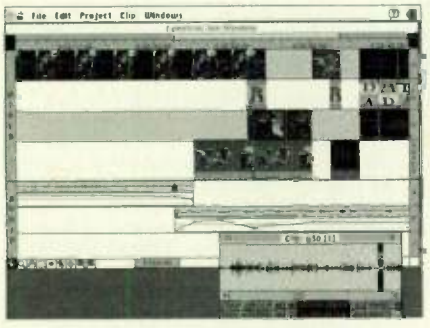


FIG. 2: Adobe *Premiere* provides three video tracks at the top, separated by an "effects" track (second track down). There are three audio tracks at the bottom. Beneath each audio track is an Audio Fade Control track that lets you create and drag unlimited break-points to define the soundfile's amplitude envelope contour. The soundclip windows let you set in and out points and markers at SMPTE addresses.

avoid clipping. For example, a 2-channel track results in a 50 percent volume reduction on each track, four channels has volumes reduced to 25 percent of the original level.

Sound Manager 3.0, supported by *QuickTime* 1.6, performs channel mixes with improved algorithms that do not necessarily reduce channel volume levels. In addition, the new *Sound Manager* offers audio playback at full resolution by routing 16-bit audio to an installed NuBus card (e.g., any Digidesign card.) By offloading the work of functions such as mixing, decompression, and sample-rate conversion (the capabilities depend upon the processing power of the sound card) to new output drivers developed by these companies, *Sound Manager* 3.0 frees a portion of the CPU from processing the audio. As a result, video frame rates for *QuickTime* movies should be one to three frames faster. It also means you'll be able to support more tracks of higher-quality audio.

Sound Manager 3.0 also offers plug-in modules (called "sifters") for signal processing, which are analogous to the video CODECs (compressor/decompressors) that make hard drive-based video playback possible. Standard plug-ins include modules that perform sample-rate conversion, audio mixing, MACE, and ADPCM (a popular DOS/MPC 4:1 audio compression scheme). Third parties may create plug-ins that could add any conceivable function to *Sound Manager* 3.0's digital signal-processing pipeline—software-based EQs, filters, reverbs, DDLs, pitch-shifters, and other DSP effects—though no user interface exists to interact in and use these elements in applications. (For more on *Sound Manager* 3.0's impact on music software, see sidebar "Sound Manager for Music.")

GETTING SOUND INTO QUICKTIME

You can use any of your current digital audio hardware to record sound to import into *QuickTime* movies. Additionally, most *QuickTime* video capture cards support audio recording either simultaneously with the video or separately (often a better strategy, because you get better video frame rates, though you might have sync problems later). *QuickTime* 1.6, in conjunction with Apple's CD-300 CD-ROM drive and version 4.0.2 of the *Apple CD-ROM* driver software, also lets any *QuickTime*-aware application import digital audio from a standard audio CD over the SCSI bus and save it as a *QuickTime* movie (see Fig. 3). In other words, you can open any CD-audio track directly in the digital domain, which is a very cool new feature.

Most *QuickTime* boards offer 8-bit sampling at 22 kHz or 11 kHz, but newer cards push the sampling rates up to CD-quality. Macromedia's MacRecorder and Articulate Systems' Voice Impact Pro are excellent low-cost solutions for 8-bit sound, and Media Vision's Pro Audio Spectrum-16 is a budget 16-bit option.

The three main players in the *QuickTime* video board arena also support some audio capabilities. SuperMac's Spigot and Sound Pro bundles a MacRecorder, and the pricier Digital Film supports 44.1 kHz, stereo sampling rates, but the resolution is limited to 10-bits. Radius's VideoVision offers 8-bit, 22 kHz sound recording. RasterOps MediaTime has Digidesign's Audiomedia hardware built onto their card, so CD quality is a snap. If you own a 16-bit audio card in addition to one of the above-mentioned video boards, you can use *Sound Manager* 3.0's ability to select a separate input and output source and

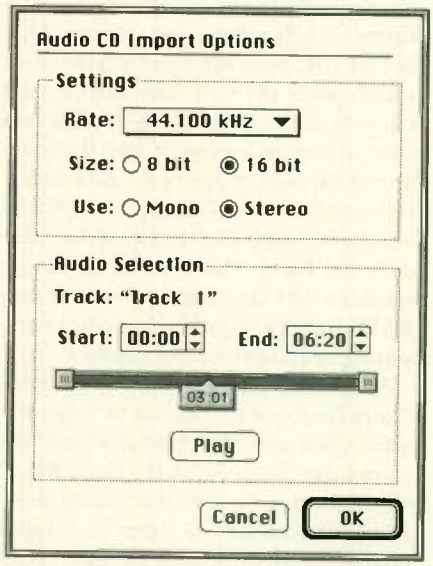


FIG. 3: *QuickTime* 1.6 allows you to directly import digital audio data off an audio CD if you use Apple's CD-300 CD-ROM drive and version 4.0.2 of the Apple CD-ROM driver software.

Sampling Rate	Resolution	Channels	Storage one min in KB	CD-ROM playback?	Usage Comments
22.254 kHz	8-bit	Stereo	2,607	maybe	Music and voice: Sound will consume 44 KB/sec of playback bandwidth.
22.254 kHz	8-bit	Mono	1,304	yes	Music and voice: Sound will consume 22 KB/sec of playback bandwidth. Only useful for playback through the external audio port. (The Macintosh built-in speaker won't reproduce sampling rates greater than 11 kHz.)
22.254 kHz with MACE 3:1	8-bit	Mono	435	maybe	Voice and sound effects: Consumes at least 7 KB of available playback bandwidth. MACE decompression will add about 20% to the CPU load and reduce fidelity.
11.127 kHz	8-bit	Stereo	1,304	yes	Music and voice: Consumes 22 KB of available bandwidth.
11.127 kHz	8-bit	Mono	652	yes	Music and voice: Consumes 11 KB of available bandwidth.
11.127 kHz with MACE 3:1	8-bit	Mono	217	maybe	Voice only: Consumes at least 3.5 KB of available playback bandwidth. MACE decompression will add about 20% to the CPU load and reduce fidelity.

Table 1: Acceptable sample rates for CD-ROM *QuickTime* movies.

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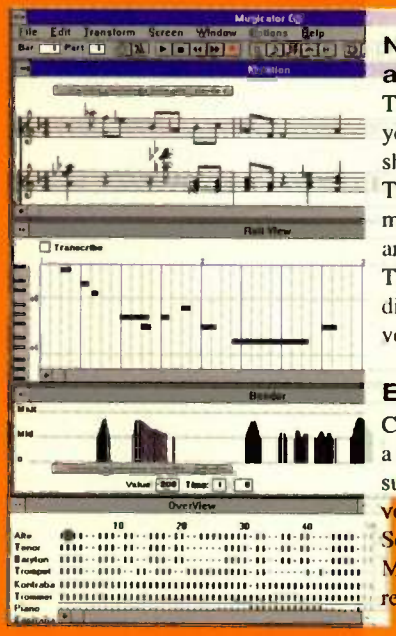

Notation, Piano Roll, Controller, and Overview Windows

The Notation View shows your music in standard musical notation. See your music the way you want to. The Piano Roll view is an "x-y" grid showing actual note duration on the x axis and pitch levels on the y axis. The Controller View is a graphic display representing non-note performance data. Use this to shape graceful velocity curves, bend notes or see and edit any other performance gesture as easily as moving your mouse. The Overview window represents measures of music, graphically displayed against tracks. Use this window to move the chorus, copy a verse, and edit large chunks of music.

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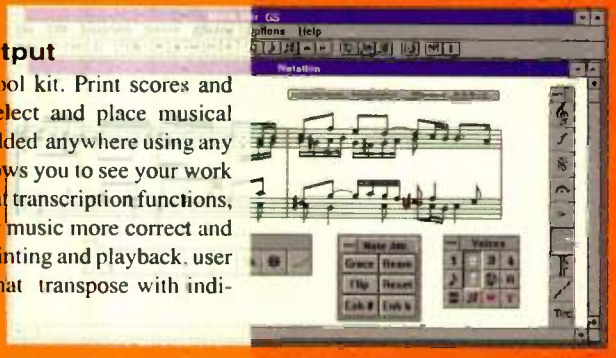

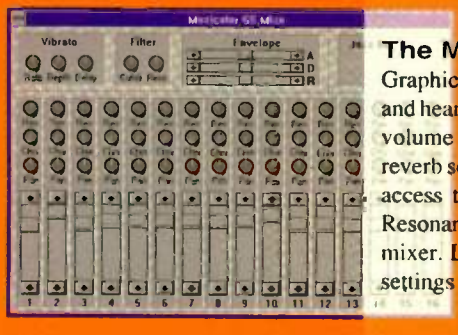

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override the default setting of these cards' built-in audio connections.

QUICKTIME AND MIDI

Apple plans to add a "Music Track" to *QuickTime* version 2.0 that will provide MIDI support for *QuickTime* movies. Tentatively called the "Macintosh Music Architecture," the entire package includes a software-based General MIDI synthesizer and the option to add third-party components. These components can take the form of alternative software-based synthesizers, or mappings to external hardware devices or NuBus-based synthesizers, such as the Digidesign MacProteus. The music track will be able to address these boards through an upcoming version of Apple's *MIDI Manager*. Unlike hardware MIDI sound modules, the Music Architecture will not be limited to sixteen MIDI channels.

Besides patch, channel, and instrument assignments, Apple intends to provide a mechanism controlling such parameters as tempo, transposition, channel volume, and other MIDI manipulations we have come to expect. Such on-the-fly audio control, unavailable with *QuickTime*'s current digital audio-based sound track, coupled with the immense reduction in audio storage requirements for Standard MIDI Files, will change the sound of *QuickTime* movies forever.

MAKING MOVIES

There are already some exciting CD-ROMs available that focus on the musical applications of *QuickTime*. Check out Interactive Records' "So You Want to Be A Rock and Roll Star" (see "Multimedia Musician: Interactive Music Lessons," in the February 1993 EM), Macworld Ventures' *Rock, Rap, and Roll*, Voyager's *Hard Day's Night*, Compton's New Media's *The Compleat Beatles*, and the new Peter Gabriel and Motley Crüe CD-ROMs.

Music and audio may be the unwanted stepchildren of multimedia production, but there's no question that with the proper support, they can make all the difference in the world.

Christopher Yavelow *wrote* The Macworld Music and Sound Bible (IDG) *and co-authored Random House's* QuickTime Book *and Bantam's forthcoming* Multimedia Power Tools *book/CD-ROM.*

The Digital Domain

By Larry "the O" Oppenheimer

Defending the purity of the source signal yields great digital recordings.

Less than twenty years ago, Thomas Stockham was a lone voice in the wilderness. The Salt Lake City visionary tried to convince the audio world to accept his Soundstream system, which captured sound using a new and radical method: digital recording.

By and large, the industry regarded Stockham's idea as less than viable. But today, as thousands line up to take home affordable 8-track digital tape or hard-disk recording systems, his vision is unarguably vindicated. Now, however, recordists are faced with mastering the idiosyncrasies of the digital medium.

THE DIGITAL CHALLENGE

Adapting to the digital-audio world doesn't have to be a difficult challenge. The nature of digital recording dictates some differences in approach from analog recording, but it also sharpens the focus on many concerns analog recordists have always faced. In particular, the inescapable truth of "garbage in/garbage out" looms large, because the digital medium offers no haven for flaws in the source material or the signal chain.

The scourge of digital recording is noise. Before you even think of pressing the Record button or setting levels, check the noise floor of your recording environment. It's difficult to gauge how much (or how little) your system impacts sonic hygiene unless you complete this simple test: Raise your monitor level to its maximum volume and listen to the amount and quality of noise when there is no signal. Be *extremely* careful. If someone accidentally plays a note while you've got the monitors cranked up, your speakers and ears (as well as your nerves) can be seriously damaged. It's best to test the noise floor before the session begins.

As much as you struggle to record pristine analog tracks, you have to sweat a little harder when recording digitally. No longer can you rely on tape hiss to cover up a noisy microphone or signal processor. To help meet this sonic challenge, manufacturers have developed quieter microphones, microphone preamps, instrument pickups, and even audio cables.

Unfortunately, clean equipment does not ensure clean tracks. It's critical that the various gain stages along the signal chain do not add noise. Usually, the first stage—the microphone or line preamp—has the most impact on overall noise performance. But don't stop there. Ascertain which components in your system have the best and worst noise performance, and set your levels accordingly. For example, if your mic preamp is noisy when pushed to the max, back it down to a "quieter" setting and use the mixer's mic trim and/or input fader to produce the desired level.

Of course, critical listening is only helpful if the monitoring environment is good. A computer fan (or other background noise) can mask the fine details you're listening for. Also, precise monitor speakers are imperative. What's the use of striving to record amazing sounds if your monitors can't accurately reproduce the fruits of your labor?

If your recording environment is compromised by excessive audible hiss, the seek-and-destroy methods of analog recording still apply. Try to locate the source. Is it a noisy preamp? Fractured gain staging? A bad audio cable? You can either solve the problem or live with it, but remember, the digital medium often highlights sonic flaws.

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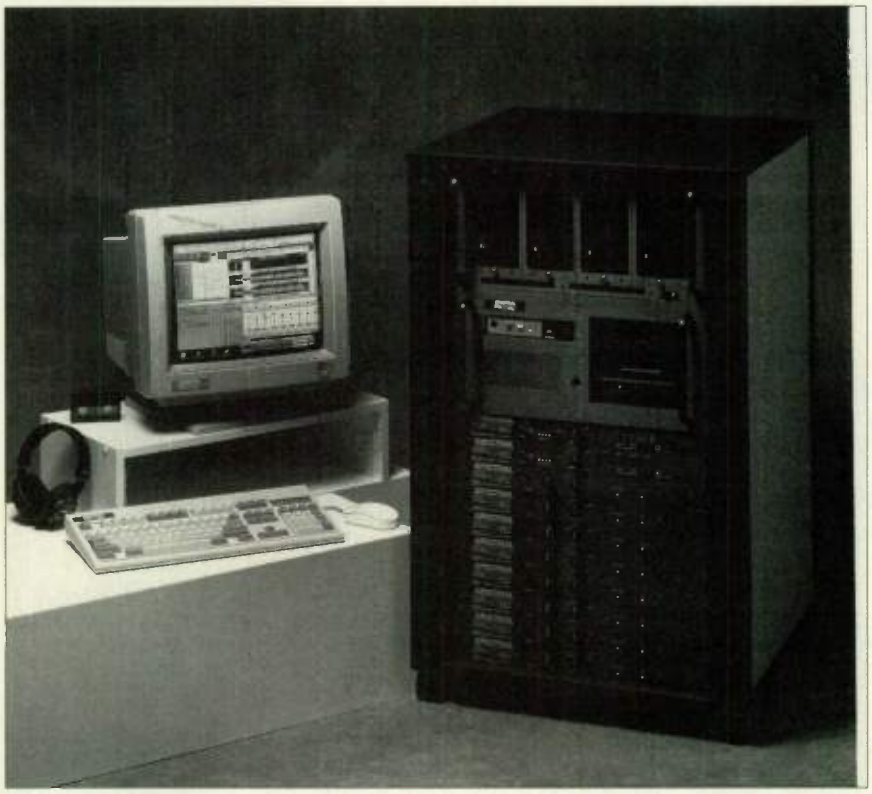


Hard-disk recording systems, such as the Spectral Synthesis Digital Studio shown above, offer the powerful advantage of random access. This capability allows the user to easily edit bits and pieces of different tracks, or even performances, without touching the original recordings.

that less is more. A high-quality mic, well-placed in a good-sounding room, should be matched with short, premium cables and a clean preamp. Then, the signal should be routed directly to the recorder. Assigning signals to a subgroup adds another layer of electronics and the possibility of added noise.

But no matter how pristine your signal chain is, acoustic miking is subject to unplanned environmental fanfares, which are eagerly documented by digital recording's extremely fine resolution. Beware of ambient noise, such as traffic, creeping into the background of a track. If the interstate highway runs through your backyard and room modification is not an option, you have two choices: Apply sonic bandages such as EQ and noise-gating, or record things that are less sensitive to the unwanted noise.

Taking the latter first, if you record a low-frequency track, such as a bass guitar, the traffic rumble may be acceptably masked by the source. Needless to

Tape-based, digital multitrack recorders, such as the Alesis ADAT and Tascam DA-88 (shown), offer inexpensive data storage compared to hard-disk systems. Users can just let the tape run and record multiple takes of a work without fretting over available storage space.

say, loud rock 'n' roll drums, distorted guitars, and aggressive synth patches can cover a multitude of sins.

The "bandage" approach, however, requires putting on your sonic-sculptor hat and employing signal-processing tricks. A highpass filter is the most common tool for reducing rumble, but take care not to thin out the overall sound. If you have comprehensive EQ control (via your mixer input channels, or an outboard graphic or parametric equalizer), cutting the signal below 100 Hz often diminishes low-end mud. You can also reduce audible hiss by rolling off some high frequencies. Noise-gating can clean up unwanted sounds by shutting down the signal when the instrument is not playing. This approach works best on loud tracks, such as amplified guitars and blaring horn sections, that mask the environmental noises during a performance.

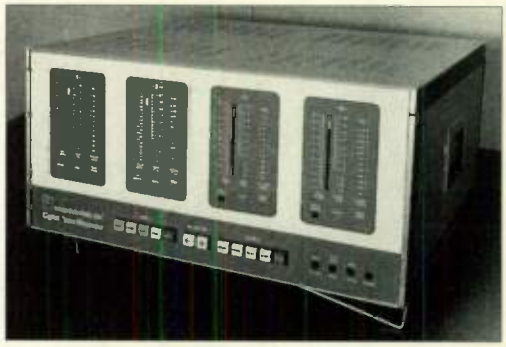
Sounds input directly (without using a microphone) are still subject to unwanted noise from bass-guitar pickups and synthesizer and signal-processor outputs. Here, EQ and gating are often your surest weapons. To diminish pickup hum, have the bassist rotate until the quietest position is found, and ask that he or she play without moving from that spot.

OPTIMUM LEVELS

The digital medium also differs significantly from analog in the case of recording levels. The dynamic range of the analog medium is limited by increased tape hiss at low signal amplitudes and the recorder's headroom at high levels. Digital does not suffer from tape hiss on low-level material, but weak signals can exhibit quantization distortion. This distortion occurs when the digital medium attempts to convert a low-amplitude signal into finite values. Sometimes a puny level makes it difficult to get an accurate "description" of the incoming signal, and sample errors occur. Low-amplitude, high-frequency material is affected the most by quantization errors.

At high recording levels, digital offers no gradual increase in distortion as the headroom limit is approached (as analog often does). But going a fraction over the headroom limit produces immediate and horrendous digital clipping. On some material, you might get away with the occasional clipping of a peak, but more than that is just plain ugly. Take this into account when calibrating your mixer level to your recorder level: 0 VU on your mixer should be anywhere from 12 to 20 dB below the clip level of your digital recorder.

Where should you set your recording levels when recording digitally? Essentially, you are playing a game of brinkmanship, trying to see how close you can go to the edge of overload without going over. Signal peaks, such as those produced by a drummer's performance dynamics, can be deadly. I tend to err on the side of caution when setting recording levels. To my ears, a touch of quantization shenanigans caused by low recording levels is infinitely less annoying than digital clipping. If you're the nervous type, taming dynamics with a fast, transparent peak limiter often soothes "overload" tensions.



At the 1976 Audio Engineering Society (AES) show, Thomas Stockham debuted his Soundstream Digital Tape Recorder by playing a digitally recorded and edited overture of an opera entitled *The Mother of Us All*. The opera session may have been the first practical digital field recording.

DIGITAL PARANOIA

If everything is done right, you should have a digital recording of startling clarity and detail. But when your finest aesthetic sense is thrilled by your achievement, should you rest on your laurels? Negative. It's time to get paranoid. Digital data can be very robust, but the storage medium may not be quite as tough, and the consequences can be dire.

If a digital tape acquires a crinkle—this happened to an Alesis ADAT S-VHS master on a recent project I played drums on—or a disk drive fails, an entire cut (or even the whole master) may be rendered unplayable. I even had a recording savaged by the digital recording system itself. These impending tragedies always remind me of a computer-industry adage: Digital data does not exist until it is stored in at least two places. You should always have safety and backup copies of your digital masters.

Many hard disk-based systems allow backup to DAT, which is an inexpensive way to buy some sonic security. (You can always erase and reuse DATs that store early backup versions.) I usually make a backup at the end of each hard-disk recording session. The only time I might risk not making a backup is if I add one minor and easily reproducable overdub. But after each session in which I add new tracks, I make a safety copy, even if the process takes so long that it means leaving the system alone to make the backup while I do other things (like sleep).

If you own one Alesis ADAT or Tascam DA-88, it makes sense to find a "backup buddy" so you can link machines to make safety copies. Keep in mind that making a safety is worthwhile even if you can't stay in the digital domain. A safety copy with an extra generation of D/A and A/D conversion is better than no safety at all. Don't forget to use the best tape you can afford. Also, prepare your tapes for safe data storage by "breaking" the tape before recording. Simply fast-forward the tape to its end, then rewind it back to the beginning. This procedure helps reduce the likelihood of tape dropouts and other media-related artifacts.

A CD-R (recordable CD) deck is an excellent method of archiving finished products. The stability of CDs in comparison to digital tape or hard disk more than justifies the cost of the medium. (Current stand-alone models start at approximately $7,000; the CDs themselves list at $30 each.)

CONCLUDING BITS

Digital recording is more accessible than anyone—except maybe Tom Stockham—could have envisioned twenty years ago. It's not really harder than analog recording; it just has some different characteristics and is less forgiving of errors. But once you develop a few basic good habits, great digital recordings will be yours.

In addition to being an in-demand engineer and producer, **Larry the O** *may be the Bay Area's busiest "band" drummer. He currently holds the sticks for local acts Stone Fiddle, Amazon Queen, Ascot Jacket, and Dave Crimmen.*

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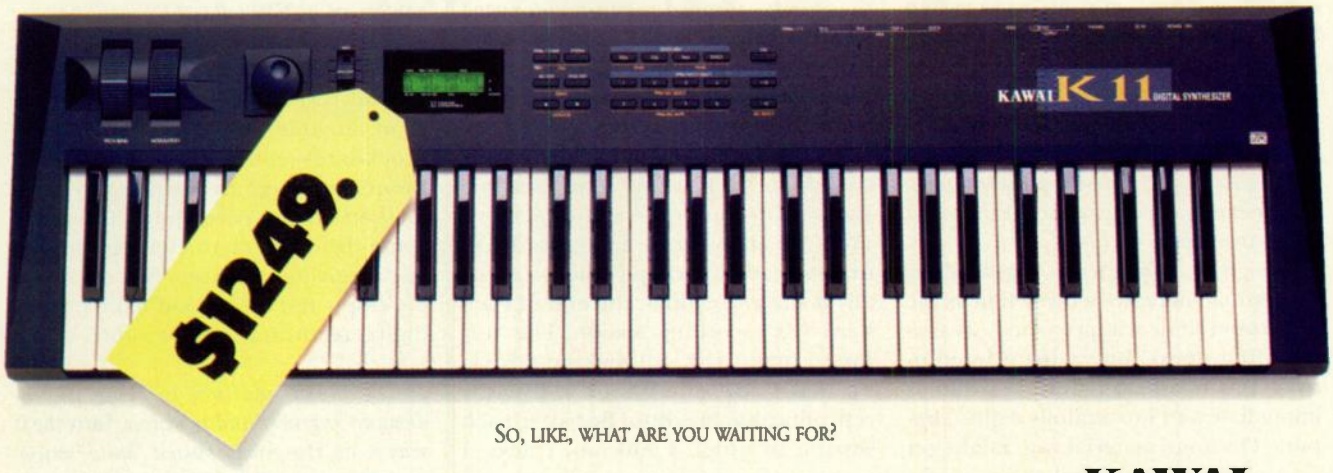

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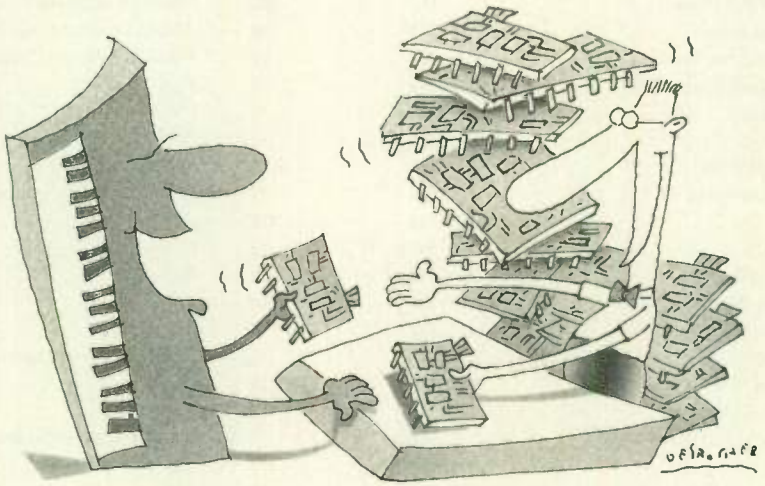
Questions & Answers

By Alan Gary Campbell

The techno-answer man discusses board-swapping and adapters for Yamaha breath controllers.



Q. What exactly is "board-swapping," and how does it relate to service? Is it a good thing, or a bad thing from the consumer's point of view?

A. Some manufacturers provide service through their authorized service centers by replacing circuit boards and major subassemblies, as opposed to troubleshooting and repairing boards at the component level. Since the troubleshooting time is minimized, this provides the advantage of fast turn-around (assuming that the replacement board is in stock or readily available). In addition, it provides uniform quality of repair via factory-refurbished boards that are relatively easy for the entry-level technician to replace. Finally, factory troubleshooting of defective boards allows the manufacturer to monitor failure modes and improve product reliability. The replacement boards generally carry a manufacturer's warranty, in some cases up to 90 days.

On the downside, manufacturers often take advantage of a "board-swap" policy as an excuse to provide the service technician with only as much technical information as is needed to identify and replace the affected boards. They do not, in such cases, provide schematics. The technician is left with little recourse: A major CPU board burnout and a bad pitch wheel-circuit diode both require a $250 board-replacement, which is a good deal in the former case, a bad deal in the latter.

This approach reduces the training required to service specific products and allows manufacturers to keep proprietary circuitry secrets a bit longer. But keeping technicians in the dark makes them feel untrustworthy and inadequate to the task, encourages laziness, and does nothing to hone service skills. As boards become more complex, board-swapping becomes more relied upon, technicians receive less training (since less is needed), and it becomes ever harder to find qualified service technicians.

A real solution to this problem will most likely involve a reapportioning of component-level service, with much less of it performed by music store-based service departments and small, independent shops. Stores and smaller service stations cannot afford the megabuck test equipment (such as signature analyzers; logic analyzers; ultra-fast, digital memory 'scopes; and surface-mount rework stations) needed to repair high-tech gear quickly and effectively. Even a reasonable parts inventory can be cost-prohibitive today, when semi-custom CPUs and DSPs sometimes cost as much as whole boards once did. (They are the equivalents of whole boards, really.) The trend in component-level repair is toward larger, regional service centers that can acquire the service volume and staff to afford full-blown service equipment and achieve a profitable balance between board-swap and component-level service.

Q. Is there a way to make an adapter that allows the Yamaha BC-1 and BC-2 breath controllers to work with the continuous-controller inputs on non-Yamaha gear?

A. This is a frequently asked question. The BC-1 and BC-2 use strain-gauge components to sense pressure variations, and they require a special interface circuit and a relatively high bias voltage to function. It is not possible to wire a simple adapter cable to allow these units to work with the continuous-controller or pedal inputs on non-Yamaha gear, which are generally intended to connect to

JACK DESROCHER

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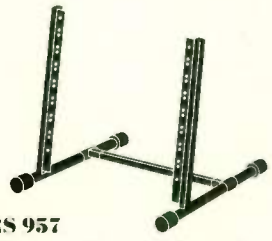

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potentiometer-type controllers. The only way to achieve this is to use a "smart" interface device, such as the Anatek Wind Machine, that interfaces with the breath controller and convert all those huffings and puffings to MIDI data.

Yamaha formerly manufactured the MCS2 MIDI Control Station (described in a sidebar on p. 30 of the January 1987 EM), which incorporated a breath-controller input and a merge function. You can still find these second-hand, though they're becoming scarce.

Q. Most keyboards, tone modules, drum machines, etc., employ battery-backed RAM. These batteries cannot be recycled and end up trashing the environment. Can you install a rechargeable battery instead?

A. You can't directly substitute a rechargeable battery for a lithium cell, as a circuit modification would be required to charge and discharge the battery. Also, there is often not enough space on the circuit board to allow the modification.

Some electronic-music devices have used rechargeable batteries to back up

▼

Future memory technologies will not rely on battery backup.

RAM (e.g., Oberheim drum machines). Unfortunately, rechargeable batteries, at the current level of technology, fail more quickly, use up more non-renewable resources, and cause more environmental pollution than do their non-rechargeable counterparts. Anyone who has lived with a cordless phone for a while can probably attest to the lack of reliability of rechargeable batteries. In contrast, the lithium batteries generally used in synths and effects can last up to ten years. Further, rechargeable batteries are bulkier and much more expensive.

Low-power, memory-IC technology continues to improve, and the current and backup-voltage requirements are becoming remarkably low. In some applications, the task can be performed by extremely low-leakage capacitors instead of batteries. If you own a Casio CZ-101 or CZ-1000 synth, you may have

observed this phenomenon. The CZ owner's manual states that the backup batteries must be replaced within five minutes of removal, or the memory contents will be lost. Yet the current drain of the memory ICs and the leakage current of the backup capacitor are so low that it is not uncommon for CZs to retain the memory contents a month or more after the batteries have been removed. Of course, the deliberate incorporation of such a scheme would demand that the unit be turned on, periodically, to recharge the capacitor.

Manufacturers will soon be required by law to provide battery-collection points for recycling, which will help to alleviate the problem of pollution and mineral-resource depletion. It is a given that future memory technologies will not rely on battery backup.

Q. The owner's manual for my PC and the caution panel on the diskette carton says not to let the diskettes get near the monitor. How am I supposed to keep them away from the monitor when it sits on top of the computer? For that matter, isn't the electromagnetic junk from the monitor impinging on the disks the whole time they're in the drive?

A. This is not as mysterious as it seems. The cautions are meant to prevent the user from allowing magnetic media to come in close contact with the monitor or any other electromagnetic field-producing device. The magnetic permeability of air is relatively low, so it is sufficient to keep an inch or more of air between these relatively weak fields and your disks. Moreover, the disk is effectively shielded when it is in the drive. This gives a clue with regard to safe shipping of magnetic media: Leave several inches of "air" around the media by containing it in an inner carton, surrounded by packing material sufficient to secure it within an outer carton.

Q. A single key on my Roland RD-250 digital piano squeaks, and it's really annoying. Is there some way to give it a lube job?

A. The key mechanism in an RD-250 is lubricated with white lithium-based grease (Lubrimatic, or similar) at the key pivot at the rear of the key, and at the side-motion gasket underneath and to the front. To get to this, you have to open the case; dismount, remove, and invert the keyboard; disengage the locking mechanism for the affected key; and remove the keytop. This is *not* a do-it-yourself job; refer the work to a qualified technician. There is a lot that even a tech can screw up with this much disassembly; the last time I worked on an RD, my helper, holding the dismounted keyboard upright, slipped, and the keyboard tipped over and broke my foot! Fortunately, the unit was resting on the floor at the time; I don't want to think about the energy it would have imparted had it fallen from the bench. A membrane-switch segment that has formed a partial vacuum under the dome can also cause a squeaking sound. Lift one corner of the membrane, then replace it, to stop this.

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

Reviews

Peavey DPM SI Synthesizer

By Jim Pierson-Perry

In pursuit of the synth/sequencer/master-keyboard hat trick.

Since its surprise entry in 1989 with the DPM 3, Peavey Electronics has marketed a steady stream of well-designed, good-sounding keyboard products. The latest offering, the DPM SI Phase Modulation Synthesizer (SI for short), is a keyboard "workstation" that combines a sample-playback synthesizer, a sequencer, two effects processors, and lots of master-controller MIDI processing.

The 32-voice polyphonic, 16-part multitimbral SI falls in the middle of the Peavey synth pantheon. Its synthesis features are more advanced than those of the DPM 2 (reviewed in the December 1991 **EM**), but it lacks the built-in disk drive, ability to import samples, and dual oscillators per voice of the DPM 3 family. (The DPM 3 was reviewed in the March 1990 **EM** and the DPM 3SE in the July 1991 issue.)

Peavey's DPM SI is an excellent value, offering 200 quality presets, a good variety of modulation options, two independent effects processors, and an outstanding 16-track sequencer with 96 ppqn resolution.

With the new synth, Peavey continues the practice of using powerful, general-purpose DSP chips driven by a ROM-based operating system. Future enhancements can be made by changing the operating-system chip, rather than redesigning customized synthesis circuitry.

HARDWARE OVERVIEW

The front panel holds a 40 × 2, backlit LCD with six underlying "soft" buttons, the functions of which change as you invoke different menu pages. Twenty buttons access system and editing functions. Pitch bend and modulation wheels, a master volume slider, and a data slider complete the anterior controls.

The rear holds the MIDI In, Out, and Thru jacks; a footswitch jack; a memory-cartridge slot; and two pairs of ¼-inch, L/R output jacks. The left main output jack is stereo and doubles as a headphone jack; the other outputs are mono. Unfortunately, the headphone/left output is bad news: The signal is quite weak, and I only heard the left-channel signal on a set of stereo headphones that were in good working order. Surprisingly, there is no CV foot-controller jack, which is a major omission, especially in a synth with extensive MIDI modulation options. Using the volume slider while playing two-hand parts is difficult for those with two or fewer hands.

The footswitch jack works with any single-pedal or dual-pedal footswitch of either polarity. Footswitches can trigger sustain, serve as modulation sources, trigger drum samples, or function as Inc/Dec buttons. They cannot trigger sequencer functions, however.

Memory cartridges can store patch data, but not sequences. All data, however, can be saved as a SysEx dump. Given the sheer number of patches, setups, and sequence data that can be stored, it's a shame Peavey didn't include a disk drive for more efficient storage. Undoubtedly, this was a price-control decision.

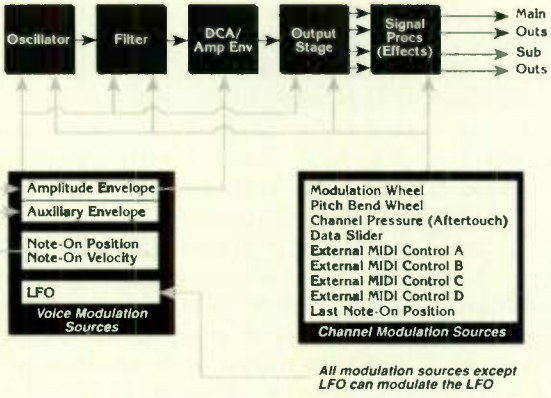


FIG. 1: The DPM SI's basic voice architecture comprises one oscillator, a resonant lowpass filter, and a digitally controlled amplifier (DCA). The signal is panned at the output stage, fed through the effects processor, and routed to the audio outs. A substantial set of modulation sources provide interactive, real-time parameter control. (Courtesy of Peavey.)

The 76-note, unweighted keyboard senses attack Velocity and Channel Aftertouch. Velocity sensitivity can be set to soft, medium, or hard in the global menu. Aftertouch comes in with moderate pressure and responds well. The action feels the same as virtually all unweighted synth actions.

SOUNDS

The SI houses 174 16-bit wavesamples in 10 MB of ROM. Up to 500 patches can be accessed at a time: 200 presets in ROM, 200 user patches in battery-backed RAM, and 100 from a cartridge. Unfortunately, the manual does not include a list of the preset Singles, Combis, or drum kits, which I consider a major omission. (*Peavey's representative informed us that the SI now ships with a plastic card that lists the 200 presets.—Ed.*)

Overall, the SI's preset programs (Singles and Combis) range from good to excellent, with most in the very good range. The instrument's sonic quality is also impressive; I heard no nasty artifacts in the samples and no gross grunge in the effects processor. The reverb is also clean and clear. You get good sound value for your money.

The majority of the sounds fall into the rock/pop instrument group—pianos, organs, lead synths, guitars, basses, and drums—and there are some orchestral emulations, mostly strings. Although there are some pads, the SI offers little in the way of spacey ambiences or special effects. The presets seem poised to challenge the Proteus, in that they are straightforward and do not offer a lot in the way of dynamic timbral development. However, the synth's modulation capabilities make it easy to come up with spacey, dynamic timbres.

The SI provides ten user-editable drum kits, each of which can contain any 32 wavesamples (percussion or otherwise). The drum samples draw from standard rock and jazz kits, rap sounds, with a scattering of Latin, orchestral, and ethnic instruments. They work well in a pop or rock setting, but less so for orchestral or world music.

Note that if you want to use an external controller in conjunction with the SI's keyboard, the SI won't read and merge incoming controllers unless you have operating system ROM 1.29. Also, except for the volume slider, SI controllers have no effect on notes triggered from an external MIDI device.

USER INTERFACE

SI operations are grouped into menus of related tasks: global setup, MIDI configuration, sound and Performance editing, sequencing, and copying. These menus are accessed through dedicated buttons on the front panel. Each menu contains multiple pages (display screens on the LCD, with associated soft-button functions), which are reached using the Increment and Decrement buttons. The editing and sequencing menus are so extensive that a separate set of buttons lets you jump to specific pages in them.

Within a page, parameters can be changed through the Inc/Dec buttons, footswitches, data slider, or the keyboard (for note ranges, a nice touch). Additional buttons let you exit a menu or operation; compare the original and edited versions of a program or Performance; copy various data types between programs, sequences, etc.; and confirm that, yes, you are sure you want to complete an operation.

In general, the user interface, which will be quite familiar to Ensoniq synth owners, works well. Menu pages are organized logically, with minimal clutter, and the system doesn't require esoteric button-presses for navigation. There are, however, a few weak spots. I wish the menu pages would "wrap around" as you go through them, particularly in the MIDI and global menus. In addition, use of the soft keys is somewhat unintuitive. You press a key to activate a parameter for editing, but you use the Exit button to deactivate it; why not another push on the same soft key?

When developing sounds, I often want to compare the current edit to the original. While the Compare button does this, it takes you out of Edit mode; to resume editing, you have to go back into Edit mode and find the page you were working on. I want pressing the Edit button immediately after a Compare operation to dump me back in the Edit menu, where I started.

Choosing oscillator waveforms is tedious. The manual has no ordered list of waveforms, and it's difficult to find the wave you want. A list should be included in the appendix.

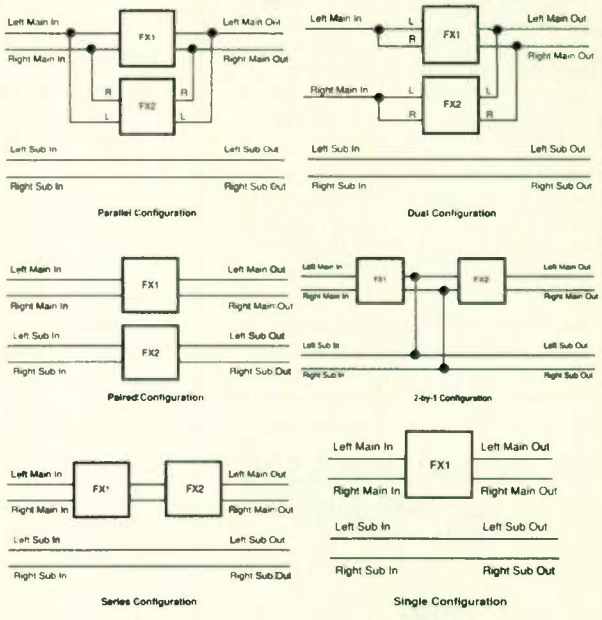


FIG. 2: The SI's effects processors can be used in any of six preset configurations. Except for reverb and Qverb, you can plug any effects algorithm into either processor. (Courtesy of Peavey.)

BUILDING SOUNDS

The SI has a richer architecture than I expected for a synthesizer in its price range. There are two levels of sound programs: Singles and Combis. In addition, there are two types of multichannel control setups: Multis and Performances.

A Single is the basic voice structure and is composed of an oscillator, a low-pass filter with adjustable cutoff and resonance, and a digitally controlled amplifier (DCA). The signal is panned to the desired stereo position on the output bus(es), fed through the effects processor, then sent to the audio outs.

Combis are combinations of up to four Singles and can have tremendous timbral complexity. Each Single gets its own key and Velocity range, transpose, detune, initial volume, and predelay (fade-in). All Singles in a Combi play on the same MIDI channel and have the same pan and output-bus settings. Depending on their setup, Combis can provide simultaneous splits, layering, and Velocity crossfades between the component Singles. The SI uses a proprietary dynamic voice-allocation algorithm that intelligently steals the "least useful" note in play. Most of my long, sustained notes were in pad sounds, and the voice-stealing was so subtle I didn't notice it.

The SI architecture offers lots of opportunities for modulation (see **Fig. 1**). Thirteen different modulation sources afford extensive real-time control over many synthesis and effects parameters. The sources include two 5-stage envelopes (one of which is dedicated to the DCA) and one LFO per oscillator; note position and Velocity; Velocity of the last note played; mod and pitch-bend wheels; Aftertouch; data slider; and four user-designated, external MIDI controllers. The controllers are divided into Voice and Channel sources. Voice sources can affect parameters in the oscillator, filter, and amplifier. Channel sources can affect the effects processor and any Single or Combi parameter. Unfortunately, all envelope times or levels are affected simultaneously by modulation; you cannot address a single stage.

As mentioned earlier, the ten user-programmable drum kits can use any 32 of the onboard samples. Each waveform gets its own key range, tuning, filter cutoff, decay time, stop mode, level, pan, and output bus routing. The preset kits follow the General MIDI map. Stop mode dictates whether the sound will die out naturally, play while the note is held and choke on release, or choke when another wave is triggered (e.g., so open and closed hi-hats don't sound simultaneously).

The SI provides three alternate tunings: major just intonation, minor just intonation, and mean tone. You can also program two new user tunings with any number of notes in an octave. When you choose an alternate tuning, it is applied to all Singles and Combis.

A given Single or Combi operates on one MIDI channel. To use the SI as a multitimbral device for sequencing, you create Multis, a multichannel construct that contains up to sixteen Singles, Combis, and/or sets of parameters for controlling external MIDI devices. In addition to its sound-making components, a Multi includes settings for the initial volume, pan, and output bus for each MIDI channel. The SI holds 50 Multis in memory. Unfortunately, you cannot audition programs from the SI keyboard while setting up a Multi. You can, however, audition them using an external keyboard.

PERFORMANCES

The SI also holds 100 Performances in battery-backed RAM. Performances are SI setups that enable it to work as a master controller, primarily for live performance applications. A Performance can control up to four Singles/Combis, each with its own keyboard zone and MIDI channel, and up to four external MIDI devices. With the SI's merging MIDI In, you can even

Product Summary

PRODUCT:
DPM SI Keyboard Composition Center
PRICE:
$1,799
MANUFACTURER:
Peavey Electronics
711 A St.
Meridian, MS 39302
tel. (601)483-5365
fax (601) 484-4278

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

use a remote controller (e.g., a MIDI guitar or strap-on keyboard) and play through the Performance routings.

As in most MIDI synths and master keyboards, Zones are specified key ranges to which you map the onboard sounds and external MIDI devices. This lets you create splits and layers. In addition, DPM SI Zones that use onboard sounds have controls for level, output bus, pan, effects processor on/off, effects program, and filter brightness. Zones sending to external MIDI devices have controls for the MIDI output channel, initial volume, Program Change (including Bank Select), and MIDI output filtering (separate from the global settings). In both cases, you can transpose the notes.

In addition to the timbral controls, you can solo and mute Zones in real time from the soft buttons. This requires some "hidden" button presses, i.e., there is no dedicated front-panel button or soft button with LCD indicator; you have to search through the manual to identify the correct sequence of button presses. It would be more useful to show Zone status on the LCD with a dedicated soft button.

There are a few other noteworthy Performance features. A Zoom Edit command takes the current Zoned internal Single or Combi into the editor without having to exit the Edit menu for the Performance. Selecting a new Performance causes the SI to automatically send an All Notes Off message and reset Pitch Bend, Mod Wheel, Sustain, and Aftertouch for the four MIDI channels of the previous Performance. You can disable any of these reset functions individually, which is a welcome touch.

EFFECTS

The SI boasts two 24-bit stereo effects processors. These can be applied, using the two output buses, in any of six preset series/parallel configurations (see Fig. 2). Each processor can produce any one of thirteen algorithms: reverb, chorus 1 and 2, delay, shelving filter, 5-band graphic EQ, gate, distortion, exciter, rotating speaker, Qverb, and bypass. In general, the effects are of good or excellent quality, with reverb, Qverb, and delay getting especially high marks.

Although you can't edit the series/parallel configurations, you can choose which effect goes in each spot, with the exception of Qverb and reverb. Qverb is a special "superambience" function that supplies predelay, 5-band graphic EQ, and a reverb tail. It requires so much processing effort that it can only be used by itself. Reverb can be assigned to either processor, but not to both.

You can assign individualized effects settings for each program, but only one algorithm per processor can be active in a Multi or Performance, or when using the sequencer. The active effects setting need not be taken from one of the components of the Multi or Performance; you can create your own effects setup, or copy one from any onboard Single or Combi.

Each effect has several customizable parameters. All allow control of the wet/dry mix, and the reverb, chorus, Qverb, delay, and rotating speaker effects also allow real-time MIDI control of a few parameters.

For those not satisfied with the SI's internal effects, the Sub audio out can be used for a stereo effects send/return loop. The returned signal is summed

with the main audio out bus. This format also lets you feed a separate audio signal as the return, which is then mixed with the main output bus.

MIDI IMPLEMENTATION

The SI directly responds to a somewhat limited MIDI message set: Note-On Velocity, Channel Aftertouch, Pitch Bend, Mod Wheel, and Volume. Program Changes can be translated through a program map. The SI can also recognize any four user-selected, external MIDI controllers (1 to 120) and assign them as modulation sources (CTRL A through D) for the internal sounds. This works especially well with a general-purpose MIDI device, such as the Peavey PC-1600 MIDI controller or JLCooper FaderMaster.

Independent MIDI filtering options let you set the SI to respond and/or transmit Pitch Bend, Mod Wheel, Volume, Aftertouch, Sustain, Program Change, and SysEx. This eliminates undesired incoming MIDI messages and customizes control of external MIDI devices.

A Global menu parameter lets you redefine which MIDI note number should be middle C, transposing the SI keyboard for all uses. Unfortunately, if you use an external keyboard and hold a note while changing this value, you get a series of hung notes. But if you use the SI keyboard, everything's fine.

Finally, if you run out of voices, multiple SI synths can be chained together into a single unit, using a MIDI Overflow feature.

THE SEQUENCER

The 80,000 event, 16-track sequencer is versatile, easy to use, and far superior to the sequencers found in many competing instruments. It runs at 96 ppqn resolution and can record all MIDI messages recognized by the SI except SysEx. You can use it for linear recording (up to 50 sequences), or take a pattern-based approach and assemble sequences into up to ten songs.

Overdub and Overwrite recording modes are available for single-track or multitrack recording. Transport controls operate through the LCD soft buttons, and the SI can recognize incoming MIDI Start, Stop, and Continue messages. Punch in/out is done manually, through soft buttons, which I found awkward when playing a two-hand part. I'd like to be able to use the

footswitch for this.

There are numerous playback controls and editing options. Tracks can play on any designated MIDI channel and loop independently. Quantization can be adjusted for playback only, or saved as a track edit. Mixing functions let you determine whether the track will play the SI, an external MIDI device, or both. You can set Program Change, volume, pan and output bus (for internal sounds only), and MIDI channel (for external devices only). You can record Volume and pan moves into the sequencer on all tracks, while it plays, providing automated mixdown. Track-editing functions include copy, merge, insert, delete, erase, transpose, scale Velocity, time adjust (± 384 clicks), and quantize (quarter note to 64th-note triplet). Micro editing allows you to add, delete, and change at the individual event level.

SUMMING UP

Overall, I am impressed with the design and capabilities of the DPM SI. Almost every time I thought I'd run into a limitation, it turned out to be a default setting that could be changed. The sounds are good, and the master-controller features are excellent, particularly considering the price range and additional features. The manual is well-written, but it needs another proofreading; a better index; a list of waveforms, drum kits, and presets (within the manual, in addition to the plastic card); and a tutorial on using the sequencer.

Most of my criticisms of the SI could be readily addressed in a software upgrade, except for the lack of a foot-controller jack. Others, such as its inability to accept new waveforms and lack of a disk drive, were probably design tradeoffs to give the important features without blowing up the price. Nonetheless, the DPM SI is more than capable of holding its own against the competition, and I readily recommend it. Peavey has another winner on their hands.

Jim Pierson-Perry *is a research clinical chemist by day, musician and writer by night, and father to four daughters and sixteen pets. As Warren Zevon put it, "I'll sleep when I'm dead."*

Roland SP-700 Sample Player

By Allan Metts

Serious sample playback for sound seekers and synthesists.

Like the automobile industry, the music-equipment industry has its Ferraris, Cadillacs, and Chevrolets. The Cadillacs usually have more sonic power, a slicker user interface, or a hotter new technology than their less-expensive counterparts, but don't provide the performance of the Ferrari. At $2,895, the Roland SP-700 Sample Player is priced like a Cadillac,

so I was eager to compare its features with those of other sample players on the market.

KICKING THE TIRES

The SP-700 is a sample player with 24-voice polyphony, 16-part multitimbral operation, and synth-like real-time digital filters and amplifiers (called Time-Variant Filters and Amplifiers, or TVFs and TVAs, in Rolandspeak). The unit has eight analog outputs, each with its own programmable equalizer. It has no digital inputs or outputs except the SCSI port and offers no sample-editing features. All sounds are processed internally at 48 kHz; the unit automatically converts sound data recorded at other rates.

The unit ships with 8 MB of RAM, expandable to 32 MB with standard 4 MB SIMMs. (There are eight SIMM slots, configured in 2-slot banks.) Surprisingly, you cannot install other SIMM sizes. Because it has no internal sample ROM or storage—there is no floppy drive, nor can you install an internal hard drive—the SP-700 isn't much more than a large paperweight without an attached CD-ROM or external hard drive.

The SP-700 loads sounds and programs directly from the Roland S-770/S-750 library and loads Roland S-550, S-330, and W-30 sounds and programs with a Convert Load function. Convert Load also imports Akai S1000 samples, although the manual never mentions this useful capability. I was able to load S1000 samples from a Prosonus CD-ROM, but the process was slow: A 6 MB file took almost fifteen minutes. Still, the ability to access the large libraries of S1000 sounds greatly increases the SP-700's sonic palette.

The front panel has a large, backlit LCD display; data-entry wheel; volume knob; headphone jack; five "soft" function keys; and enough page, parameter, and cursor buttons to easily perform all editing operations. MIDI and SCSI activity indicators and a power switch round out the front.

PETER DIGGS

Roland's SP-700 sample player lets you process samples with resonant filters and construct elaborate layering schemes, but it has no sample-editing features.

Two DB-25 SCSI ports; MIDI In, Out, and Thru; and eight unbalanced, ¼-inch outputs (configurable as stereo pairs) occupy the back panel. A convenient, removable panel provides access to the memory modules, SCSI terminators, and SCSI-bus power switch.

ENGINE ARCHITECTURE

The basic sonic building blocks are raw samples that you load from SCSI disk or via MIDI Sample Dump Standard. You

can combine up to four samples in a Partial (see Fig. 1), which includes the parameters for sample layering, switching, and crossfading. A 4-sample partial reduces polyphony to six notes. Each Partial includes one TVF with resonance, one TVA, and all the basic parameters for creating complex sounds (more in a moment). The filter and amplifier each have a 5-stage envelope generator, and the filter envelope can also be applied to pitch. The SP-700 depicts both envelopes in the display at once, which makes editing easy.

Once you've created the Partials, you combine and map up to 128 of them to independent note ranges in a Patch. Each Patch is assigned to one or more of the 32 Parts in a Performance. Each Part includes one Patch, along with settings for level, pan, and cutoff-frequency offset as well as MIDI-channel and audio-output assignments. Because you can assign the same Patch to two or more Parts, you can use a Patch in several different ways at the same time without redundantly gobbling memory.

At the top of the hierarchy, a Volume is the entire collection of Samples, Partials, Patches, and Performances. You can allocate two areas in the SP-700's memory in 1 MB increments to hold Volumes A and B. Although this provides two simultaneous sets of data (each containing up to 64 Performances, 128 Patches, 255 Partials, and 512 Samples), only one Volume can be edited and played at a time. This architecture lets you play Performances from one Volume while loading the other if your attached SCSI device supports this feature. To my knowledge, only Ensoniq's EPS/ASR samplers offer a similar function.

UNDER THE HOOD

To try out some of the synth-like functions, I took basic sawtooth-wave samples, created two Parts in a Performance that were slightly detuned, and processed them with the SP-700's filters and amplifiers. The result was a wonderful analog-synth sound that took me back a few years. The filters are quite smooth and can operate in low, high, or bandpass modes. The filter sweeps had none of the "stepping" that seems to characterize other digitally controlled filters. Roland also threw in an Analog Feel parameter that can randomly detune the pitch, slightly or severely, each time a note sounds.

The LFO features are pretty complete, with Delay, Key Follow, and Key Synchronization parameters. (In the latter mode, the LFO always starts at 0° of phase for each note played; this is similar to oscillator hard-sync on some synths.) There are eight LFO waveforms, including the usual sine, triangle, up and down sawtooth, square, and random waves. In addition, Bend Up ramps up sharply to a predetermined sustain level, and Bend Down ramps down to a sustain level. When applied to pitch, the last two waveforms create a pseudo-portamento effect. (The SP-700 has no true portamento.) A Rate Detune parameter subtly alters the LFO rate each time you play a note, which is great for string ensembles comprised of several solo voices; each voice has its own slightly different vibrato rate, just like a real string section. Unfortunately, each Partial only has one LFO to share between pitch, filter cutoff, amplitude, and pan modulation.

When the SP-700 runs out of polyphonic voices, it uses dynamic voice-allocation with last-note priority; new notes cut off old ones. Using the Patch Priority feature, however, you can specify one Patch in a Performance that

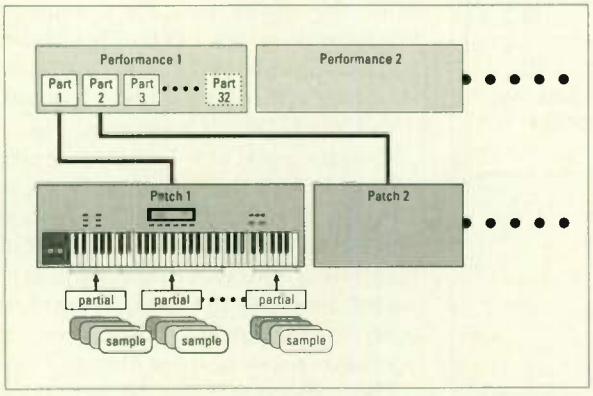


FIG. 1: You can combine up to four Samples in a Partial, which contains the parameters for Sample layering, switching, processing, and crossfading. Partials are combined and mapped to MIDI notes in a Patch. Each Patch is assigned to one or more of the 32 Parts in a Performance. A Volume comprises the entire collection of Samples, Partials, Patches, and Performances. (Courtesy of Roland Corporation.)

takes priority; its sustaining notes are not cut off by new notes. Patch Priority is either on or off; Patches can use one voice (monophonic), or all available voices (polyphonic), but you can't allocate three or four voices to a Patch.

You can also assign Patches to one of sixteen groups and use the Cutoff Grouping parameter to ensure that voices in the same group *always* cut each other off. For example, this is useful when you want a closed hi-hat to cut off an open hi-hat.

Unfortunately, the unit offers no provision for sample editing. If you want to tweak a sample's loop point or start time, you must do it in a computer or sampler and reload it into the SP-700.

CRUISE CONTROL

I was sorely disappointed with the real-time control capabilities of the SP-700. You can only use one continuous controller per Patch. For example, you can't have one slider for the sample mix and another for the cutoff frequency, with a footpedal controlling LFO rate. Not only that, you can't map *any* MIDI controller to resonance. With today's proliferation of inexpensive MIDI fader boxes, such an arrangement is hard to accept.

Otherwise, the SP-700's MIDI implementation is quite good. Velocity and keyboard position can affect filter, amplifier, envelope generator, LFO, pitch, pan, and sample-mix parameters. Pitch keyboard-tracking is variable from zero to two semitones, which is useful for building complex sounds, or experimenting with microtuning. Velocity messages can follow several different response curves.

The SP-700 responds to Release Velocity and Polyphonic Aftertouch. Program Changes can load a Volume from disk (but not from CD-ROM), switch between Volumes, or change individual Patches within a Performance. This implementation is great, although I wish it could load a Volume from CD-ROM in response to a Program Change. (Given the loading time of many CD-ROM drives, however, that could be a long, slow process.)

TAKING IT FOR A SPIN

The SP-700 has a wonderful user interface. Simply select one of five editing modes and use the soft buttons, movement keys, and data wheel to alter parameters. You can use a MIDI keyboard to audition your sounds during all stages of editing.

Three special keys—Command, Name, and List—light up any time you are in a menu or field within a menu where they can be used. The Command button accesses a set of handy utilities and editing aids, and the Name button lets you easily name sound elements on a virtual QWERTY-keyboard page.

You can press the List button any time you have to pick something, be it disk files, Samples, Partials, Patches, or Performances. I appreciate the ability to audition sounds when a list is presented. I also like the ability to tag multiple items in the list and perform an operation on all of them at once.

There always seems to be more than one way to do something in the SP-700. You can change many parameters in either the Performance, Patch, or Partial modes, and there is often more than one way to reach a particular display page. Up to ten pages in the SP-700's menu structure can be marked,

and a Jump button puts you there quickly and easily.

You can choose to edit Partials or Patches by themselves, or within the context of their parent structure. For example, you can hear the Patch you are editing with the other Patches in a performance. I really like the single/Global toggle in the Partial editing screen; in Global mode, parameter changes affect all Partials in the current Patch. Anyone who has ever tried to tweak a velocity-sensitivity parameter for 128 samples in a drum kit will appreciate this feature.

One real time-saver is the presence of twenty Partial templates only a few keystrokes away. These templates have envelope, filter, and amplifier parameter preprogrammed for several classes of instruments (piano, organ, brass, etc.). Ten of the templates are user-definable.

Mapping samples to MIDI notes in samplers and sample players is often tedious. The SP-700 takes some of the pain out of this process by letting you map samples from either the front panel or a MIDI keyboard.

OPTIONAL STORAGE COMPARTMENTS

The SP-700 supports various SCSI hard drives, tape-backup units, and CD-ROM drives. The manual provides a short list of SCSI devices known to be compatible, but Roland can supply a more complete list. Be careful to check compatibility before you buy a SCSI peripheral.

You can save any sound component to the disk drive. Everything saved to disk includes a Volume ID, which lets you filter directories to find a desired sound quickly. This feature was particularly useful on the included CD-ROM, which contains almost 3,000 samples. The Volume IDs can also save disk space, letting you store sound components in only one disk file.

The selection of disk operations is excellent. In addition to saving and loading, you can rescan for SCSI devices, restart them, park the drive heads, sort and delete data, and back up to a SCSI tape drive. A Quick Load feature lets you specify a list of commonly used sounds and their source drives for easy loading. A Volume can load automatically from any SCSI device on power-up. Disk operations take about eight times longer when

this mode is active, however.

The SP-700 has a convenient Volume backup function that copies all sound parameters in a Volume, excluding sample data, to separate battery-backed RAM that acts like a RAM disk. When you load the data from this RAM disk, the SP-700 automatically searchs a CD-ROM or other SCSI device for the appropriate sample data. The sample player can also save its default drive, startup volume, and other global parameters in RAM.

You can store system and Volume parameters on a remote device using MIDI System Exclusive data dumps. If your computer can't handle all the data at once, the SP-700 can split its data into several messages of a smaller size. Unfortunately, the SP-700 does not support the SMDI SCSI sample-transfer protocol (discussed in the June 1993 "Computer Musician" column); as a result, you must transfer samples using the painfully slow MIDI Sample Dump Standard.

LEATHER SEATS

Roland put a host of other goodies into the SP-700. As mentioned earlier, each audio output includes its own narrow-band, quasi-parametric equalizer. Each Patch or Partial is routed through one (or two, if it's a stereo sound) of these EQs before reaching the assigned audio output. The EQ's center-frequency and gain parameters let you boost or cut (±12 dB) a low frequency (16 to 600 Hz) and a high frequency (750 Hz to 18 kHz) from the front panel or under MIDI control. You can specify different EQ settings for each Performance.

Each Performance includes its own MIDI data filter, so different types of data can be accepted or ignored by the SP-700 on each of the sixteen MIDI channels. Roland also threw in a nifty MIDI data monitor; the monitor is located ahead of the data filters, so it doesn't reflect the filter settings, but you can switch off System Real Time message display to avoid swamping the monitor with MIDI Clock and Active Sensing messages. An equally cool voice display shows the number of polyphonic voices being used on each of the 16 MIDI channels. A Phase Lock feature ensures that all Parts on the same MIDI channel play the same notes simultaneously. This is handy for layered sounds, which can sound a bit

flanged without this feature.

The Listen Delete feature is unique. As you play your sequence on the SP-700, the unit ascertains which Partials currently loaded in memory are not required. It then deletes any unused Partials to conserve memory. You can instruct this feature to ignore any Part or MIDI channel.

The manual is hefty, roughly equivalent in size to a small phone book. It

There always seems to be more than one way to do something in the SP-700.

has step-by-step examples of most editing processes, many illustrations, and explanations of topics such as SCSI and head parking. It contains all the necessary information in sufficient detail, but its small type, many abbreviations, obvious cutting and pasting, and highly technical style make it difficult to read. In addition, explanations are sometimes vague, and the organization is a bit strange. For example, the separate sections near the end of the manual on Performance Mode, Patch Edit Mode, Partial Edit Mode, Disk Mode, and System Mode should be chapters in the main body. On the positive side, page cross-references, an index, and a table of contents make information relatively easy to find. There is also a "How-to" table of contents for 71 common operations and topics.

Product Summary

PRODUCT:
SP-700 Sample Player
PRICE:
$2,895
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	● ● ● ●
AUDIO QUALITY	● ● ● ● ◖
VALUE	● ●

CD SOUND SYSTEM

Given that all the top units offer good sound quality and lots of features, a sample player's success depends on the quality of its sound library. Roland offers three CD-ROMs of ready-to-go samples and programs, with four more on the way. In addition, Roland distributes several third-party libraries for the S-770/SP-700, including Prosonus' "Orchestral Strings," Club 50's "Foundations," Producer Sound Effects Library's "Composer's Collection," and Northstar's "Drumscapes." Q-Up Arts offers its "Sonic Images" set for the SP-700/S-770, and East-West Sound Warehouse is selling its "Bob Clearmountain Drums" and "Dance Industrial Sets." East-West also distributes the Denny Jaeger "Master Violins," AMG "Rhythm of Life Percussion Library," and "Funky Drums from Hell" sets.

Roland includes a "Preview" CD-ROM with the SP-700 that contains 600 MB of sounds from their sample collection, including some of the Northstar, Prosonus, and East-West sounds. There are plenty of drums kits and special effects, along with a good variety of popular, orchestral, and ethnic instruments. Some of my favorite "fun" sounds are the film-ambience pads, such VS Fantasy and Underworld, but the bread-and-butter sounds are as good or better than anything I have in my fairly extensive sample collection. The SP-700's sounds are of high quality, although I did find a few with rather obvious loop points (especially Huge Stereo 2 and Vector Pad).

Most of the Volumes on CD are too big to load into a standard SP-700 with 8 MB of memory. I got around this by loading sounds as individual Patch files, but I was never able to load certain sounds due to memory constraints. I was bothered that I found no useful acoustic piano or sax Performances that would load into 8 MB, although I could load individual Patches.

0 TO 60

So is the SP-700 deserving of its Cadillac-like price tag? After all, you can spend about the same amount of money on an Ensoniq ASR-10R and get full

sampling capability, effects, and a sequencer; but Ensoniq's instrument holds less RAM than Roland's. A Kurzweil K2000R costs a bit more, but it has an effects processor, more synth power, and can be upgraded to a full sampler. You can buy a 16-voice Peavey DPM SP sample player for under a grand, but it lacks filters, battery-backed parameter RAM, and many other SP-700 features.

Compared to some competing products, the SP-700's resonant filters, graphic display, and Listen Delete features may be worth a higher price. To top it off, the SP-700 provides a user-friendly program-editing interface. And there's no question that Roland's sound quality is excellent; I never noticed background hiss or unpleasant artifacts. Still, the SP-700's price seems steep.

Of course, if you already have a Roland S-770 or S-750 sampler, the SP-700 expands your available voices without having to purchase another sampler, so you don't have to pay for redundant sampling features.

If you want to add a killer resonant filter sweep to a variety of samples and like the Roland library, this could be the sound module you've been waiting for. Just don't forget to bring the SCSI drives.

(Special thanks to Prosonus for loaning the S1000 samples.)

Allan Metts *is an Atlanta-based MIDI consultant, musician, and electrical engineer. Allan and his wife can't afford a Ferrari or a Cadillac; they both drive Jeeps.*

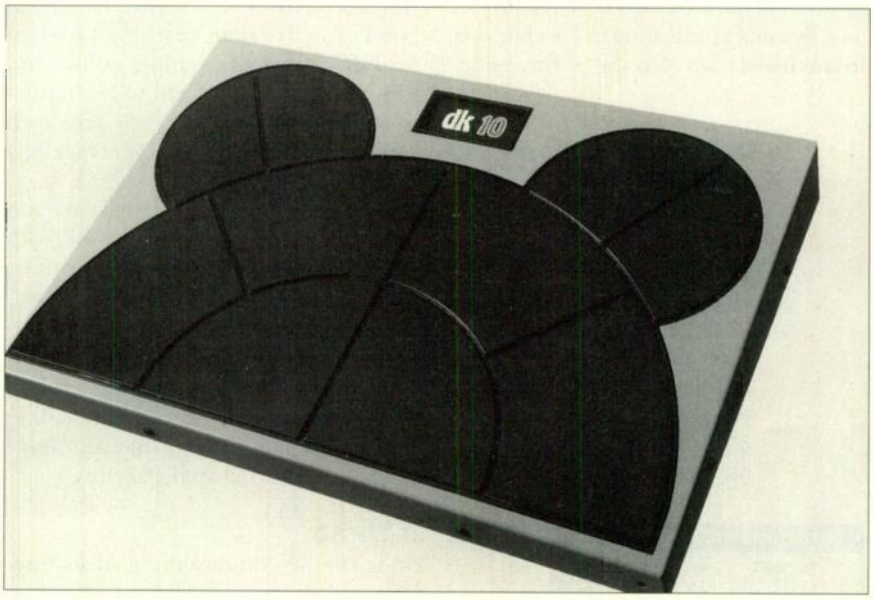
KAT dk10 Percussion Controller

By Paul Lehrman

Let your fingers do the drumming or stick it.

MIDI percussion controllers are now commonplace in recording and live performance, but for the most part, they have remained tools for ambitious percussionists. Many acoustic drummers publicly proclaim that MIDI is an evil plot to put them out of work but privately admit they are intimidated by the complexity and learning curves of existing systems.

Non-drummers have stayed away from MIDI percussion controllers because they're expensive and laden with unwanted features that make them difficult to program. Besides, many keyboardists can rap out wonderfully complex rhythms with their fingers, but when you put drumsticks in their hands, they're all thumbs. Many percussion pads aren't sensitive enough to respond to fingers, making them useless to anyone who can't handle sticks.



KAT's dk10 offers ten pads that can be played with either fingers or sticks. It has relatively few features but is extremely easy to use.

Many of these problems are addressed by the dk10, a new product from KAT. This Massachusetts company has been making an impressive range of percussion controllers for several years, so they know how to design drum pads for the rest of us.

OVERVIEW

As the least-expensive multipad controller in KAT's line, the dk10 is nearly identical in appearance to the company's more elaborate drumKAT and drumKAT EZ controllers. It has ten pads, arranged in a semicircle with two "ears." (In fact, it looks more like a cartoon mouse than a cat.)

Jacks in the back accept note-editing and channel-editing footswitches, a hi-hat footswitch, and a kick pedal. There are MIDI In and Out jacks, a power switch, and a jack for 9 VDC power. (A "wall wart" power supply is included.) The construction is sturdy sheet metal, with rubber feet for tabletop use. The dk10 also works well on a heavy-duty, black music stand, as long as you tighten the dickens out of it. There are also screw holes for mounting on an optional stand.

The pads are quite responsive, with four preset Velocity curves that are selected by holding two pads while stepping on a footswitch. The unit beeps once for curve 1, twice for curve 2, and so on. Playing the pads with fingers produces good results, and you can even get the Velocity up near 127 if you don't mind using your knuckles. In most cases, however, you'll probably want to globally boost the Velocity values after sequencing if you play a track with your fingers. The Velocity range with sticks is excellent.

PROGRAMMING

Programming the dk10 is simple. Plug the supplied footswitch into the note-editing jack, step on it, hold it down, and repeatedly hit the pad you want to program. The MIDI note assigned to the pad increments by a half-step each time you hit it, and you can audition the results with a drum machine or other MIDI instrument. If you overshoot, stomp on the pedal twice, and the notes start back down as you hit the pad. When you have the right note, release the pedal and go to work on another pad.

Every time you invoke a programming function, the device sings a little

• DK10

"tick-tock" song, with a different song for each function. Since there's no display (not even a power light), these songs are all the feedback you get. Fortunately, it's pretty difficult to get lost.

There are four user-definable kits and six factory-preset kits, which include many popular drum machines and the General MIDI percussion map. To change kits, turn off the dk10, press and hold the pad that corresponds to the desired kit number, and turn the unit back on. With an optional second footswitch, you can hold down footswitches 1 and 2 and hit the pad that corresponds to the desired kit. The box sings out the kit number, bleeping from one to ten times. Storing and copying kits, or saving and loading the memory using MIDI System Exclusive, involves similar gestures. They're not particularly intuitive, but they're easy enough, and the manual is clear.

KICKING THE KAT

The hi-hat pedal serves two purposes: It sends a MIDI note number when you step on it, and it sends a second note number from any pad that's in Hi-Hat mode. Normally, these pads produce hi-hat sounds, but they don't have to. Several pads can be in Hi-Hat mode, each programmed with two different note numbers. For example, one pad might be set up so the pedal switches between high and low bongos, or open and muted congas.

If you use an ordinary footswitch (or the supplied one) for the hi-hat pedal, the Velocity of its note is always 64. If you want control over the Velocity, you need the optional hatKAT footpedal.

Product Summary

PRODUCT:
dk10 Percussion Controller
PRICE:
$499
MANUFACTURER:
KAT
300 Burnett Rd.
Chicopee, MA 01020
tel. (413)594-7466
fax (413) 592-7987

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

An ordinary footswitch doesn't work for the kick drum; you need a special pedal, three of which are available from KAT. Like the main pads, there are four preset Velocity curves for the kick drum input.

CONCLUSIONS

KAT left out plenty of features to keep the price and complexity level down, but they won't be missed by many users. Many drum synths and samplers now let you Velocity-switch sounds internally, so Velocity layering on the pads isn't so important. Calling up different kits "on the fly" with Program Changes is only crucial if you're playing live, so the absence of this feature might be inconsequential for you. The sensitivity and gate time (time between Note On and Note Off) are not adjustable, but the factory settings are fine for the vast majority of applications.

What's left is a good-quality, easy-to-learn, affordable percussion controller that, at $499, won't break your bank account. Whether you're a keyboardist or a drummer, if you've been putting off getting a percussion controller for some reason, you are running out of excuses. The dk10 percussion controller is almost guaranteed to improve your drum tracks, and it won't drive you batty in the process.

When **Paul D. Lehrman** *was a teenager, he loved to terrify his family by bringing a drum set home from school and practicing in his room. Now he uses headphones and only terrifies himself. Somehow it isn't the same.*

dbx 172 SuperGate

By Michael Molenda

This supreme clean machine takes out the garbage.

I have a confession: I'm a slave to Order. My desk is as clear as an airport runway, I rewrite telephone messages until they are neat and legible, and if I see a crooked picture frame at an art exhibition, I straighten it. And guess what? I'm also very fussy about audio signals.

The sputter and hum of a guitar amp, the hiss of a noisy signal processor, and even the audible rustling of clothes when a vocalist isn't singing drive me crazy. Recording and mixing would be intolerable without noise gates.

By muting signals below a user-defined threshold, careful noise gating allows only the actual performance of an event to be audible. This means that when an instrument, vocalist, or effects processor isn't "playing," any noise can be completely silenced. In addition, experimenting with parameters can create audio tricks, such as the popular gated-reverb effect.

So I was very excited to review dbx's new model 172 SuperGate. If the 172's "super" designation is to gating what ultra chocolate is to ice cream, I'll be one blissful studio rat.

AROUND THE BOX

Just one look at the SuperGate's front panel is all you need to survey its processing power. For one thing, it's not just a noise gate. The 2-channel, single-rackspace unit also includes expansion and ducking functions. Well-labeled, sturdy knobs control key frequency, key bandwidth, input threshold, expansion ratio, attack, hold, release, and depth. A 13-segment LED gain-reduction meter is joined by a generous helping of status LEDs, which light up when a function is active.

Status lights may seem pretty boring as features go, but it was comforting to confirm with a glance whether the master link was on, or whether I had accidentally left the key monitor enabled. The lights also make it easy to audition processing options—it seems I always bounce between noise gating and expanding—without getting lost.

The SuperGate's back panel is clearly laid out, with separate I/O sections for channels 1 and 2. XLR jacks are employed for the main input and output signals, and a ¼-inch jack services the external key input for each channel. In all cases, either balanced or unbalanced signals are accepted. Nominal signal level is +4 dBu. A ground-lift switch, voltage switch (115V or 230V),

fuse compartment, and AC power-cord jack (the 172 has an internal power supply) complete the unit's back-panel goodies.

The SuperGate does not have a power switch, which means it must be unplugged to power down. I don't relish groping behind effects racks to unplug gear after each session, so I recommend plugging the unit into an accessible power strip with an integrated on/off switch.

It's important to note that the SuperGate's XLR input and output connections are wired pin 2 hot (+) and pin 3 cold(-). Stupidly thinking that an XLR cable is an XLR cable, I initially used cables wired pin 3 hot. Then I spent the next half-hour convincing myself I was crazy. The SuperGate seemed to thin out every signal it processed and produced a noticeable difference in volume level between processed and bypassed signals.

Luckily, the sonic anomaly shamed me into reading the instruction manual, which exposed the problem. However, because the Trident mixer at my studio is pin 3 hot, I had to beg my more technically adept partner to wire the proper cables. When I talked to dbx, they claimed that their configuration is standard in the industry. In practice, however, I've found that the pin "standard" depends on who you talk to and which equipment you own. In any case, check your equipment for compatibility, and be prepared to customize your XLR cables if you have a mismatch.

UNDER FIRE

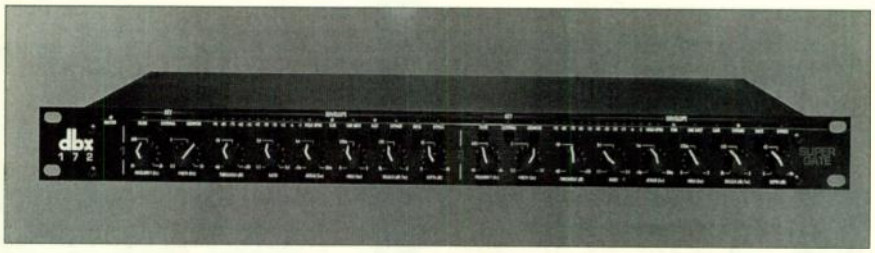
I recently recorded the perfect project for testing a "super" gate. The tracks were laid down fast with minimal setup or preparation, as the idea was to capture the passion and immediacy of a performance. In short, the tracks were a mess. (The project was also an experiment to see if I could let go of my order obsession long enough to produce an intentionally ugly record.)

The first job for the SuperGate was cleaning up the lead vocal, which was recorded, *sans* headphones, in front of blasting studio monitors. Obviously, the rhythm tracks bled through the microphone (a Sennheiser MD-421), and the level of the guitars, bass, and drums were almost as loud as the vocal. I attempted to diminish the level of the bleed tracks in relation to the vocal by employing the SuperGate's expansion function. Unfortunately, a rather extreme expansion ratio of 4:1 was required to decrease the volume of the rhythm tracks to a workable level. Although some coloration is unavoidable when routing signals through dynamics processors, I didn't like the coloration this admittedly extreme setting imposed; the vocal sounded squashed and dull. However, when I loosened up the ratio, I still heard a slight dullness. I decided to bail out on the expander.

Step 2 involved using the noise gate to cut out the bleed-through tracks between vocal phrases. This approach was more successful. The trick was to shut down the track when the vocalist stopped singing, so that the vocal reverb decays weren't compromised by instrument bleed.

The SuperGate did its job with brutal efficiency. I set a quick release time and a fairly hefty threshold, and the vocal track was silenced immediately following the end of a vocal phrase. The new problem—one common to vocal gating—was that the signal threshold I needed to mute the rhythm track bleed-through was also snipping off the preliminary attack of opening lyrical phrases.

Luckily, one of the features that makes the SuperGate a super gate came to the rescue. TCM (Transient



The dbx 172 SuperGate includes an internal key filter that allows the user to isolate specific signals for processing. This capability was a life-saver when removing some obnoxious cymbal crashes from a stereo tom-tom submix.

Capture Mode) activates a 7-stage, all-pass filter circuit that produces 300 microseconds of signal-path delay. In practice, the TCM delay is inaudible, but it allows the SuperGate to *anticipate* the arrival of transient signals. (The gate seems to open before the signal arrives.) For my clipped opening phrases, I simply pushed the TCM button, and the gate allowed the vocal to appear as clean as if it was sung *a capella*. Because I abhor spending excessive time tweaking parameters during a mix—I like to keep the creative energy flowing—I appreciated just hitting one button to solve a common problem.

Another quick fix the SuperGate offers is OneShot mode. This function is like a sonic "conformer" that shifts the hold times where the gate opens to remove any difference in the amplitude of the input signal. For example, if a drummer hits a snare drum with varying amounts of power, OneShot makes sure that the SuperGate doesn't close down the softer hits in relation to the louder ones. If you've ever tempted insanity by trying to find the exact threshold to gate a signal with fluctuating dynamics, OneShot can keep you out of the asylum. I was able to tailor the gate action to elegantly fade reverb tails and guitar sustain without chatter (which is produced when a signal fluctuates near the set threshold, and the gate starts an annoying on/off action).

One such situation involved planned, melodic feedback that began at the end of a guitar solo and continued as a sonic texture through the bridge and into the final chorus. The amplitude of the feedback fluctuated greatly, and the gate kept cutting the signal in and out. By activating OneShot and setting the Hold parameter to approximately one second, I was able to stave off the gate chatter completely. When the feedback reached the final chorus, it faded smoothly to silence.

For supreme signal-sanitation, the SuperGate includes two voltage-controlled, 24 dB-per-octave key filters, one for each channel. Center frequencies are selectable between 60 Hz and 6 kHz, and the bandwidth control can be adjusted between 0.5 and 10 octaves. The key filters enhance the overall selectivity of the unit to prevent false triggering and allow the user to isolate signals for critical gating. For

example, you could completely gate out any kick-drum sound that bleeds into a snare mic (provided the two drums are never played simultaneously) because the two signals are at different frequency ranges.

This feature saved my butt on an important client's session when I realized—at mixdown, of course—that I had made a serious boo-boo recording the drums. To gain maximum impact from the toms, I savagely compressed them to tape. Unfortunately, I forgot that the drummer placed his cymbals very low and almost directly over the toms. While the compression helped the toms sound like cannons (which is good), it also turned the cymbals that bled into the tom mics into sustained, high-end sizzle fry (which is bad). I couldn't raise the tom level in the mix without bringing some frightful cymbal spatters front and center.

However, the key filters allowed me to gate out the high-end information without comprising the tom sounds. The toms were recorded onto three tracks—rack tom 1, rack tom 2, and floor tom—of an analog 16-track deck, so I assigned the tracks to a stereo subgroup and routed the signals to the SuperGate's two channels via the separate (left and right) group sends and returns. Then I used the SuperGate's Key Monitor function so I could find the tom frequencies that I wanted to exclusively trigger the gate. After that, it was simply a matter of adjusting the threshold control to open the gate only when the toms were struck.

I was saved. Because the cymbal frequencies were tuned out of the gate's triggering threshold, the toms explod-

Product Summary

PRODUCT:
172 SuperGate
PRICE:
$869
MANUFACTURER:
dbx Professional Products
1525 Alvarado St.
San Leandro, CA 94577
tel. (510) 351-3500
fax (510) 351-0500

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

ed into the mix with the impact I craved, but without the awful sizzle. Attempting this sonic rescue maneuver with a conventional noise gate would have involved setting up a side-chain between the gate and a graphic or parametric equalizer. That takes more equipment (you need a good equalizer), more time, and more aggravation. Even then, I don't think I could have completely muted those compressed cymbals. The SuperGate's handling of these butchered tom tracks sold me on the rationale of spending almost $900 for a noise gate.

CLAMP DOWN

Admittedly, even if you're a big fan of noise gates, the SuperGate is probably more gate—at more cost—than the average home recordist can use. A $869 price tag is a little steep for a bedroom-studio budget, especially when decent quad gates are available for about half that price. Also, the expansion function altered signals a bit much for my taste. Even when expanded lightly, signals tended to sound dull. And although the ducker worked fine, its applications are somewhat limited for the average home studio, unless you do a lot of voice-over or advertising work.

But there is no doubt that the 172 SuperGate's comprehensive signal controls make it a major contender for the ultimate noise gate crown (under-$1,000 division). I'd also like to nominate the instruction manual for an award; it's easy-to-read, concise, and offers helpful parameter suggestions for common gating scenarios. So if you're the type of person who goes around straightening picture frames, the cost of a SuperGate is a small price to pay for a supreme clean machine.

EM *managing editor* **Michael Molenda** *has just released the premier single from his infamous retro new-wave band, Ascot Jacket.*

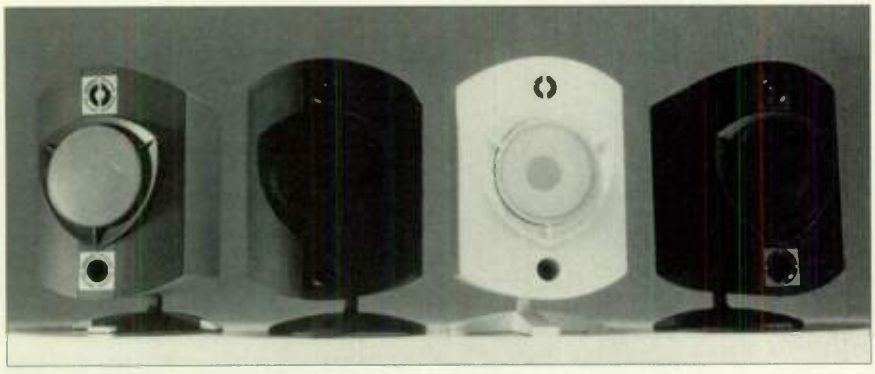
Rock Solid Sounds Solid Monitor System

By Neal Brighton

A compact subwoofer system puts big bass in small places.

The problem: You are composing and mixing dance music in a cramped home studio and you can't *feel* the bass. One solution is to knock down a few walls so that some huge monitors can fit into your studio. However, a less destructive solution is to buy a compact speaker system that incorporates a subwoofer to reproduce the low end you crave. This brings us to the Solid Monitor system by Rock Solid Sound.

The Solid Monitor system, designed by Rock Solid Sounds' parent company, B&W, is composed of two, small, satellite speakers (the Solid Monitors) and one medium-sized subwoofer (the Twin Bass). For those unfamiliar with such systems, the subwoofer reproduces extreme low-end frequencies, while the satellite speakers typically handle the low-mids (and possibly some lows), mids, and high frequencies. A lot of dance, live-music clubs, and theaters employ subwoofers to produce body-thumping bass without having to install mammoth speaker systems.



The Solid Monitors mount on multiple-position stands for easy wall or ceiling mounting and serve as "satellites" when used with the Twin Bass subwoofer system.

• ROCK SOLID

The home recordist, however, can take advantage of subwoofer systems to mix rap and dance music, or assemble film and video sound effects. This provides a reference similar to the audio environment of a dance club, movie theater, or even the ultra-bass "trap" of a blasting car stereo system. If your musical style is bottom heavy, a subwoofer can be a critical mixing and recording reference.

SOLID CONSTRUCTION

The Solid Monitors are constructed of thick, durable plastic—the manufacturer obviously spent big bucks in tooling costs—and are available in black, gray, and white. The modern-looking cabinets enclose a heavy-duty, 5-inch woofer coupled with a small, high-dome tweeter. Good-quality passive crossovers are firmly mounted to the inner plastic shell, and the cabinet has a port at the bottom front. Connections are made with either straight speaker wires, or banana plugs.

The Solid Monitors are mounted onto a ball-jointed stand that allows you to set the speakers in multiple positions. This feature is really nice, as the speakers can be easily mounted to a wall or ceiling, or placed conventionally atop the mixing console.

The Twin Bass subwoofer is made of a combination of high-density particle board and molded plastic parts. Like the Solid Monitors, the Twin Bass uses high-quality components that are solidly mounted to the frame. The subwoofer sits on plastic legs and looks

Product Summary

PRODUCT:
Solid Monitors and Twin Bass

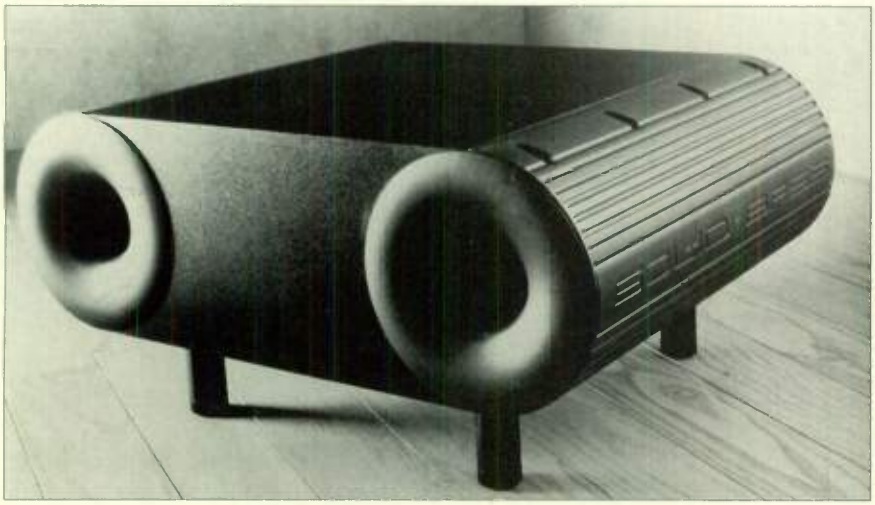
PRICE:
Solid Monitors $299/pr.
Twin Bass $350

MANUFACTURER:
Rock Solid Sounds of America
PO Box 8
54 Concord St.
North Reading, MA 01864-0008
tel. (508)664-3406
fax (508) 664-4109

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

something like a coffee table. Actually, the only things I found that were less-than-solid were the small, somewhat wobbly, plastic legs that attach to the bottom of the woofer.

The monitors and subwoofer are magnetically shielded, so you don't have to worry about interference if the system is placed too close to a computer monitor or television set. Another excellent feature is a built-in device that protects the speakers from overload damage. When the safe power-handling limit is reached, the input level is automatically reduced.



The Twin Bass subwoofer may look like an modern Italian coffee table, but it delivers enough low end to shake up your studio.

Assembling the Rock Solid system is simple. Because the crossovers are passive, no separate power hookups or separate amplifiers are needed. Just plug the left/right outputs of your power amp into the subwoofer's inputs, and connect the monitors to the subwoofer's left/right outputs. Any amplifier that delivers between 20 and 150 watts can run the system.

THE SOUND

After stuffing the subwoofer under my mixing console and replacing my normal monitors with the satellite speakers, I listened to everything from rap to classical music. I was immediately impressed. The Rock Solid system is clear and delivers a lot of punch on the bottom end. It took a little while to get used to the heavy bass produced by the subwoofer, but the lows are so well-defined that my acclimation time was minimal.

The Solid Monitors produces even, clear midrange frequencies, but the high frequencies—specifically the 10 kHz to 12 kHz range—are a bit harsh for my taste. I ended up doing the classic studio "fix" of putting a piece of tissue paper over the tweeters of both Solid Monitors to calm down the high end.

I have no such complaints about the Twin Bass. It really delivers rock-solid bottom. I could feel the floor move around my feet. The effect was great for amusement park-style rumbles, but for critical listening, I had to stand up and walk a few feet back from my usual monitoring position.

THE DIVERSITY FACTOR

If you record and mix various types of music, the Rock Solid system is probably an ill-advised choice as an exclusive reference. This assessment isn't a knock against the system's audio quality—I really like the way these monitors sound—but the enhanced bass may not allow a critical real-world reference for certain types of music.

However, if you already own some small close-field monitors that you trust, and you want to branch out into dance club music, theatrical sound design, or bass-intensive musical styles such as rap, the Rock Solid system is a solid choice. Compact subwoofer systems such as these are a great way to get a big sound into a small space.

Neal Brighton *is co-owner of Sound & Vision studios in San Francisco.*

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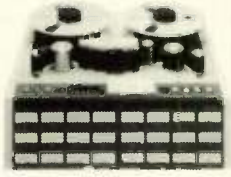

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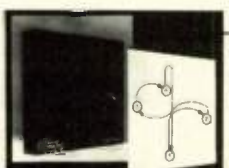

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PRO FILE

The Electric Cello

Jami Sieber reinvents the "rock 'n' roll" cellist.

By Michael Molenda

As far as aural voyeurism goes, discovering a cross-fertilization of musical genres is a lusty delight. I've been a sucker for art rock, jazz rock, bohemian jazz rap, and even Elvis Costello's collaboration with the Brodsky String Quartet. So I was extremely curious when the Mother Lode of grunge rock—Seattle—disgorged a slick, political rock band with a startlingly innovative cellist as a core member.

The band, Rumors of the Big Wave, takes its activism seriously. (They are slated to perform at China's first environmental awareness concert this fall.) But while the causes ROTBW supports are critical and worthwhile, I was more captivated by the "musical activism" practiced by cellist Jami Sieber on the band's new release, *Burning Times* (EarthBeat Records).

Sieber not only enlarges the vocabulary of the cello by employing signal processing and the occassional anarchic performance technique, she is pioneering a new species of that instrument: the *electric* cello. Reportedly only 100 of these instruments currently exist.

"Actually, the instrument discovered *me*," remembers Sieber. "I was playing acoustic cello in a band and Eric Jensen, a local cellist, approached me about trying the prototype of an electric cello he designed. I loved it. I bought the first production model he made in 1987."

Unfortunately, championing a new instrument has its drawbacks. A constant frustration is that Sieber must remain ever-vigiliant that the electric cello is properly recorded.

"Recording can be nerve-wracking because few engineers have any experience with the instrument," she says. "You see, the sound of the acoustic cello *is* what it is: a block of wood with a resonating board that has generated the same relative timbre for hundreds of years. But the sound of the electric cello must be created from scratch. And believe me, it can sound really cheesy if it's not recorded right."

Sieber's Jensen electric cello is a 5-string model with a slim rosewood body and an ebony neck. Just like a solid-body electric guitar, only minimal sound is generated by the instrument itself. ("You really can only hear it acoustically if it's bowed," she says.) To ensure a wonderful sound is constructed, Sieber often sits with the recording engineer to audition EQ adjustments and signal processing.

"Typically, the engineer takes a direct output from the cello and records the signal dry (without effects)," says Sieber. "But I may request that my effects are recorded to tape along with the dry signal if I'm nervous about the engineer's concept of the cello sound. I don't like fixing things in the mix."

Getting the right "performance" sound is important because, in the studio, Sieber records live with the band, monitoring her instrument (and the other musicians) on headphones.

"I'm not just a support player," stresses Sieber. "I often establish the rhythmic groove. For example, on the song 'Nightmare' [from *Burning Times*], I set up a tabla-like rhythm by striking the cello with a timbale stick and running the signal through a digital delay."

While Sieber maintains that overdubbing instruments track-by-track would rob the band of its "cataclysmic energy," live recording often causes yet another problem.

"I wasn't brought up in a rock 'n' roll thing," laughs Sieber. "So it seems like I'm always the one in the band shouting, 'Turn it down! Turn it down!'"

Rumors of the Big Wave (Sieber is second from right.)

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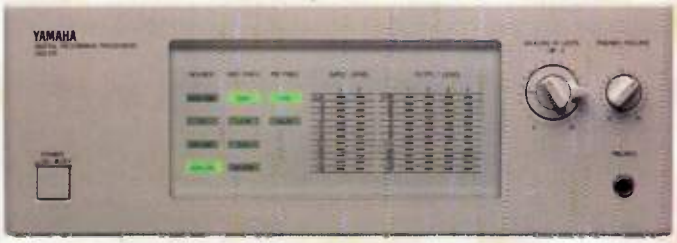

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