Ooo-weee-ooo! Build Bob Moog's EM Theremin

Electronic Musician®

February 1996

Top Secrets!

EM reveals the recording techniques used by:

k.d. lang

Green Day

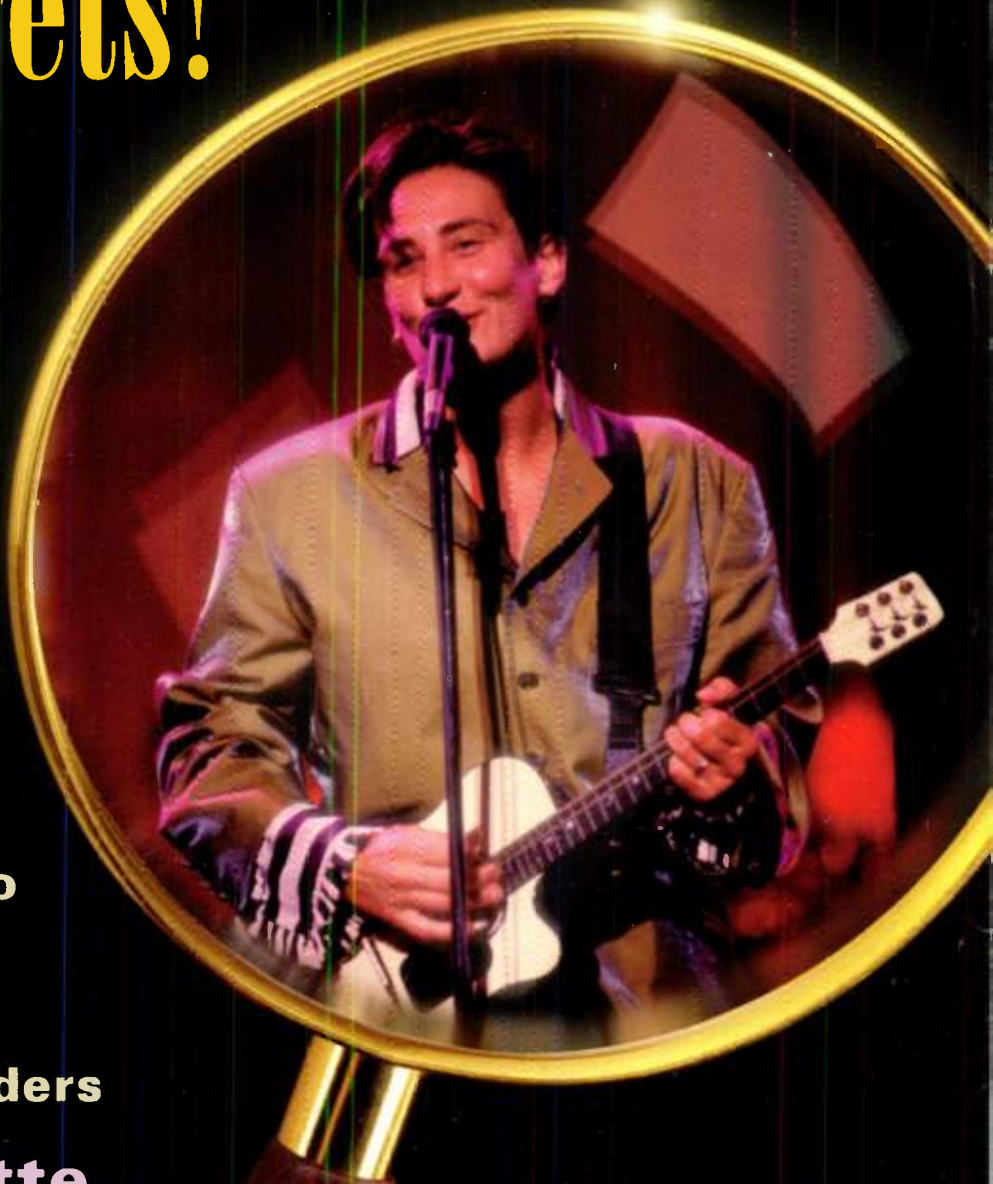
Jane Siberry

Stevan Pasero

Pop Rocket

Pharoah Sanders

Alanis Morissette



1202 VLZ

OM LOW-NOISE MIC/LINE MIXER • MADE IN USA

NEW MS1202 VLZ

12-CHANNEL HIGH-HEADROOM LOW-NOISE MIC/LINE MIXER • 12-CHANNEL HIGH-HEADROOM LOW-NOI

MS1202 VLZ

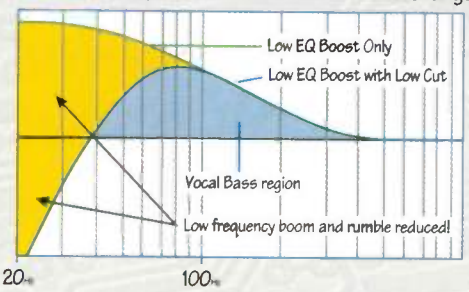
- 4 mono mic/line chs. with
- studio-grade mic preamps
- 4 stereo line-level chs.
- 2 aux sends per ch.
- 2 stereo aux returns
- Aux 1 master level
- Efx return to Mon. 1
- Aux 1 pre/post switch
- 3-band EQ w/Lo Cut filter
- Mutes on every channe.
- Extra stereo bus via Mute
- Easy metering via PFL Solo
- Control Room monitoring
- XLR & 1/4" outputs
- Multi-way metering
- Headphone output
- 4 channel inserts
- Sealed rotary controls
- Built-in power supply

also includes Mackie extras you don't get with other comparably-priced mixers:

- A 50-page manual written in easy-to-understand language. It includes step-by-step hook-up and operating instructions, a glossary of pro audio terms, hints and tips on everything from phantom power to balanced lines and numerous attempts at lame jokes (Dense, boring, humorless manual translated from another language available upon request).
- Tech support from real people. No trips through a voice mail maze; no endless waits on hold. If you need help or advice at any time you'll quickly get through to a pro audio veteran who knows the MS1202 VLZ backwards and forwards.

60dB GAIN on first 4 channels via balanced XLR mic inputs let you record even the faintest sound sources with incredible clarity.

LO CUT FILTER (Chs. 1-4). With the exception of bass guitar, low frequency synth sounds and kick drums, almost all sound is in the audio range above 75Hz. Our Lo Cut Filter reduces or eliminates unwanted frequencies below 75Hz. It's great for cleaning up the "mud" in recording & live sound work, and also lets you boost lower vocal ranges without increasing stage rumble, mic thumps, etc. (see the drawing above). This 18dB/octave filter lets you safely and creatively use the Lo EQ on the higher bass frequencies.



3-BAND EQ on all channels. You asked for it. Musical EQ like on our CR-1604 & LM-3204. Others have copied our EQ points (12kHz, 2.5kHz and 80Hz) but not the warm, musical sound that our expensive, discrete circuitry produces.

EFX TO MONITOR switch and level control on Aux Return 1. When you're using the output of Aux Send 1 to feed stage monitors, you can now blend reverb or other effects back into the Aux Send 1 monitor mix, separate from the house mix (just like with our SR Series.)

A MUTE ON EVERY CHANNEL PLUS AN EXTRA STEREO BUS! As on our CR-1604, pressing a MUTE switch UNassigns the channel from the main L/R bus and reassigns it to the Alt 3-4 output. You can create two stereo pairs for output to a 4-track, bounce multiple tracks onto 2 more tracks, or preview a source not yet in the main mix via phones or monitors.

PFL SOLO makes level setting easy. Just push a solo button, watch the famous Rude Solo LED start blinking, and adjust the trim control (ch. 1-4) for 0dB on the meters. Solo also replaces your source selection, feeding the control room and phones. Great for previewing or cueing a signal prior to adding it into the mix. This solo is non-destructive. It doesn't interrupt the main left/right, 1/4" TRS or XLR outputs.

LEVEL SET MARKER. When used with PFL/SOLO, the level set procedure gives you low noise, maximum headroom and best dynamic range every time! No more guessing about how to set your gain trims. No more worrying about internal clipping!

OTHER COOL STUFF includes sealed rotary controls, solid steel chassis, thick, double-sided fiberglass circuit board and our signature built-in power supply that provides plenty of current for the MS1202 (instead of a wimpy, outlet-eating wall wart).

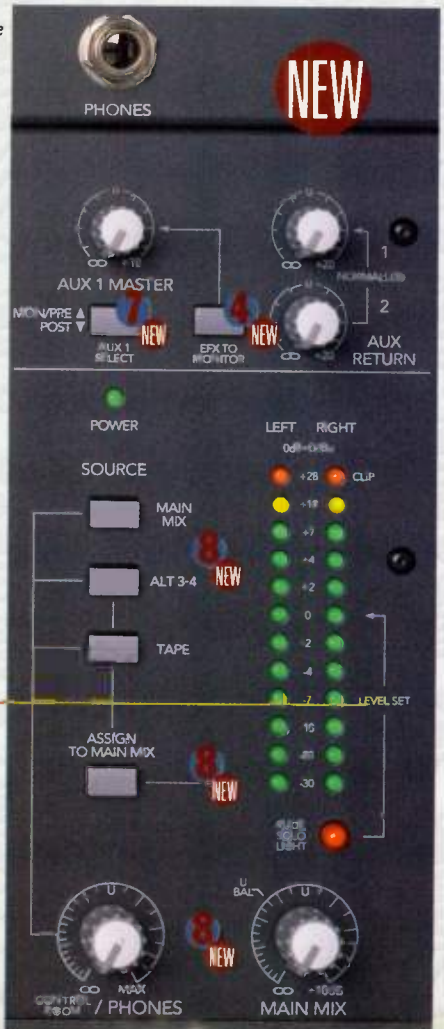
IN STOCK AT MACKIE DEALERS NOW EVEN AS YOU READ THIS!

NEW

WE'VE ADDED A DOZEN NEW

Global AUX 1 PRE/POST switch. Aux Send 1 on each channel can be pre-fader/pre-EQ (great for stage monitor mixes), or post-fader/post EQ (for effects in the studio).

CONTROL ROOM/PHONES SECTION with level control. A mini-version of a popular 8•Bus feature that adds boocoo monitoring, mixdown and metering flexibility. Headphone and Control room amp outputs are now separate. Switches let you select any combination of Main Mix, Tape In and Alt 3-4 signals for routing to the Phones and Control Room outputs and meters. Perfect for creating custom headphone mixes, monitoring tape levels, etc. Plus, an extra button lets you re-route this multi-source signal back to the main mix! For example, a new input via Tape In or a source from the ALT 3-4 stereo bus. It's a feature that has been appreciated on our CR-1604.



MS1202 NEW VLZ

MS1202 VLZ

12x2 MIC/LINE MIXER

• 12-CHANNEL HIGH-HEADROOM LOW-NOISE MIC/LINE MIXER • MADE IN USA

12-CHANNEL HI

IMPROVED MS1202

FEATURES & VLZ CIRCUITRY TO OUR CLASSIC 12-CH. MICROSERIES MIXER!

1 WHAT IS VLZ? *VLZ stands for Very Low Impedance. Originally developed for our 8•Bus consoles, it's a unique Mackie approach to circuit design that reduces thermal noise and seriously cuts down on crosstalk. The end result is that VLZ design cuts circuit thermal noise in half! VLZ demands high current – which requires a beefy power supply. Naturally the MS1202 VLZ has one with far more current output than any other ultra-compact mixer.*

2 ALL INPUTS & OUTPUTS BALANCED *(except RCA-type tape inputs & ch. inserts). The MS1202 VLZ is compatible with anything you can plug into it. Plus, balanced lines let you run long cable distances with minimal hum and buzz. You can also use unbalanced lines, if ya need 'em.*

AN ESSENTIAL PART OF ANY PRO AUDIO TOOLKIT.

No matter what size your main mixer is, there's always a use for a MicroSeries 1202 VLZ. With its great specs and superb sound quality, you can use the 1202 right alongside big PA or recording consoles as...

- *A keyboard or drum submixer*
- *A high quality mic preamp*
- *An effects submixer*
- *A –10dBV to +4dBu level matcher*
- *A headphone or monitor mixer*
- *An emergency back-up mixer*

10 BALANCED XLR MAIN OUTPUTS *(along with balanced 1/4" TRS output jacks). XLR outputs let you connect the MS1202 VLZ directly into amps, workstation modules, pro VTRs and other equipment that have female XLR line level inputs without having to use an adaptor. Press the adjacent 30dB pad switch to match the higher input sensitivity of camcorders and other mic level inputs.*

11 RCA TAPE LOOP INTERFACE *provides convenient hookup to tape decks and other line level devices with "phono"-style connectors. The interface's internal +4dBu operation lets you get the most from both semipro and pro equipment.*

12 VIRTUAL PAD *on first 4 channels' line inputs. Now there's 10dB of attenuation when trim is all the way down. Unity is at 9:00 instead of 7:00. When mixing down the hot outputs of digital multitrack recorders, this extra "pad" lets you add gobs of equalization without overload.*

1) *Although the MS1202 is designed as a desktop mixer, it can also be rack-mounted in 7 spaces.*

2) *Keith Medley, our Applications Specialist likes to demonstrate its ruggedness by throwing a 1202 onto the floor and then standing on it. No damage. A true story, but don't try this at home unless you really trust us.*

IT TAKES UP UNDER ONE SQUARE FOOT OF WORKSPACE, BUT WE DIDN'T COMPROMISE.

The MS1202 VLZ is directly descended from our 8•Bus consoles. Same high headroom & low noise. Same electronic components. It's designed to play in the big leagues with digital multitrack recorders, workstations and hard disk recorders. Yet its suggested retail price is just $429.*

9 PHANTOM POWER *(with its own switch) so that you can use high-quality condenser microphones.*

For 5 years, our Micro Series 1202 12-ch. mic/line mixer has racked up an impressive track record[1]. It's toured with superstars, gathered network news, worked 24 hours a day in video post suites, pinch-hit as a submixer next to mega-consoles and recorded audiophile direct-to-DAT albums. The 1202 has also been the ultra-reliable main mixer in more home studios than you can shake a patch cord at.

Why? Because the MicroSeries 1202 has proven itself to be the best sounding – and best value – small mixer you can buy. Better mic preamps. Less noise. More headroom. And legendary reliability[2].

But we haven't let the MS1202's success go to our heads. For the last 5 years, we've been reading warranty cards for suggestions on how we could improve it.

This is the result. Same great value. Same rack-mountable, built-like-a-tank construction. But with some exquisitely handy new goodies that make it an even more effective tool for both recording and live performance.

F'instance, we've added a complete Control Room section that makes monitoring, tracking and mixdown easier. For on-stage performers, we added PFL Solo switches on every channel, reverb foldback into Mon. 1, and balanced inputs & outputs.

Plus stuff everyone will appreciate, such as midrange EQ, ALT 3-4 (the extra stereo bus first introduced on our CR-1604), mute switches on every channel and 8•Bus VLZ circuitry for even less noise and crosstalk.

Visit your Mackie dealer (the new MS1202 VLZ's in stock right now) or call us toll-free for detailed information.

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I N S I

FEATURES

DEPARTMENTS

D E Electronic Musician®
ten! years of hot tracks & big gear
FEBRUARY 1996 VOL. 12, NO. 2

COLUMNS

REVIEWS

Cover: Photo Imaging by Paul Morrell.
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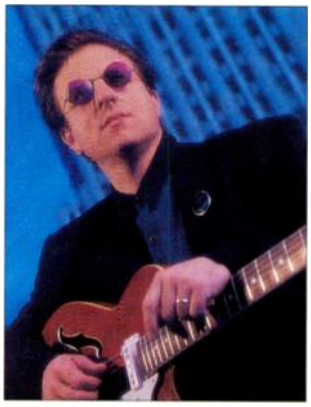
Hit Us with Your Best Shot.

Constructive criticism keeps **EM** relevant, vital, and on its toes.



ROBERT PERRY

Artists learn the hard way that whenever they produce a work for public consumption, its destiny is up for grabs. The masses can love it, hate it, or simply ignore it. And pleasing everyone is impossible: no matter what you do, somebody will cheer and somebody will hiss. Pretty scary, huh? As editor of this magazine, the harsh unpredictability of public approval incites a major wig-out every month. I worry about whether the current issue is stimulating readers or whether disgruntled *ex*-subscribers are burning stacks of **EM** out in a field somewhere. My torment is driven by the fact that, because I can't ask each and every one of you for a personal critique, I don't know what you're thinking. Aarrgh!

But thanks to **EM** Marketing Manager Elise Malmberg, we do get a formal opportunity to check in with a statistical sampling of our readers. Once a year, a random selection of domestic subscribers are mailed a questionnaire and given space to write in personal comments and criticisms. We just received the 1996 survey, and I was extremely gratified that 95 percent of the remarks were raves such as "EM ROX <—> Nuff said!" However, some readers did post concerns, and I'd like to address them.

As an audio professional, I'm distressed that you would have everyone believe they can record in their home.

Personal music production is a reality. Duh. Everyone who reads this magazine knows that amazing recordings are being produced in home studios. One of our editorial mandates is to help readers attain the "technical ability" to make exquisite recordings. I refuse to believe that audio excellence is restricted to "professionals" who labor in commercial studios.

What's the deal with these "personality" interviews?

Our interview series—"Creative Space," "A Day in the Life," and "Production Values"—are designed solely for the purpose of revealing audio production and recording tips. We're not *Rolling Stone*. Our interviews don't dwell on past history, cultural importance, or sartorial splendors; we lay out the nuts and bolts of an artist's creative process. I think it's important that pros pass on the fruits of their experience, and the interview format is ideal for communicating this information.

As you've expanded your coverage to multimedia and the Internet, aren't you concerned that you're spreading yourselves too thin?

Modern music production is a brutally diverse field. When I started making records twenty years ago, all I needed to know was how to place a mic, navigate a console, and push Record. Now I'm doing multimedia scores on myriad formats, running a music-publishing company, licensing masters to European record labels, uploading audio files to the Web, and lunching with entertainment lawyers. In today's music industry, diversity is critical. We want our readers armed with enough comprehensive knowledge to take their careers as far as they desire.

At **EM**, self-improvement is a never-ending quest. I owe many thanks to any reader who takes the time to offer a critique, suggestion, or compliment. In this, our tenth year, we're even more committed to being the best gear and audio-production mag available. So don't be bashful. If you've got a beef, let us have it!

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With the resounding success of the DP/4+, you're probably wondering, "why doesn't ENSONIQ make a smaller DP for the home studio user *(like me)* on a budget?"

Well, enough of you asked, and we're happy to oblige – with the DP/2. A two-processor version of the DP/4+, for about half the price. *(Now you're talking!)*

The DP/2 can process one true stereo or two discrete mono sources, through two of the same custom DSP chips we use in it's big brother. It offers the same unequalled range and quality of algorithms as the DP/4+, plus new combinations designed specifically for the home/project studio. And we've built them into a whopping 600 Presets, ready for any challenge.

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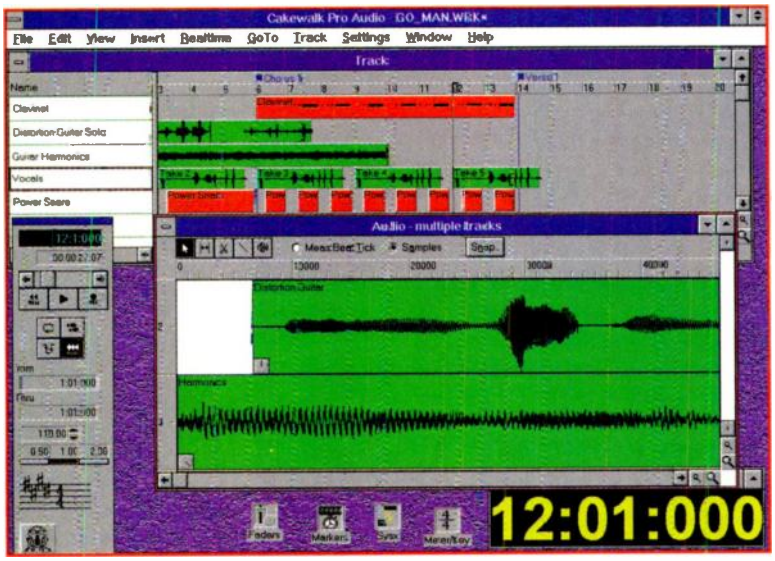

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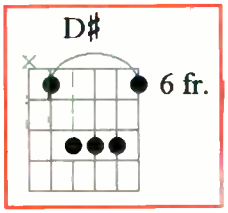

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▶ ENSONIQ MR-RACK

With the MR-Rack ($1,695), Ensoniq has raised its synthesizer technology yet another notch. This 1U rack-mount synth module features improved audio fidelity thanks to 18-bit DACs and a 44.1 kHz sample-playback rate. Its signal-to-noise ratio is rated at -103 dB. The unit also has a pair of aux L/R outputs in addition to the main L/R outputs, all of which are on balanced (TRS) ¼-inch jacks.

The 64-voice polyphonic synth offers more than 450 sounds, including a full GM set, plus 64 ROM and 32 RAM Performances (16-part multitimbral setups). It features 12 MB of waveform ROM, including all-new strings, piano, brass, drums, and voices.

In addition, the MR-Rack accepts up to three internal, user-installable expansion boards. Each board holds up to 24 MB of wave ROM (multiple Banks of up to 128 sounds and 32 Performances per Bank). Planned expansion boards include an 8 MB drum board ($250), a 20 MB Dance/Hip-Hop board ($425), and 24 MB World and Piano boards ($500 ea.). To top it off, a front-panel data-card slot accepts 512 KB, 1 MB, and 2 MB PCMCIA RAM and ROM cards.

The synth's voice architecture provides up to sixteen layers, each with a full signal and control path (i.e., oscillator, multimode filter, EGs, LFOs, modulation routings, and so on). The MR-Rack has 45 preprogrammed Pitch Tables, and it's the first Ensoniq synth to support the MIDI Tuning Standard (including individual note tuning), which lets you send custom Pitch Tables from compatible products (e.g., software). The new unit also introduces the second generation of Ensoniq Transwaves, many of which were created with new resynthesis techniques. (Transwaves are sweepable wavetables that produce dynamic transitions between selected waveforms.)

A new 24-bit DSP chip powers the effects section, which features six stereo buses. Three of these buses are dedicated to the global reverb, with independent send levels. Another send gives you a wet/dry mix into a global chorus and a send level into the global reverb. A fifth send provides a wet/dry mix into an insert effect, a wet/dry mix into the global chorus, and a send into the global reverb. The last bus provides a dry mix. There are 40 insert effects, including reverbs, choruses, delays, and various combinations. A new "Chatter Box" algorithm uses complex filters to morph between vocal formants.

With the SoundFinder feature, one knob selects the sound category and another knob selects the desired sound. Sounds can be located alphabetically, by instrument category, or by location (ROM, RAM, card, etc.). To make programming easier, Ensoniq will send registered users a free MR-Rack runtime version of Mark of the Unicorn's *Unisyn* editor/librarian software for Mac and Windows. Ensoniq Corp.; tel. (800) 553-5151 or (610) 647-3930; fax (610) 647-8908; Web http://www.ensoniq.com.

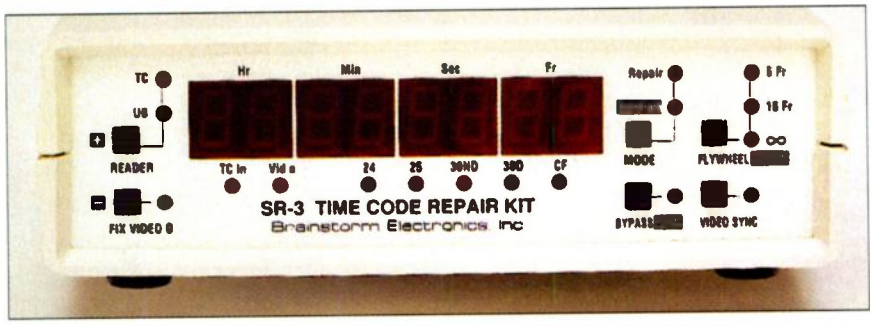
Circle #404 on Reader Service Card

▼ BRAINSTORM SR-3

Synchronization headaches are common in the studio, and a primary culprit is faulty time code. Often the average time-code generator/reader can't properly analyze and repair these problems, but Brainstorm Electronics' SR-3 Time Code Repair Kit ($595) can.

The SR-3 can regenerate time code over dropouts while locked to incoming code or an external video reference. It can reduce jitter using phase-locking to clock the output time code, which it continuously updates to follow variations in the incoming code. The unit analyzes video phase, and if the incoming code is synchronous but out of phase with the video reference, the SR-3 can automatically align the time code to the closest video-frame edge. Missing or false drop-frame flags are automatically detected and repaired, and a front-panel LED confirms the repair in progress.

In addition, the SR-3 can generate and read all standard time-code formats. Time-code generation is referenced to an internal crystal or external video. The unit has a large front-panel display that can show time code or user bits. The LEDs indicate the incoming format; 24, 25, 30, 30 drop-frame, and NTSC frame rates are supported.



Also new from Brainstorm is the SA-1 Time Code Analyzer ($895), which offers the same analyzer functions as the company's SR-15+ but in a smaller, portable package. The SA-1 identifies time-code errors along with the faulty addresses, video phase, code format (24, 25, 30, or 30 drop), and actual frame-rate frequency (such as 29.97 or 30 fps). A beeper sounds when errors are detected, and a button resets the displays.

The SA-1 has a rear-panel serial port and can send a text-file report that includes format, video phase, and time-code errors to an external computer or printer. The unit can operate on an optional 6 VDC power pack (price tba) for location work. Audio Intervisual Design (distributor); tel. (213) 845-1155; fax (213) 845-1170; e-mail brainst@aol.com.

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In 1992 we introduced low cost disk recording with our 4-track DR4d. Thousands of DR4d's have found their way into broadcast facilities, recording studios, post production houses, and project studios. Combining our experience with input from thousands of end users, we created the DR8 and DR16. Whether you're just starting out with your first 8-track, upgrading your current tape-based MDM, or even if you're planning on a double-whammy, 128-track, multi-interfaced, graphically-based, post production facility, the new DR Series from Akai will serve your needs and grow with you in the future. It's an important fact to consider when someone tries to sell you a "budget" digital recorder that never really meets your needs. Check out these features and you'll "see" what we're talking about.

Record/Edit The new DR Series utilize our latest 24-bit internal processing technology enabling simultaneous 8-track recording with the transparent digital audio quality that has become an Akai trademark

Three dedicated LSI's (Large Scale Integrated circuit) for recording, mixing, and optional EQ provide real-time performance and stability of operation that computer based units simply cannot provide.

Real-time random-access editing features like copy, insert,copy + insert, move, move + insert, erase, delete, slip, and sliptrack inspire creative efforts that are simply unthinkable with tape based recorders. The TAKE function allows you to record up to five separate takes of a critical solo, or enables you to compare separate effects treatments of a singular passage. The jog and shuttle wheels make finding precise edit points a breeze, while the familiar tape-machine style transport controls and autolocator make operating the DR Series recorders like working with an old friend.

DR8 - $3495.00 ■ Sugg. Retail Price
8 Track Disk Recorder

MORE FEATURES:

- 18 bit ADC • 64X oversampling
- 20 bit DAC • 8X oversampling
- 24 bit internal processing
- 16 channel digital mixer
- Dynamic MIDI mix automation
- Built-in mic preamps
- 2AUX sends
- 109 point autolocator
- AES/EBU and S/PDIF digital I/O
- 50 pin SCSI port

DR16 - $4995.00 ■ Sugg. Retail Price
16 Track Disk Recorder

EVEN MORE FEATURES:

- Balanced 1/4" TRS in/out
- Switchable +4/-10dB line levels
- 8 in 8 out + stereo master (DR8)
- 8 in 16 out + stereo master (DR16)

Media The DR8 can be equipped with an optional internal 1 GB SCSI drive, while the DR16 is available with an optional 2 GB internal SCSI drive. The DR Series recorders are both equipped with a standard 50 pin SCSI port alowing a combination of up to seven SCSI drives with disk overflow recording capability. Lists of compatible drives are available from Akai product information.

Data backup is achieved through standard audio DAT or Exabyte.

At the time of this writing, the Iomega Company is preparing to go into production with their new 1 GB "JAZ" drive, a removable media SCSI drive which will greatly enhance the capabilities of our new DR Series recorders. Stay tuned for more info in our upcoming ads. Better yet, test drive a new DR Series recorder today at your local Akai dealer.

Now You Can See It.

OPTIONS:

- SuperView™ SVGA card - $699
- ADAT interface - $299
- MIDI interface - $299
- S.M.P.T.E. read/gen - $379
- RS422 video sync - $299
- BiPhase film sync - $299
- 2nd SCSI port - $299
- MT8 MIX controller - $799
- 8 channel 3 band parametric EQ - $550
- 16 channel 3 band parametric EQ - $699

Mixing Some of our competitors' disk recorders use a portion of their recording LSI to provide mix capability. While this saves money, it can also produce audio artifacts like "zipper" noise when adjusting such critical functions like EQ, pan, and fader level. On top of that, many disk recorders won't even let you make real-time adjustments during mix down, eliminating a critical part of the creative recording process. The heart of the DR mixer is a 16-channel, 24 bit custom LSI designed to provide real-time dynamic digital mix capability. Built-in 99 scene snap-shot automation for all functions and dynamic automation via external MIDI sequencers, combined with 8 or 16 channel 3-band parametric EQ option, ensures that the only limit in the DR Series mixer is your imagination. With its built-in 16 channel mixer, the DR8 becomes the perfect compliment to any 8-track recorder you might currently own. It can mix down its 8 tracks of internal digital audio with an additional 8 inputs from a sampler, tape machine, or a live performance, all in the digital domain. The MT8 mix controller provides a 16 track console format for dynamic remote control of all mix and EQ parameters.

ELECTRONIC MUSICIAN 1996 EDITORS' CHOICE

(Monitor/Keyboard/Iomega Drive and Batteries not included.)

SuperView™ We sort of went into a frenzy packing new features into our DR8 and DR16. When we stepped back to take a look at what we'd done, we realized we crammed a whole roomful of equipment into a single 5U box. In order to help keep track of everything that's going on inside our "studio in a box", we developed the SuperView™ SVGA monitor board. SuperView™ mounts internally in the DR8 or DR16 and provides envelope and track information for up to 16 tracks of audio, as well as region highlighting for record, playback, and edit. SuperView™ is further enhanced by 16 track level meters with indicators for left/right master out and aux 1/2 out. The time indicator will read in the same format as the DR front panel. SuperView™ requires no external computer, simply plug your SVGA compatible monitor into a SuperView™ equipped DR Series recorder and you're ready to go. SuperView™ enables real-time video representation of audio status; no waiting for screen re-draws. What you hear is what you see.

SEE US AT NAMM BOOTH #4031

Keyboard Interface To increase the power of SuperView™ even further, we added an ASCII keyboard input to the SuperView™ card, allowing a standard ASCII keyboard to operate as a control interface for SuperView™ equipped DR Series recorders. Function keys will provide the ability to zoom in on a single track, as well as zoom in/out timewise for precise edit capability. All tracks and locate points can be named, allowing you to manipulate and track large amounts of data in a very simple manner. A unique interface has been developed to allow track arming, transport control, and edit functions directly from the keyboard, providing enhanced productivity through an intuitive human interface design.

AKAI DIGITAL

Akai Digital
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Fort Worth, TX 76102, U.S.A.
Ph. 817-336-5114
Fax 817-870-1271

▼ FOLDED SPACE MICRO ROOM

With all due respect to amp and speaker simulators, some recordists aren't satisfied unless they can use an amp in an acoustic space, especially when recording guitar, harmonica, and bass. Unfortunately, that sometimes means dealing with loud sound-pressure levels. Aside from potentially angering the neighbors, this can cause sonic bleed into other live mics, particularly when recording vocals or live rhythm sections.

Folded Space Technologies' Micro Room ($395) offers an alternative to electronic simulators. The 12 × 12 × 22-inch, acoustically isolated enclosure

contains a Shure SM57 mic and a specially designed, all-paper, 5.25-inch, 8-ohm, cone speaker. Other microphone and speaker options are available upon request.

A built-in attenuator (switchable between -15 and -20 dB) lets you use the Micro Room with any power amp up to 100W RMS. The system has a low-impedance (XLR) mic output and a ¼-inch, speaker-level input.

The enclosure's interior is treated with 2-inch acoustical Studiofoam. The cabinet is made of ¾-inch hardwood ply finished with textured epoxy. The Micro Room weighs just 35 pounds. Folded Space Technologies; tel. (404) 633-2507; fax (404) 321-5094; e-mail 74602.1733@compuserve.com.

Circle #406 on Reader Service Card

▶ FURMAN IP-2 ISO PATCH

You might want to hear the industry buzz about new recording gear, but you certainly don't want to hear buzz in your audio system.

Ground loops are a major source of buzz and hum. One way to get rid of these nasty problems is by inserting an isolation transformer at the output of the offending gear.

Furman's IP-2 Iso Patch Dual Isolator ($69) uses a pair of isolation transformers to help clean up your audio rig. The 2-channel unit has balanced, ¼-inch input and output jacks that handle line-level signals.

If two channels of electrical isolation aren't enough, check out Furman's IP-8 Isolated Patch Bay ($259). This 1U rack-mount device integrates isolation transformers into an 8 × 8, half-normaled patch bay. Furman Sound; tel. (415) 927-1225; fax (415) 927-4548.

Circle #407 on Reader Service Card

▼ AARDVARK AARDSCAPE

As discussed in EM's December 1995 "What's New" AES report, the fast-growing popularity of digital recording has stimulated a demand for products that let you record digital audio with analog-like sound quality. Although most of these products use tubes, that is not the only possible approach. Aardvark's AardScape ($850) uses solid-state electronics to simulate the natural distortion of tape saturation and the "warmth" generally attributed to analog recording.

The AardScape gives you a choice of soft, medium, or hard tape saturation with a front-panel switch. The amount of "warmth" and "drive" can be selected from a pair of 9-position, detented rotary controls. A 3-position Brilliance switch lets you optimize the frequency content of the saturation effect for different types of program material. Levels can be checked with a 9-segment LED ladder. An input-level knob, bypass switch, and power switch complete the front panel.

The unit supports +4 dBu I/O on balanced, XLR connectors and -10 dBV I/O on unbalanced, ¼-inch connectors. Aardvark; tel. (313) 665-8899; fax (313) 665-0694; e-mail lovell@aardvark-pro.com.

Circle #408 on Reader Service Card

64 VOICE POLYPHONY---8 MEG OF ROM---640 PROGRAMS---61 NOTE KEYBOARD---500 MIXES

Creativity Is Priceless. Now, It's Also Affordable.

Introducing The Alesis QS6

How much is your creativity worth? You really can't put a price on something so valuable. The powerful new **QS6™ 64 Voice Expandable Synthesizer** gives you everything you need to push your creativity to new levels. It's the affordable solution for musical inspiration.

Studio Quality Sound

The QS6 has everything from realistic acoustic instruments to cutting-edge and vintage synth sounds, all accessible at the touch of a button. Its digital 16-bit linear non-compressed samples provide warm, clean, and incredibly accurate voicing for every performance. The onboard multieffects - reverb, chorus, flange, delay, rotating speaker effects and more - use the same advanced processor as our Q2™ Master Effects. Combine these effects with the massive sound library, and you'll create CD-quality mixes right from your synth. QS6's rhythmic/ sonic loops let your creativity groove just by holding down a single key. The semi-weighted keyboard offers velocity, release velocity and aftertouch for expressive playability. It's all packed into a tough all-metal chassis that will take the punishment when you take your show on the road.

Variety and Expandability

The QS6 offers a huge palette of internal sounds - 8 megabytes of sample waveforms, 640 Programs, and 500 Mixes - giving you thousands of timbral options to choose from. This sonic library can be expanded instantly by simply plugging in a 4MB or 8MB Alesis QuadraCard™, like our acclaimed Stereo Grand Piano card.

Also, the QS6 includes Alesis' exclusive Sound Bridge™ software (for Mac and PC) which allows you create custom cards with your own sound files from your computer. This innovative technology guarantees that you'll always have access to new sounds.

Powerful Synthesis Engine

The QS6 uses the same advanced synthesis architecture as its big brother, the QuadraSynth Plus™. True 64-voice polyphony lets you assemble complex sequences and rich, stacked chords. Its 16 channel multitimbral Mixes and a built-in computer interface (also for Mac and PC) give you easy access to the world of MIDI sequencing, software and composition. In fact, we've included a free CD-ROM with the QS6 that's packed with extra sounds, killer sequences, and Steinberg's Cubase Lite™ sequencing software to help get your creative juices flowing.

The QS6 is an instrument that was crafted to help you unlock your creative talents. Stop by an Alesis Dealer and start creating new music with the newest keyboard from Alesis.

See us at NAMM Booth #'s 3735 & 4042

For more information about the QS6, see your Authorized Alesis Dealer or call 310-841-2272.

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perfect tool for producing music in professional or home studio environments. Logic for Windows (also available for Macintosh) will offer you entirely new possibilities and its flexibility will amaze you again and again.

Also available as 100% native code version for PowerPC!

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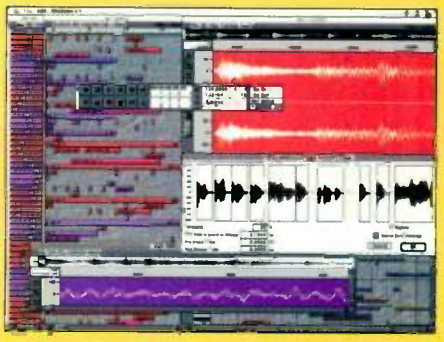
The add-on integrated module that turns Logic into a total digital studio!

Install the Logic Audio Module with Logic on your Mac/Power PC, and all doors to the exciting world of digital audio recording will swing wide open. You can use the Apple Sound Manager to record* and play up to 12 tracks or use any of the audio hardware options from Digidesign (4-48 tracks**). Arrange MIDI and audio tracks on one surface, edit the pitch and length of a digital audio track in one process, adapt the groove of your MIDI tracks to the groove of an audio track, turn monophonic digital



recordings into printed score and enjoy what many users say is the best music program ever made.

The Logic Windows Audio Module is scheduled for Q1/96

* *16 bit Audio-in Mac only*

** *16-48 tracks using TDM Extension*

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TDM Extension

The Logic TDM Extension will make your Pro Tools III a total state of the art Digital Audio Workstation!

In combination with Digidesign's Pro Tools III system and Logic Audio, the TDM Extension allows for 16 - 48 digital audio tracks. Thanks to a special Audio Object in Logic's Environment you can create virtually any Pro Tools mixing desk that you may need. All Plug-Ins (digital effects) can be fully automated including Aux Sends and Master Outputs. Plug-Ins can also be inserted and deleted during playback and every possible TDM configuration can be saved

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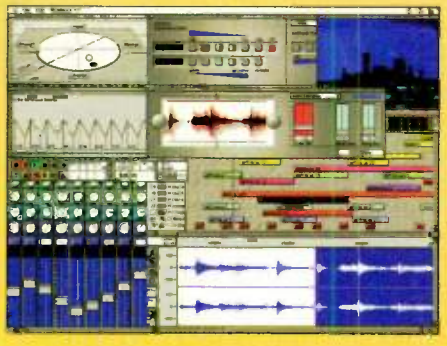
Logic Audio is our flagship product in the Logic Series. This package integrates the complete Logic program with the Audio Module. You get up to 12 tracks using Apple's Soundmanager (AV), 4 - 48 tracks** with one of Digidesign's hardware options, or 4 - 8 tracks with the Yamaha CBX D3/D5 (add CBX Extension). Included at no extra charge is the legendary Digital Factory, our collection of power utilities for creative DSP editing of your audio material. The Digital Factory™ includes



the Time Machine™, the Quantize Engine™, the Silencer™, the Groove Machine™ , the Audio Energizer™, the Audio to Score Streamer™, Audio to MIDI Groove Templates™ and more. You owe it to yourself to seriously check out this program before you consider buying anything else.

** *16-48 tracks using TDM Extension*

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Control the innovative CBX D3 and D5 Digital Recording Processors with Logic Audio using the CBX Extension. With each CBX unit you add an extra 4 digital audio tracks, 4 outputs and 2 inputs for up to 8 CBX tracks. Logic Audio is the only program that lets you use all Mac/PPC (AV), Digidesign and CBX tracks simultaneously including all options of the powerful Digital Factory.

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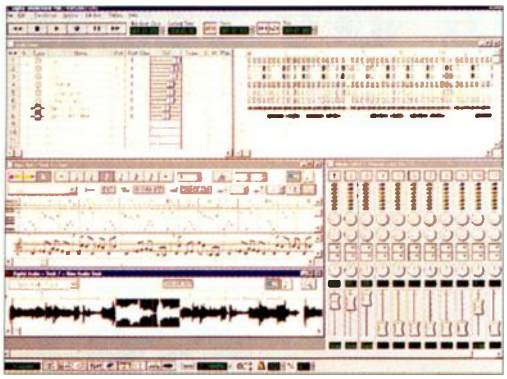


▲ VOYETRA DIGITAL ORCHESTRATOR

Integrated digital audio sequencers seem to be popping up everywhere, so it should come as no surprise that the electronic-music pioneers at Voyetra are right in the thick of it. *Digital Orchestrator Plus* ($159.95) lets you record and edit MIDI and digital audio, with support for drag-and-drop. The software syncs to MTC, SMPTE time code (all frame rates), MIDI Clock, and Song Position Pointer.

Audio editing features include cut, copy, paste, and merge, with unlimited track-bouncing. The program can import WAV files and supports multiple sample rates. Effects-processing algorithms supply delay, chorus, flange, compression, reverb, and gating, and waveforms can be reversed. The program offers tap tempo, fit time, and accelerando (which changes the tempo over time).

As with most such programs, the number of audio tracks is limited by your computer hardware (i.e., CPU power and disk access speed and throughput). Voyetra estimates that you can record approximately eight mono tracks at 22.05 kHz or four tracks at 44.1 kHz, synchronized with MIDI tracks, on a 90 MHz Pentium.

All the MIDI features of Voyetra's *MIDI Orchestrator Plus* sequencer are included, and support for SysEx messages has been added. The program provides more than 1,000 MIDI tracks, 480 ppqn resolution, and a mixer screen. The Measure/Track Editor includes volume sliders and assignable real-time controllers and supports Program Change and Bank Select. You also get a piano-roll editor with scrubbing and an event-list editor. The program's transcription engine converts MIDI files into standard music notation with up to ten staves.

Digital Orchestrator Plus also offers a variety of MIDI transformations, including the ability to set, offset, scale, and humanize Velocity, Release Velocity, and note duration (which can also be quantized). You also can offset, humanize, and quantize note start times. MIDI controller events can be offset, scaled, humanized, inverted, and thinned, and you can eliminate duplicate events. Pitch can be transposed (including diatonic transposition), inverted (including diatonic inversion), and randomized.

The user interface includes a Quick Buttons feature that lets you jump between editing screens; Notepad, which lets you add descriptive text; multiple undo/redo on all edits; and online help. The program supports the General MIDI, Yamaha XG, and Roland GS specifications, and users can create custom patch mappings. Voyetra Technologies; tel. (800) 233-9377 or (914) 966-0600; fax (914) 966-1102; e-mail info@voyetra.com.

Circle #409 on Reader Service Card

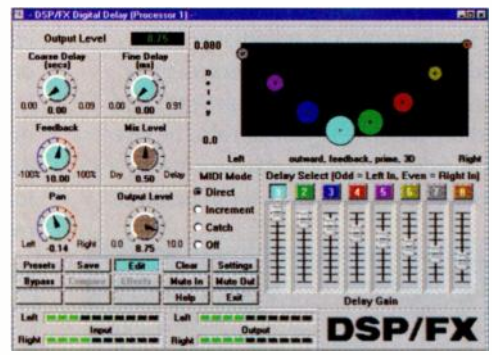
▶ POWER TECHNOLOGY DSP/FX

In an effort to bring high-quality digital audio effects processing to the PC desktop, Power Technology has unveiled DSP/FX ($1,295), a hardware/software package for Windows. The DSP card fits into any standard PC.

The software currently provides multitap delay, stereo pitch-shifting, chorus/flanging, and reverb. The company promises to add new algorithms in the future, such as parametric EQ and compression. A virtually unlimited number of user programs can be stored on the computer and recalled from within the main screen or via MIDI Program Change.

The user interface emphasizes intuitive visualization of the effect in an onscreen graphic window. For example, with the 8-tap delay, the Algorithm Visualization window contains eight color-coded, onscreen circles that indicate the placement of each tap. Internal concentric circles resize to indicate the feedback (regeneration) for each tap. The taps can be individually placed in the soundfield and manipulated in groups. The display updates continuously, in real time.

Effects levels are set with onscreen faders. Other parameters are controlled with virtual knobs. Input and output levels are displayed with virtual LED ladders. Compare and Bypass buttons are also included.



All parameters can be controlled in real time via MIDI Control Change messages. The parameter values can respond to MIDI control in three ways. In Direct mode, the values change as a direct function of the MIDI controller; changing the controller continuously alters the parameter value by the same amount. In Increment mode, the algorithm responds in stepped increments. In Catch mode, the parameter value does not change until the controller reaches the existing value; after that, it changes normally, as in Direct mode.

The system provides true 32-bit processing with floating-point calculation, which ensures that all 32 bits are always used to process the sound. In contrast, the more common 24-bit, fixed-point processors have a fixed amount of headroom before clipping and don't use their full bit resolution when processing low-level signals.

The stock hardware has stereo, 16-bit analog inputs and outputs, and the system supports multiple sample rates. A digital interface that supplies both AES/EBU and S/PDIF I/O is available. Power Technology; tel. (415) 467-7886; fax (415) 467-7386; e-mail 74723.3615@compuserve.com. ❀

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We couldn't have said it better ourselves.

"*Out of this world, exceptionally realistic, unbelievable bass end,* and *dirt when needed*, are just some of the tired expressions that could be dragged from the cliche cupboard, because this is one mother of a synth...If you want classic analog sounds then forget the secondhand pages and buy a Prophecy, and if you want to explore virtual modeling then this is the cheapest way so far. The Prophecy will be a classic in the way of the DX7, D50 and M1." – **Future Music**

"The Prophecy is a monophonic solo instrument with a projected price that puts it into the *I gotta get one* bracket. If I hadn't been told this was a digital machine, I would have accepted the analog sounds without question. I don't think I need to be a prophet to predict that the Prophecy is going to be in demand." – **Sound on Sound**

"Love at first sight. This is a synth for the future which incorporates all the best of synths past. If you like to twist, change and control sounds as you play; if you like analog; if you like realistic emulations of brass and wind; in fact if you're interested in synthesis at all, you really have to try the Korg *Prophecy*. In my humble opinion, it's the best keyboard currently available in this price range – or anywhere near it." – **Making Music**

"Divine Prophecy. If you're looking for a synthesizer that doesn't only play, but that also shapes sound, check out Korg's latest synth called the Prophecy Solo Synthesizer." – **EQ**

"Keyboard mavens will probably love this. Korg has a hot new synthesizer...Rick Wakeman's a fan: *Occasionally, and I mean occasionally, something really innovative and exciting to play appears. Prophecy comes under that rare heading.*" – **Music Monthly**

"This is an instrument that reassures sonic originality, creativity and spontaneity at a time when recreative preset-itis has become the norm. Quite simply, this is a stunning synth." – **Keyboard Review**

"This little board packs a serious punch. I really liked how the data ribbon is built onto the pitch wheel...it provides a new outlet for expression" – **Memphis Musician**

"The Korg *Prophecy*, a 37-key synthesizer featuring Korg's DSP-based Multi-Oscillator Synthesis System, has gotten a big thumbs-up from Rick Wakeman. If you heard its wailing analog-like tones at NAMM, you'd know why." – **Musician Magazine**

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PRO FILE

Cross-Culture Club

Xhange creates a multicultural stew.

By Mary Cosola

The bloody heritage of Angola would hardly seem to be fertile soil for pop music, even less so for a band that celebrates its cultural diversity. However, within this history of strife, the musical melting pot that is Xhange has flourished. Led by João Ferreira, the band recently released a self-produced CD that is full of vibrant, hopeful, and beautiful songs. Contrary to Angola's periodic storms of political factionalism, the band's eponymously titled album was built around a theme of collaboration.

"I chose to name the project Xhange to represent both *change* and *exchange*," explains Ferreira, who composes and arranges the songs, sings, and plays keyboards, flute, and percussion. "*Exchange* means the exchange of ideas with other musicians, and *change* means that the musicians will change each time, adding new ideas and sensibilities to the music."

The open forum certainly produced a wide range of styles on *Xhange*. The opening track, "Loucura Programada" is an improvised outtake from the fifth song on the album, "Loucura Programada Suite." It features a beautiful and haunting vocal duet by brothers Moses and Jose Kafala, sung over a sequenced piano and string arrangement. A few tracks later you'll encounter "Sonhos de Paz," a funky jazz-fusion instrumental with alternating electric-guitar and keyboard solos.

But Xhange is more than a blending of musical influences, it is also a blending of cultures. Ferreira was born in Central Africa and lived in Portugal and France before moving to Angola. He studied classical piano and played with the Central African National Company of Traditional Ballet. Philippe Huette (who sings and plays guitar and keyboards) was born in France, and the Kafala brothers are native Angolans. Because the players are from different parts of the world, a few different languages appear on the album. For example, the lyrics of "Haszard" are written in English, "Caravanserai" in Himbundo (an African language), and the other songs in Portuguese.

"'Caravanserai' is in Himbundo because the lyrics talk about Africa," notes Ferreira. "The song is about the pride that African people should have if they want to improve their lives; their future is in their hands, not in the hands of Western governments and all their economic and humanitarian aid."

All of the album's pre-production tracks were recorded by Ferreira and Huette in Ferreira's home studio with a TASCAM 488 Portastudio and Opcode's *Vision* running on a Mac Classic. Other gear included Korg M1 and M3 synths, a BOSS DR-660 drum machine, and a Lexicon Vortex morphing signal processor. The final recording was done in the studio of the Radio National of Angola, where they had access to an analog Studer 16-track recorder and an old 16-channel Neve mixing console. The album was mixed to DAT and mastered to a Studer CD-R deck.

"I know that working in different languages and musical styles is not a good marketing strategy," admits Ferreira. "But I don't want to be reduced to a single style. My main interest is capturing the sincerity and spontaneity of some magic moments and developing songs that transmit a special feeling from these moments." ❦

For more information, contact João Ferreira, 147 Av. do Brazil, 5 Esq., 1700, Lisboa, Portugal; tel. 351-1-840-15-03; fax 351-1-757-45-15.

João Ferreira

CREATIVE Space

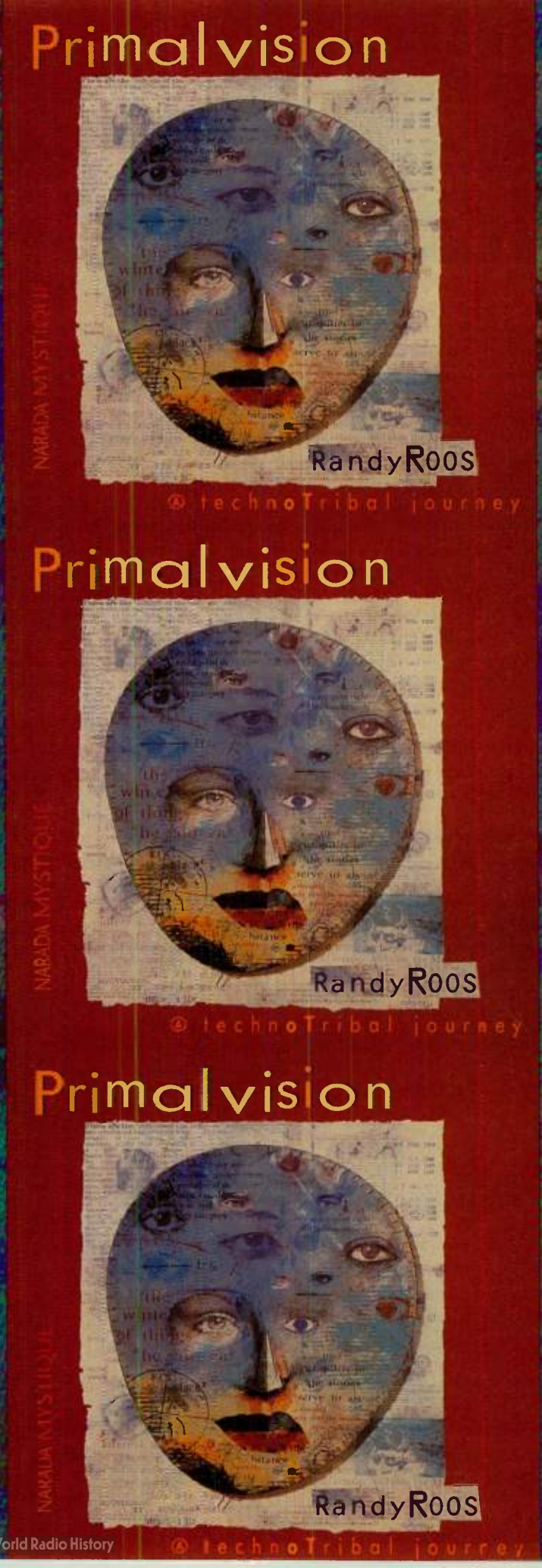
Primal Guitar

Randy Roos looks at the world from his home studio.

By Mary Cosola

One of the cruelest jokes a music journalist can play on interview subjects is asking them to label their music. Fortunately, guitarist Randy Roos is a generous soul. When I apologized for asking him to lump his music into a tidy category, he said, "Actually, it's a good exercise for an artist to try to define his or her music." What a guy.

When we got down to brass tacks, Roos decided on the key words *global, organic,* and *textured* to describe the music on his current solo album, *Primalvision* (Narada Mystique). Given the album's occasional urban dance groove and jazz guitar licks, I would add *hip* and *funky* to that list. Roos incorporates musical styles from around the world and blends them in such a way that the average listener would be hard-pressed to pinpoint one dominant ethnic instrument or genre. It's not easy to strike such a balance between musical elements, but Roos has forged a successful career by doing just that.



In his postcollegiate years, Roos played guitar with Orchestra Luna, a theatrically oriented rock group that had a recording contract with Epic Records. After Orchestra Luna disbanded, he formed his own experimental jazz quartet. Disenchanted with the idea of getting a record deal, Roos set up a home studio and started producing film and video soundtracks. That was in 1986, and ten years later he still has a thriving career as a soundtrack artist, with his main scoring gigs being the PBS shows *Scientific American Frontiers* and *NOVA*. His soundtrack work requires that he produce 20 to 30 minutes of original music a month from his project studio, Roosongs.

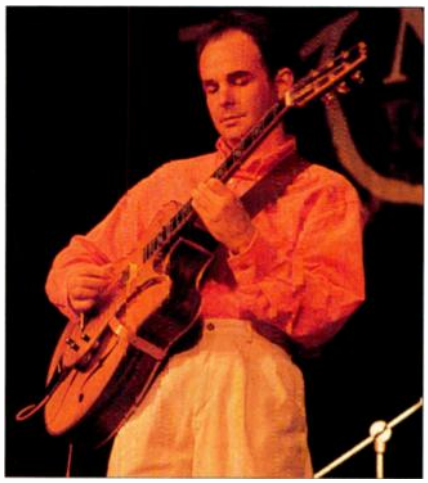
"My principal focus is my own music, but I love the soundtrack work," says Roos. "It forces me into a lot of musical areas where I wouldn't ordinarily go. It also keeps my synth chops happening."

VOCALVISION

Part of Roos' concept for *Primalvision* was to explore the universality of music, not only by blending different instrumental sounds but by manipulating an array of multicultural vocal samples. "For this project I wanted to use a wide diversity of elements while maintaining an emotional coherence across all the songs," he explains. "One of the elements that makes this cohesiveness possible is the vocals. I've been looking for a way to work with vocal gestures, rather than with lyrics and lines of thoughts. The idea is for the sound, energy, and passion of voices to be present but without any literal meanings."

Given this vocal concept, the voices on *Primalvision* are quite unusual, both in the way they sound and in the way they were created. Roos' creation of a nonspecific, global ambience obviously negated the use of recognizable lyrics. Instead, he cut up a variety of vocal samples and triggered them from his guitar using Roland's GI-10 and GM-70 guitar-to-MIDI converters mounted on a Charvel solid-body. Playing the vocals on the Charvel enabled Roos to create different effects, from the haunting background chants on "Desert Vision" to the upbeat lyrical groove on "Black Elk."

"If people are thinking of trying this themselves, they should know that I did the sample editing in my computer, not in my sampler," Roos points out. "If I edited just one of these songs in my sampler, it would have taken a month. In *Sound Designer*, I can have a song displayed graphically, so I can highlight a word, listen to it, and quickly determine whether I want to use it. Then, I can make a file out of that small segment and load it into my sampler.



Roos lets the licks fly onstage at Narada Night at the 1994 Rainbow Summer in Milwaukee.

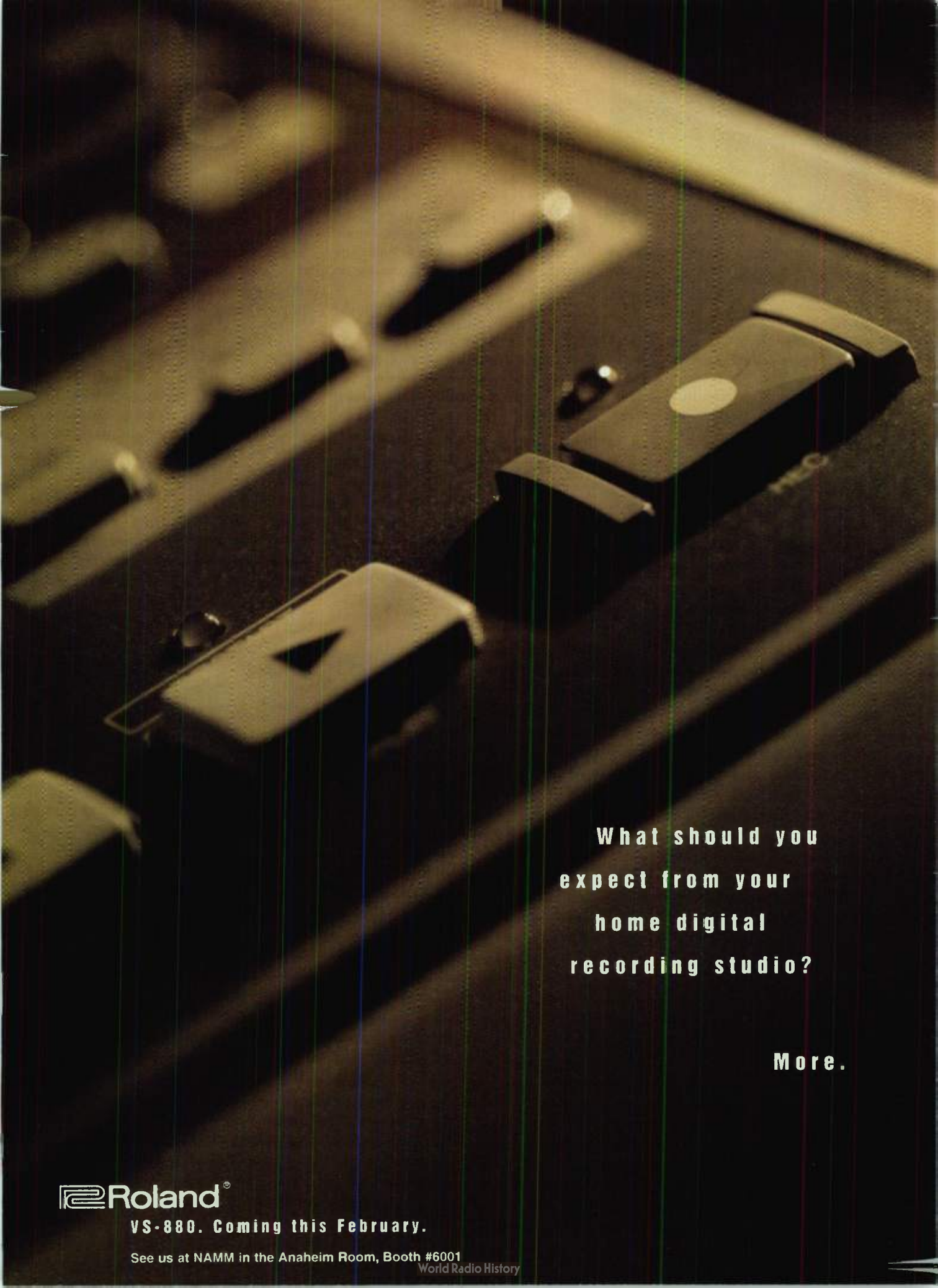
"I used Velocity cross-switching when playing the samples from my guitar," he continues. "Usually I'd have three or four different samples layered and set up to cross-switch on each note, depending on how hard the note was hit."

The samples range from a live recording of a Sioux powwow (on "Black Elk") to spoken Hindi words (on "The Craftsman"). Roos also recorded some vocal parts himself. For instance, he had his wife, Kathy, sing Gaelic words in specific notes and pitches. He also enlisted the aid of opera singer Mary Oliver and his nieces, Sinead and Deirdre O'Brien (nine and six years old, respectively). Once these parts were recorded, he would load them into *Sound Designer* and process them the same way as the samples culled from audio CDs.

Using nonliteral "vocal gestures" in conventional song structures can be a risky venture, and Roos was never really sure how the sounds would work until he played them on his guitar. "There were a number of times that I came up with material that I just couldn't make work," he explains. "In those cases, I'd have to start over with all new vocal parts. Because of that, the vocals for one song could take anywhere from half a day to three or four days to complete."

Leave it to someone who plays vocals on guitar to play hi-hat patterns on a chair. Roos and Richard Denhart (executive producer on *Primalvision*) wanted to emulate a Basque percussion technique called *txalaparta* in which players play hi-hat patterns on wooden

Randy Roos at the console of his Roosongs project studio. Note the custom Ibanez fretless guitar in the lower left corner.



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planks with heavy wooden dowels. Roos went to a friend's studio and, using a chair and rake handle that he found in the basement, gave it a try. Marty Richards, who also played some cymbal and hi-hat parts on the album, was elected player of the chair.

"Marty banged the living daylights out that thing," laughs Roos. "That chair looks a little different now, but it had a great sound. We ended up using it on 'Desert Vision' and 'Chameleon's Dance.'"

CRAFTSMEN

On "The Craftsman," Roos plays a fretless guitar that he and his friend, Steve Holland, built. Roos had the idea of patterning a guitar after a sarod, an Indian stringed instrument with a fretless metal fingerboard. To play a sarod, you have to fret it with the fingernails on your index and middle fingers, which is certainly an acquired talent.

"I wanted a fretless guitar that had a lyrical, wind-instrument feel to it," says Roos. "The problem I encountered in building a fretless guitar is that a guitar string—unlike a bass string—has so little mass that when you hold down the string, you're actually damping its vibrations."

He and Holland built a fretless prototype but weren't happy with the way it sounded. Holland suggested they try installing an infinite-sustain device he had been working on. The final product is a customized double-neck Ibanez: one neck is the 6-string fretless design with a stainless-steel fingerboard and the other is a standard 12-string style. The double-neck design was chosen because Roos wanted to be able to play conventional parts on the same guitar.

"The stainless-steel neck gives the guitar a different kind of timbre," says Roos. "There's a darker sound to the instrument because the tone is affected by the softness of your finger, rather than the rigidness of a fret. The guitar's sound is also affected by the sustain device, which gives each note a lot of body. You have this kind of rubbery attack, but the sustain device causes the output of the string to ring loudly directly after the attack. The note does not decay as quickly as it does on a conventional guitar."

The sustain device is a series of electromagnets built into the frame of a standard guitar pickup. It has twelve coils—two for each string—and a strong magnet under the coil array.

"The idea of using two coils per string is to have them wired out of phase so there's a flow of magnetic flux from one coil to the other," he explains. "This design localizes the magnetic field so it doesn't bleed over into the other guitar pickup and cause audible feedback—which could be a real problem with this type of system because you have to generate a fair amount of power in the device in order to vibrate the string. It's a little bit like having a set of six E-Bows installed in your guitar. I like that it gives me tactile control over dynamics, much like a wind instrument does. I wrote 'The Craftsman'

for Steve, who died in 1983. He was a true genius at working with metal and music."

THE PRIMAL PROCESS

Because Roos works so hard at getting the emotion of his guitar tracks right at the pre-production stage, he hates to try to re-create it once he's in the studio putting the album together. "I'm really meticulous about my pre-production tracks because I know I'm going to keep them," he says. "Once you go after something creatively and you get it, there's a lot of magic that happens. So why go back into the studio to try to get something you've already achieved?"

Roos credits the evolution of home-studio equipment with allowing him to produce pro-quality tracks at the pre-production stage. He says that this has influenced not only the way he records but the way he creates.

"The fact that the composition and production processes can now be tied together is very interesting to me," he reflects. "I used to write music the old-fashioned way—with pen and paper.

Primal Tools

To complement his studio setup listed below, Randy Roos "begged, borrowed, and rented" the following for the production of *Primalvision:* AMS DMX-1580S sampling delay, BBE Sonic Maximizer, Lexicon PCM 70, Massenberg 8200 parametric EQ, SSL stereo compressor, Summit Audio tube EQ, t.c. electronic M5000, and Urei LA-2.

Mixing Consoles	Korg KMX-122; Mackie 32•8 and 1604
Recording Media	Alesis ADAT, TASCAM DA-30
Monitor Speakers	Tannoy PBM8, Yamaha NS-10
Signal Processors	ADA stereo tapped delay; Alesis 3630; Drawmer CD-241; Korg A3; Lexicon PCM 80, LXP-15, LXP-1, LXP-5, and Reflex; Rane PE-15; SansAmp PSA-1; Yamaha REX-50
Keyboards/Sound Modules	Akai S3000 and S1000 PB; E-mu Proteus 2; Ensoniq EPS 16 Plus; Korg Wavestation, Wavestation SR, and M1REX; Oberheim Matrix 6; Roland D-550 and MKS-20; Yamaha TX-802
Computer Gear/Software	Mac Centris 650; Digidesign *Sound Designer II* 2.8; JLCooper MSB+ and Datamaster; OSC *Metro* and *Deck;* MOTU S100 editor, S-Edit, MIDI Time Piece, and Unisyn; Steinberg *ReCycle!*
Guitars	Alan Carruth arched-top guitar and flat-top steel-string guitar; Charvel solid-body electric; Guild Songbird; Ibanez (custom) double-neck with stainless-steel fretless fingerboard and Holland sustain system; Roland GI-10 and GM-70 guitar-to-MIDI converters

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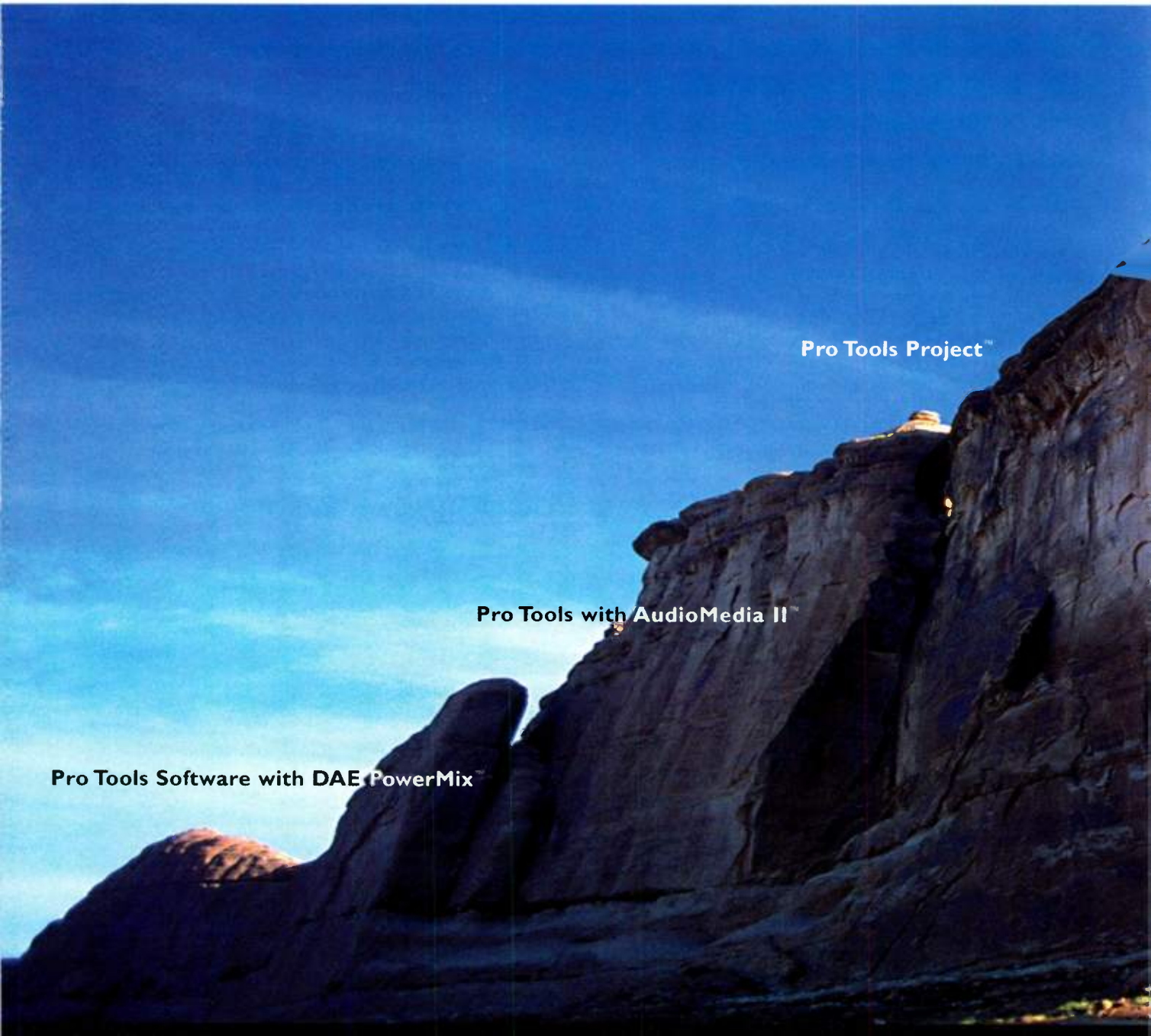

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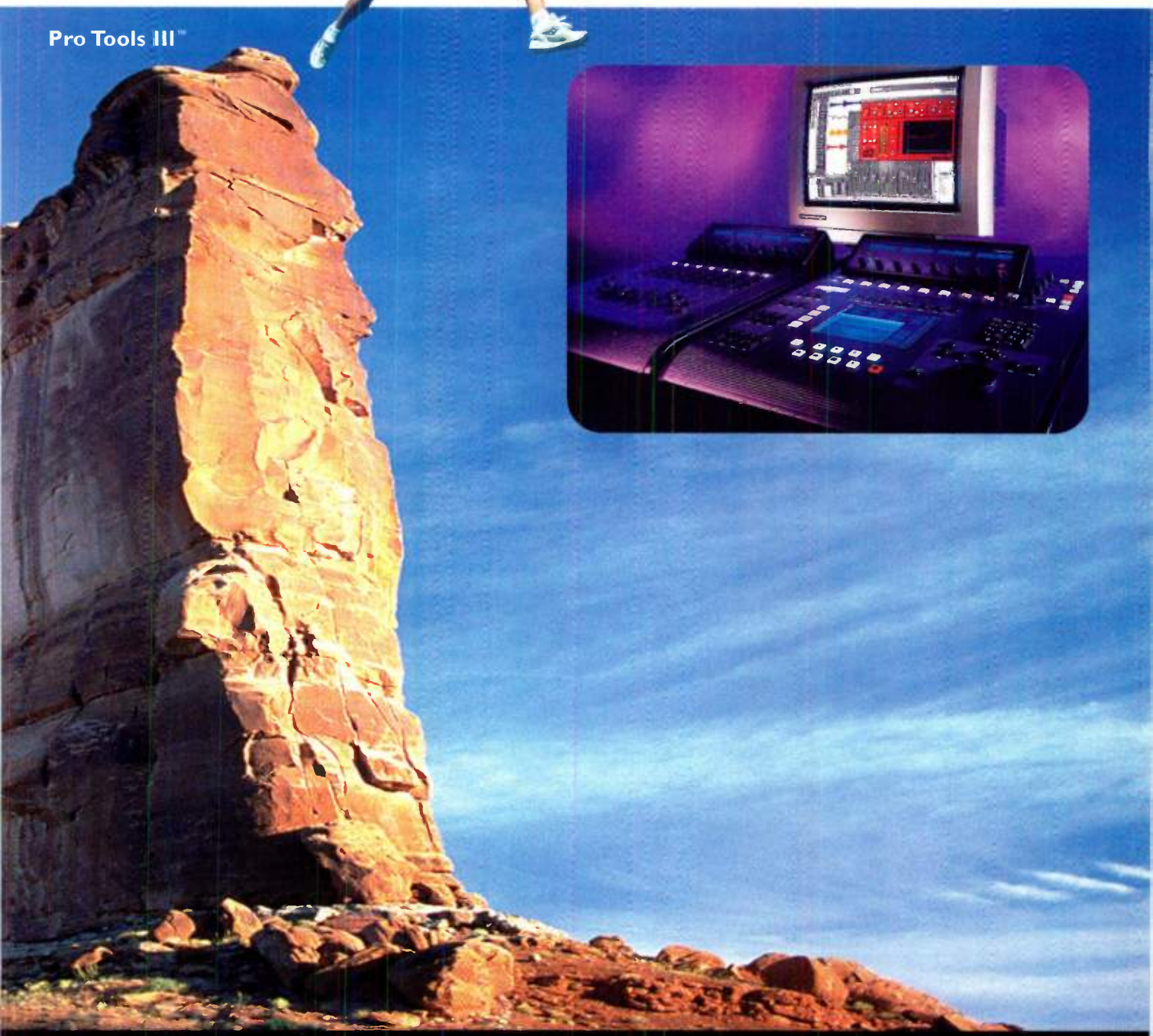

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Now, there's constant feedback between what I'm conceiving musically and what I'm actually hearing. That process is important to this record because the music was conceived, improvised, and recorded in my studio."

MASTER OF THE MIX

Comfortable as he is working in his home studio, Roos had originally planned to mix the final tracks in a pro facility. His first choice was Blue Jay studios, which is located near his home in Boston. Unfortunately, Blue Jay couldn't accommodate his schedule, so he and Denhart mulled over other options, ultimately deciding to stay put at Roosongs.

"I like to get out of my environment once in a while and go into a pro studio," notes Roos. "I think it's a healthy change. You have to understand that with my soundtrack work, I spend a lot of time in here. It's funny, though, that throughout the whole process, it never occurred to me to mix the final tracks here. But the more I thought about it, I realized that the material for the album was spawned here and taking it to another environment wouldn't necessarily be the best thing for the music."

Roos was accustomed to working with engineers who were usually hearing his tracks for the first time at mixdown, but because Denhart is on staff at Narada, he was quite familiar with Roos' pre-production tapes. "The mixdown was a collaborative process, a much different dynamic from working in pro studios," says Roos. "I must say that I've been fortunate to have had very positive experiences with engineers I've worked with in the past. But this was the first time I'd ever worked with an engineer who was already extremely familiar with what I was doing."

At the outset of the mixing process, Roos and Denhart worked side by side, building the mixes from the ground up. But after mixing a few songs, they decided this wasn't the most productive way to work.

They toyed with ways to fine tune the process and hit upon a method that worked great for them. Denhart would leave Roos alone to start a mix and then come back after a few hours to help Roos tweak the audio elements to near perfection. The whole mixdown took about two weeks, and they were satisfied with both the mixing process and the final mix. "Rich has a lot of expertise in using equalization, making timbral changes, and blending sounds together well, which was really important for this album," Roos notes.

IF YOU LOVE SOMEONE

And if you thought it was cruel to ask Roos to define his music, you should have been there when I asked him about his favorite tracks on *Primalvision*. For the uninitiated, that's a bit like asking a mother of four which one is her favorite child.

"It's so true, they *are* like your kids," laughs Roos. "Now I have to let them go out into the world and fend for themselves. That's the part of making an album that is so emotionally trying."

Mary Cosola *is associate editor of* **EM**.

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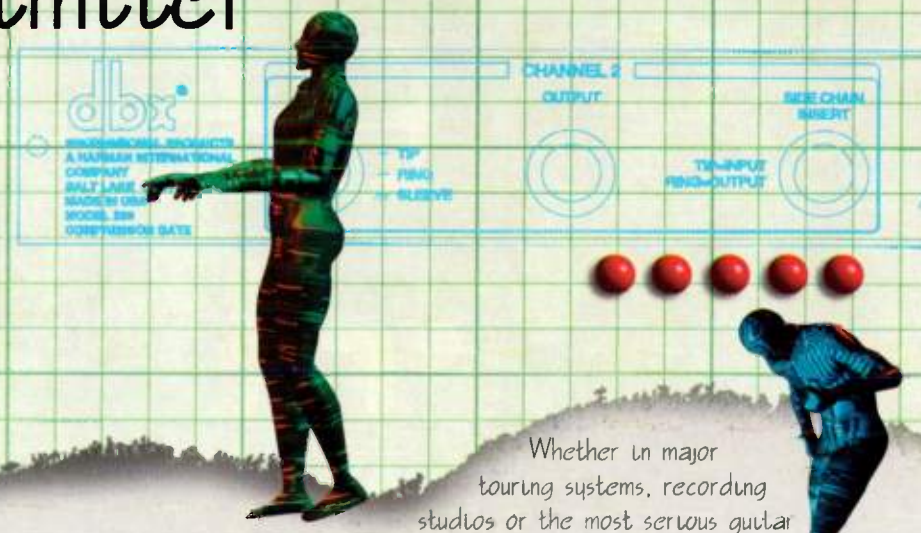

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Spy on professional engineers as they make hot tracks for hip records.

Bits &

By Michael Molenda

Athena may have sprung full grown from the head of Zeus, but making records isn't a one-shot deal. The sonic details of a recording must be painstakingly constructed piece by piece. From the rhythm section to the vocals, every single sound must blend with the other instruments in the ensemble and support the artist's creative concept. Sometimes that can mean making something sound "bad" by design. Or it can require pushing technology to capture timbres with unprecedented clarity. As the trench warriors of the audio industry, professional recording engineers must wrestle with these types of challenges every time they step into the studio.

But the pro's burden can be the home recordist's boon. There is much to be learned from the trials and tribulations of creating mass-market CDs, film soundtracks, and CD-ROM scores. Although the pros have access to expensive and sophisticated techno toys, the basic building blocks of sound production—a recorder, a mixer, some microphones, and assorted signal processors—can be found in even the most austere home studio. The trick is maximizing the potential of the tools, and this is where stealing some licks from audio masterminds can pay off.

By studying the nuts and bolts of pro recording, you can use big-studio techniques to vastly improve the audio quality of home-grown projects. And to prove that this is

Photo Imaging by Paul Morrell

Pieces

really possible, five brilliant engineers and a less-than-brilliant ringer (me), a session musician, a composer, and a sound designer have graciously bared their recording chops for your close inspection.

The feature is divided into a series of one-page "track sheets" that include drums, bass, acoustic and electric guitars, piano, sax, and vocals. There are also sections on collecting and manipulating found sounds for a film score and producing audio for a CD-ROM game. Each section is identified by the artist or project, so you can relate the engineer's sound sculpting to that particular CD and actually hear the results. Finally, we provide some tips on how to bend and shape these professional secrets to work within the typical home-studio environment.

The nine tutorials pretty much cover the bits and pieces of conventional record making and can be used as quick, easy references when you're battling with sound in your own studio. All you have to do is read, absorb, and apply what you learn. Happy tracking!

Bits & Pieces

k.d. lang • vocals

Marc Ramaer, engineer

On her latest album, *all you can eat*, k.d. lang's voice is captured with such lissome intimacy that it's easy to imagine her singing to you in your living room. The reverie wouldn't be too far off, because the album was recorded in lang's living room—or, more accurately, in the Vancouver home studio designed by her engineer and coproducer Marc Ramaer (pictured below in the fruit of his labors).

"I think that having the studio in her house helped k.d. deliver performances that were extremely captivating and honest," says Ramaer. "Sometimes she would come back from a jog, jump in the shower, and blast off a great vocal before most people get out of bed!"

The nerve center of lang's studio is equipped with standard gear available to the well-funded home recordist: a Mackie 32•8 (with 24•E Expander), three TASCAM DA-88s, Meyer HD-1 monitors, and a Mac Centris 650 running Digidesign's Pro Tools III. However, lang's lead vocals were not recorded with an off-the-shelf microphone.

"We used Neumann U 87s that were reworked by Stephen Paul in Los Angeles with new Delta 9 capsules," explains Ramaer.

When recording lang's vocals, the U 87 was set to the cardioid pattern with no frequency roll-off or input pad. No pop filter was used, and Ramaer dispensed with the conventional practice of tracking lang's vocals in an isolation booth. She sang right in the control room, positioned next to a large, glass French door.

"We always tracked vocals in the control room because that made communication smoother and everyone feel less isolated," he says. "k.d. sang either with the U 87 placed on a shock-mount stand, or she held the mic in her hand."

To ensure a pristine signal path, Ramaer routed lang's vocals direct to the DA-88s (bypassing the mixer entirely) through an SSL FX-G microphone preamp and a dbx 160X compressor. The 160X was set to a 2:1 compression ratio at a threshold of 0 dB with the "soft knee" function active. All vocals were tracked flat and any plosives were tamed by tweaking the preamp's low-pass filter.

"Our goal was to try to capture a continuous vocal performance," says Ramaer, "because stopping, rewinding, and punching can interrupt the flow. Depending on the song, we'd do full passes or concentrate on verses and then move to choruses. However, some of the tracks on the record were sung start to finish in one untouched take. We *did* use some composite vocal tracks, but there was usually a batch of just two to three tracks sung on the same day that were assembled for the final vocal track."

Vocals were tracked in the control room because that made everyone feel less isolated.

Ramaer is very sensitive to the fact that forcing a performance when "all the ingredients aren't there" will only frustrate the singer. So to ensure that lang was always at her best, he encouraged her to try and record a vocal track at least once a day, a practice he recommends to everyone.

"Just put up a song and give it a try," he challenges. "Don't wait forever and then tell the vocalist, 'Now it's time for you to sing the entire record!' That kind of pressure would make even a great singer crumble."

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Bits & Pieces

Glenn Letsch • Bass

Glenn Letsch, bassist

In the hierarchy of studio sound sculpting, the electric bass often gets less respect than Rodney Dangerfield. After all, scores of complicated and arcane engineering tomes have been published on tracking killer drum and guitar sounds. But if you seek tips on recording bass, the advice is usually condensed into one simple sentence: "Plug the instrument into a direct box."

"Many engineers just don't spend any time working on the sonic details of the bass," says session bassist Glenn Letsch. "As soon as they get some sort of signal from the bass, they're done. They move right along to getting sounds for the next instrument they're recording that day."

To combat this audio malaise, Letsch often takes matters into his own hands. A veteran of countless jingle and album sessions and years of performing with Ronnie Montrose and Robin Trower—as well as the subject of an instructional video, *The Low Down with Glenn Letsch* (Hot Licks), and author of *Bass Lessons with the Greats* (Warner Brothers)—Letsch has developed a clear idea of what a bass should sound like. And having *any* chance of that sound getting on tape means bringing his entire bass rig to each session.

"I like a bass sound that has a big strong floor and enough upper midrange articulation to bring out the nuances of the player's performance," he says. "I find the 'direct' sound to be generic, real vanilla. Whenever an engineer used to have me plug into a direct box, I felt like the bass went into a black hole. The quality of the sound was dependent on either luck or how cool the engineer was. Now, I try to eliminate any variables by showing up with my amp."

Letsch's recipe for a sublimely fat sound requires splitting the output of his bass into two signals. One signal is routed into a Demeter Tube Direct Box, and the other is plugged into an old Alembic FB1 tube preamp (hot-rodded with tubes in both the input *and* output stages). The preamp signal is patched into a Stewart PA1000 power amplifier connected to a Carvin 4 × 10 speaker cabinet. Then, the cabinet is miked with a Neumann U 47 positioned off axis to one of the four speakers. Neither signal is compressed, as Letsch feels that compression is counterproductive. ("It changes the shape of the notes and destroys relative dynamics," he maintains.) The two signals are recorded onto separate tracks to allow optimum flexibility during the mixdown; the typical combination, however, is 70 percent of the miked signal and 30 percent of the direct signal.

For Letsch, plugging into a direct box is like sending the bass into a black hole.

"I like to take care of the EQ adjustments myself, so I'll ask the engineer to record the signals flat," he says. "I always boost 750 Hz on the FB1 because that's the tweak that really gives the bass that finger-popping sound. But I try not to push the bottom too much because I don't want to intimidate the engineer. As I said, a lot of them don't deal well with bass, and if the sound is too woofy at the final mix, they'll simply bring the level down to a point where the bass becomes an inconsequential instrument. And if *that* happens, all your hard work is for nothing."

Bits & Pieces

Alanis Morissette • Drums

Christopher Fogel, engineer

Alanis Morissette's vengeful rants may have propelled her album *Jagged Little Pill* to the top of the charts, but the driving force behind her vitriol is the slamming drum sound created by engineer Christopher Fogel. The organic snap and wallop delivered by drummers Rob Ladd and Matt Laug hold their own against a churning fusillade of sequenced keyboards and slashing guitars without the aid of massive signal processing, triggered drum samples, or other effects.

"I don't go after a pristine studio drum sound, I just try to make everything sound the way it does in the room," explains Fogel. "My approach is to record things as naturally as possible, so I treat the drums as a single instrument, rather than consider the kick, snare, toms, and cymbals as separate entities. If the kick drum sounds muffled in the room, then it will sound muffled on the record. And I don't use noise gates to clean up drum tracks while I'm recording. If the snare mic has a lot of hi-hat bleeding into it, so be it. It was meant to be."

On *Jagged Little Pill*, Fogel's mic selection leaned toward dynamics because he feels that condensers tend to break up when recording drummers that hit hard. Shure SM57s were used for the toms and the top snare, and an Audio-Technica ATM 25 was used for the kick drum. Condensers were only employed where he wanted more high-frequency resolution. A Neumann KM 54 was used on the hi-hat, a Neumann KM 140 stereo mic on the overheads, and a Neumann U 87 on the bottom snare head. No room microphones were set up. The individual mic inputs were submixed to seven tracks: kick, snare, hi-hat, toms (right and left), and overheads (right and left).

The drums were recorded on ADAT with the input levels practically tickling the red.

"I used top and bottom mics on the snare," says Fogel, "because if you just position a mic on the top head, the snare can end up sounding like a tom. The bottom mic, which was capturing the actual snare sound, was mixed in to add some top-end rattle to the snare submix. I didn't flip one mic out of phase to prevent phasing problems, I simply moved the bottom mic around until it was in phase."

Fogel compressed the snare submix to produce a little more crack, with a dbx 160X set to a ratio of 3:1 and a threshold of -10 dB. He also used a 2:1 compression ratio to lengthen the signal decays captured by the overhead mics. In addition, the overheads received a few EQ tweaks. Low-frequency mush was diminished by cutting a few dB at 80 Hz, and some "silk" was added to the high-end with a 3 dB boost at 12 kHz.

The drums were recorded onto ADATs, with Fogel pushing the input levels until they "tickled the red" to eke out the best sound. Although he found the ADATs to be somewhat brittle between 2 kHz and 4 kHz—which he remedied with a few simple EQ adjustments—he thought they produced a good mirror image of the drum sound.

"The main thing to remember is that you're just a tool to make the artist's song sound the way he or she wants it to sound," says Fogel. "People don't buy records because of who recorded it; they don't care about that sort of thing. Even though I'm an engineer, I've never gone out and bought a CD because Bob Clearmountain mixed it. That doesn't mean anything to me."

Bits & Pieces

Nadja Soundtrack • Found Sounds

Simon Fisher Turner, composer

No one will ever confuse the score for *Nadja*, director Michael Almereyda's surreal film about modern vampires, with the soundtrack for *The Lion King*. As ominous, undulating mists of sound wrap around haunting piano and cello melodies, the beautiful voice of a monster whispers, "I have walked behind the sky." The eerie soundscapes were constructed by composer Simon Fisher Turner, who collected many of the soundtrack's audio elements by transforming himself into a sonic vampire.

"I wandered around New York for three weeks with a small Sony cassette recorder, a Sony DAT-MAN, and a cheap microphone, recording things very badly," he says. "The main sounds I used on the *Nadja* soundtrack were street noises, trains, and glasses. My rather low-fi approach to recording lets me work really quickly—which is critical because I'm into taping things that shouldn't be taped."

Obviously, Turner is not a disciple of convention. His *Nadja* score is a low-fi marvel, recorded exclusively on a Roland W-30 workstation and a ¼-inch, Revox "sound on sound" 2-track recorder. Turner's covert field recordings were sampled into a cheap Casio SK-1, and guitar parts were laid down using an E-Bow and an old BOSS delay pedal. "Multitracking" was accomplished by bouncing tracks back and forth on the Revox.

"Of course, we didn't *keep* everything low-fi," says Turner. "We brought the tracks into some very high-tech studios and played with them to improve audio quality and manipulate sounds. This is another reason why I like starting out low-fi: it allows you to use the studio as an instrument, rather than simply as a place to record sound."

The *Nadja* soundtrack was "performed" straight-to-picture using six stereo tracks on a Digidesign Pro Tools system. Turner brought his sample collection and two DATs full of Revox tracks into the post-production studio. Then he constructed his sound collages as director Almereyda watched scenes and listened. For the cello and piano themes, the players overdubbed their parts to the existing Revox tracks.

Turner walked through New York like a sonic vampire, stealing sounds with cheap recorders.

"We were going fresh onto a blank nothing," says Turner. "I'd put in my DATs and Michael would say 'yes' or 'no.' We were improvising to the picture, making it up as we went along. It was kind of a forced improvisation, actually. You have to hit the cues in the film, so you're not really free. But the Revox tracks allowed us to work very quickly because everything was already bounced down. You couldn't take anything away; you could only make things sound better. For example, sometimes we'd add reverb to a Revox track and only use the sound of the processed track—the dry, original track was muted out. Then, we'd overdub sounds on top of the reverberation."

Although the *Nadja* soundtrack is essentially music for the undead, it is alive and vibrant, even during its most haunting passages. "All of the samples and synths were played live," Turner asserts. "Nothing was triggered or sequenced. I do not understand sequencers at all. I wouldn't know how to say 'Good morning' to one."

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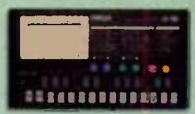

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Bits & Pieces

Stevan Pasero • Classical Guitar

Russell Bond, engineer

The stark melodicism of a classical guitar seems well suited to minimalist recording techniques. Toss up a couple of groovy mics and you're done, right? Well, not if nylon strings and fingertips have to compete against a dense arrangement of drums, bass, keyboards, and horns. Keeping the performance nuances of guitarist Stevan Pasero from getting railroaded by the backing tracks was the challenge faced by engineer Russell Bond as he recorded Pasero's latest album, *ZBRA*.

"Stevan's previous recordings have used light, minimal backing tracks so that his acoustic guitar playing could be very upfront," says Bond. "But *ZBRA* is a very uptempo record, and the trick was getting his guitar to sing through a funk-rock bed. We didn't want to subdue the rhythm tracks, so we had to add as much body to the guitar sound as possible to help it punch through."

Getting Pasero's guitar tone to stand tall required four separate tracks of audio and the help of some nifty stereo signal processing. Bond, who also co-produced *ZBRA*, recorded the album on a 48-track, Digidesign Pro Tools III system.

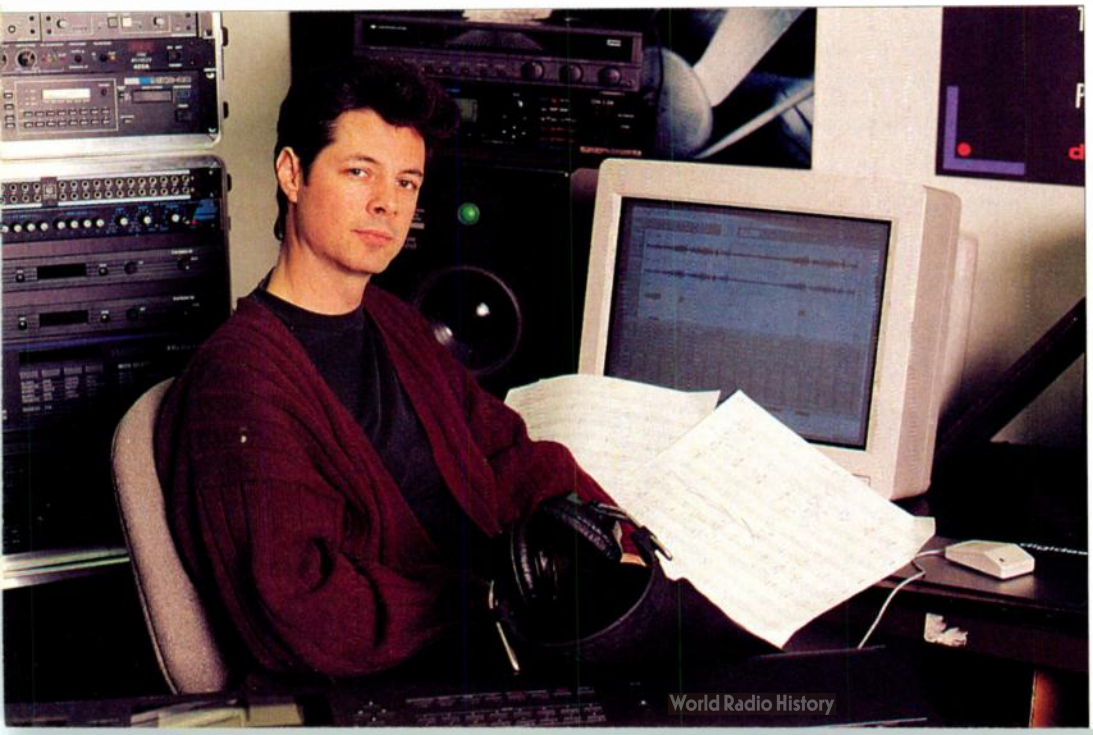
"I started out with my standard stereo miking technique," explains Bond. "First, I positioned an AKG C 460 down by the bridge, approximately 15 degrees off axis to the face of the guitar. The polar pattern was cardioid, and the mic pointed right at the B string. Then, I placed a modified Neumann U 87 three inches from where the neck meets the body. The U 87 was facing up the fretboard at a 45-degree angle, and the polar pattern was set to hypercardioid. Both mics were routed through a Focusrite 215 mic preamp/EQ and a Summit DCL tube compressor/limiter."

From that point, however, things started to get decidedly nonstandard. Depending on the song, Bond fed the U 87 into either a Digidesign D-Verb or a Lexicon NuVerb plug-in and used an assortment of small-hall reverbs to spread out the sound. (The C 460 was left unaffected.) In addition, Pasero had custom electronics added to his Lester Devoe classical/flamenco guitar to improve his live sound—a Mills microphone was placed in the cavity of the guitar and an RMC Polydrive 2 pickup system was installed in the bridge—and these enhancements were pressed into service during the *ZBRA* sessions.

Making sure a classical guitar can cut through dense rhythm tracks is not easy.

"I used the cavity mic, which was fairly boomy, to feed a stereo chorus on my Eventide DSP4000," says Bond. "The bridge pickup was routed into a Digidesign DPP-1 stereo, pitch-processing plug-in that was pitched up 3 cents on one side and pitched down 3 cents on the other. For gain and subtle EQ tweaks, the signals were first routed into a Neve Prism mic preamp.

"We used these effects to ensure that the guitar sounded larger than life," he continues. "We didn't record the effects to tape, because Pro Tools allows total recall automation. However, what we dialed in during the recording is pretty much the sound you hear on the record. Ultimately, the main guitar sound was constructed from the C 460 and the U 87/reverb tracks. The cavity mic/chorus track was mixed in for some added body, and a slight amount of the bridge pickup/pitch-shifter track was used to widen the stereo spectrum."



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Bits & Pieces

Green Day • Electric Guitar

Kevin Army, engineer

The kinder, gentler punk rock of Green Day might replace spit and anger with Beatlesque hooks, but one thing hasn't changed since the anarchic bedlam of the Sex Pistols: punk guitars still rip your face off. On the youthful trio's latest album *Insomniac*, engineer Kevin Army was entrusted with documenting their guitar assault.

"We went for a real basic, articulate sound because the guitars have to be blasting right at you," he says. "And the only way to get that type of sound is with close miking. You don't want to hear room ambience on punk rock. We're not talking about crunchy, midtempo rock songs that lumber by at 120 beats per minute; we're talking about songs that are really, really fast."

To create a suitably aggressive timbre, Army and producer Rob Cavallo used three microphones and two amps. Green Day guitarist Billie Joe Armstrong plugged into two biamped Marshall half-stacks placed side by side. Army positioned a Shure SM57 at the top of one cabinet and an Electro-Voice RE20 at the bottom of the other. Both mics were approximately two inches away from their respective speakers, facing right at the cones.

Room ambience is not something that you want to hear on a punk rock song.

The two signals were then routed through Neve 1081 preamps and into separate input channels of an Amek 2500B mixing console.

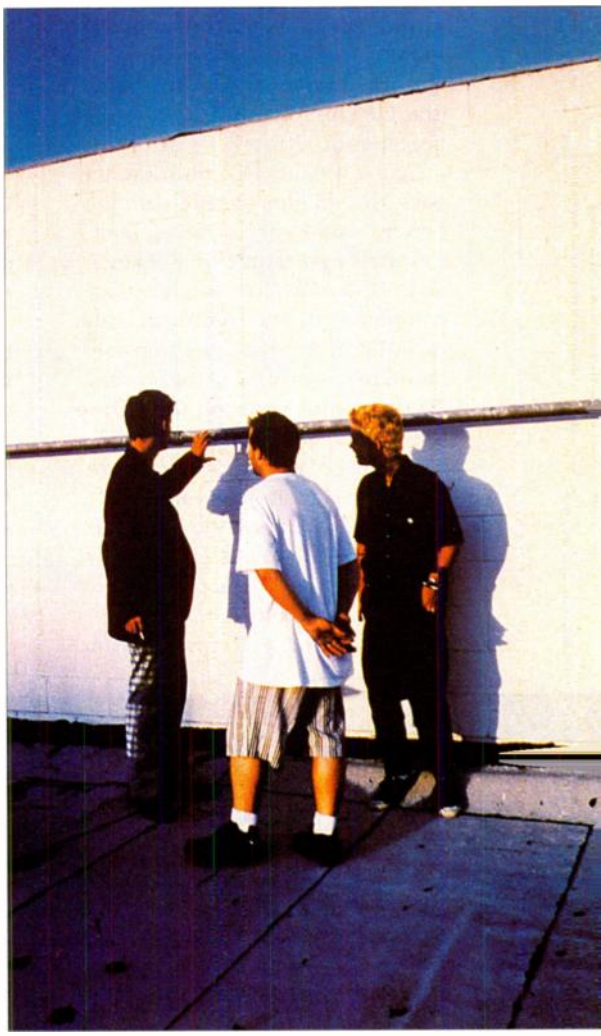
"The combination of these two mics produced a certain definition that was *almost* there," says Army. "But then I took another SM57 and placed it approximately six to eight inches away from one of the top speakers on the cabinet where we also had the RE20. This SM57 was positioned slightly off-axis to the cone and was routed into an Altec 1567A tube preamp. From there, the mic was brought up on another mixer channel, giving us three distinct sounds to work with."

But Army and Cavallo didn't wait for the mixdown to decide which combination of these sounds would create the final guitar tone. The three channels were submixed to a single track as Armstrong's performance was recorded.

"We found a setting and stayed with it," he says. "The SM57 that was positioned six inches from the top speaker ended up being the main component of the sound. The other mics were blended in to add tonal colors. For example, the half-stack that was miked with the lone SM57 sounded a little grainier than the other amp, so we mixed in that channel to add punch."

According to Army, the final balance was 50 percent of the off-axis SM57/Altec 1567A, 30 percent of the RE20/Neve 1081, and 20 percent of the (grainy) SM57/Neve 1081. Compressors were not invited to the guitar party, and although the console EQ was not used either, slight timbral tweaks were made with the tone controls on the preamps.

"On the Neve preamps, I think we just added a little top end and some bottom," remembers Army. "But I always tend to do the same thing on the Altec, which is turn the treble full up and boost the bass to about 75 percent of its maximum setting. The EQ on that preamp is pretty light, so it produces a nice boost that sounds great without being over the top."



All the guitars were recorded at San Francisco's Hyde Street Studios using two 2-inch, analog 24-track recorders.

"There was nothing fancy about it," demurs Army. "The sound is largely the amp and the guitars."

Bits & Pieces

Total Distortion • CD-ROM Score

Kent Carmical, sound designer

While recording engineers and producers embark on endless crusades to improve audio quality, many of their compatriots in the multimedia industry remain shackled to less-than-sterling sound. Because developers of CD-ROM games must reserve huge chunks of memory for whiz-bang graphic content, audio is often left begging for leftovers.

"As far as audio for multimedia goes, the smaller the file size, the better," says Kent Carmical, lead sound designer for Pop Rocket's *Total Distortion*. "We produced a completely digital soundtrack that includes more than 200 loops of mood music and 50 actual songs. All the audio spools off the CD, so file size was a critical consideration. Most of the audio tracks are 8-bit, 11 kHz mono. And even at that low audio resolution, a 4-bar music loop ate up 80 KB."

However, there *are* some advantages to low-fi sound. For one thing, Pop Rocket's creative team didn't have to expend any of their production budget on expensive audio gear or big studio rates.

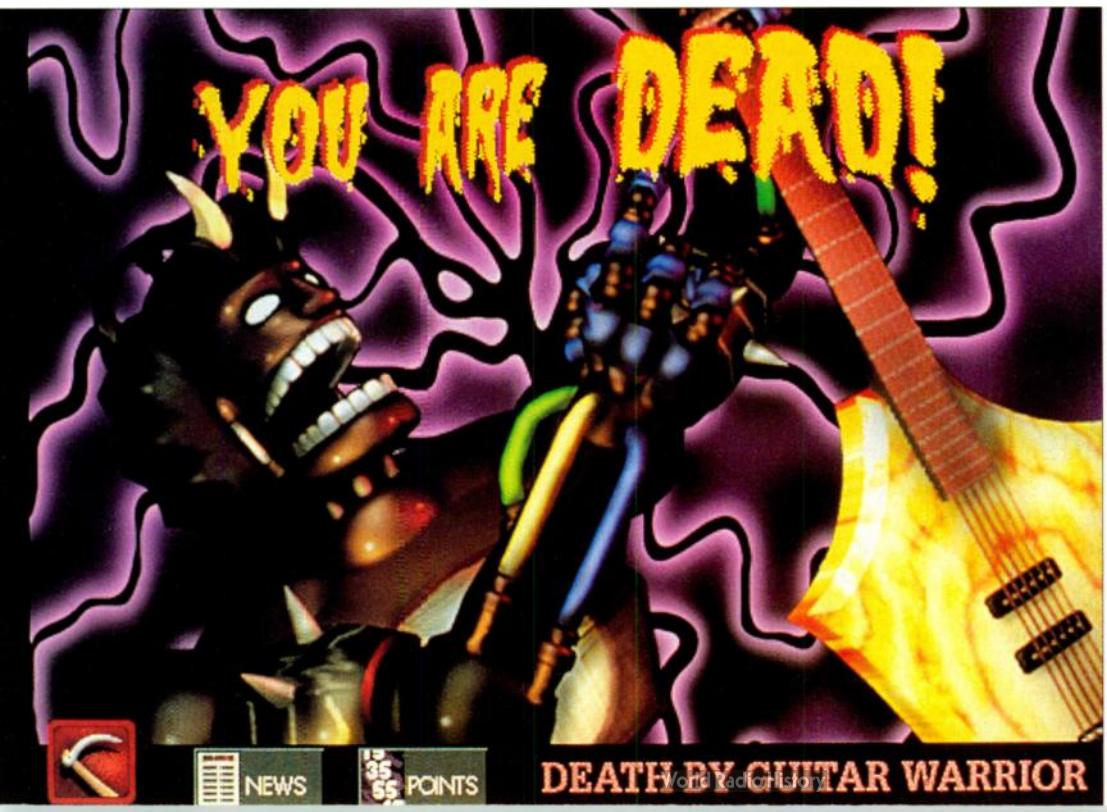
"Most of the music for *Total Distortion* was recorded in my house," says Carmical. "And it was produced using Opcode's *Studio Vision* and precious little else. I had a Mackie CR-1604 mixer, a Shure SM57, an AKG C 1000, an Aphex Model 106 compressor, a BBE 462 Sonic Maximizer, and these old Mac computer speakers by Monster Cable. In fact, most of the final mixes were done to cassette; I didn't even have a DAT recorder until late into the project."

Despite the technological limitations, the soundtrack of *Total Distortion* is well suited to the multimedia speakers used by the typical gamer. On Yamaha YST-M10s, for example, everything sounded clear, present, and, when appropriate, obnoxious.

"Well, we wanted people to be able to play the game on their computers—and therefore through their computer speakers—and still have it sound good," says Carmical. "So I kind of focused on mixing for that type of playback system. Even so, it was frustrating when we digitized the mixes at 8-bit and 11 kHz. The resolution was so bad that you'd lose things like cymbals, and distorted guitars would sometimes have these weird zipper noises. To compensate, I'd pump up the bass and twiddle with the high-end. Of course, things would change daily. You'd sample a mix, and then sample the exact same mix one day later, and it would sound different: there would be audible hiss or phasing problems or something else. It was like voodoo. Reference tones were useless. On some midlevel software tools, I swear that the VU meters are just there to dance around and look pretty. Nothing is aligned. I even tried to put a 1 kHz tone through a few audio programs. No luck. The signal would come up at 0 VU one moment, and -3 dB the next. Everything was just wildly inconsistent.

The 8-bit, 11 kHz resolution was so bad that cymbals would disappear.

"But, actually, the biggest challenge on *Total Distortion* had little to do with technical gremlins," continues Carmical. "It was designing all those small loops of music to be interesting enough so that you wouldn't puke when you heard them over and over."



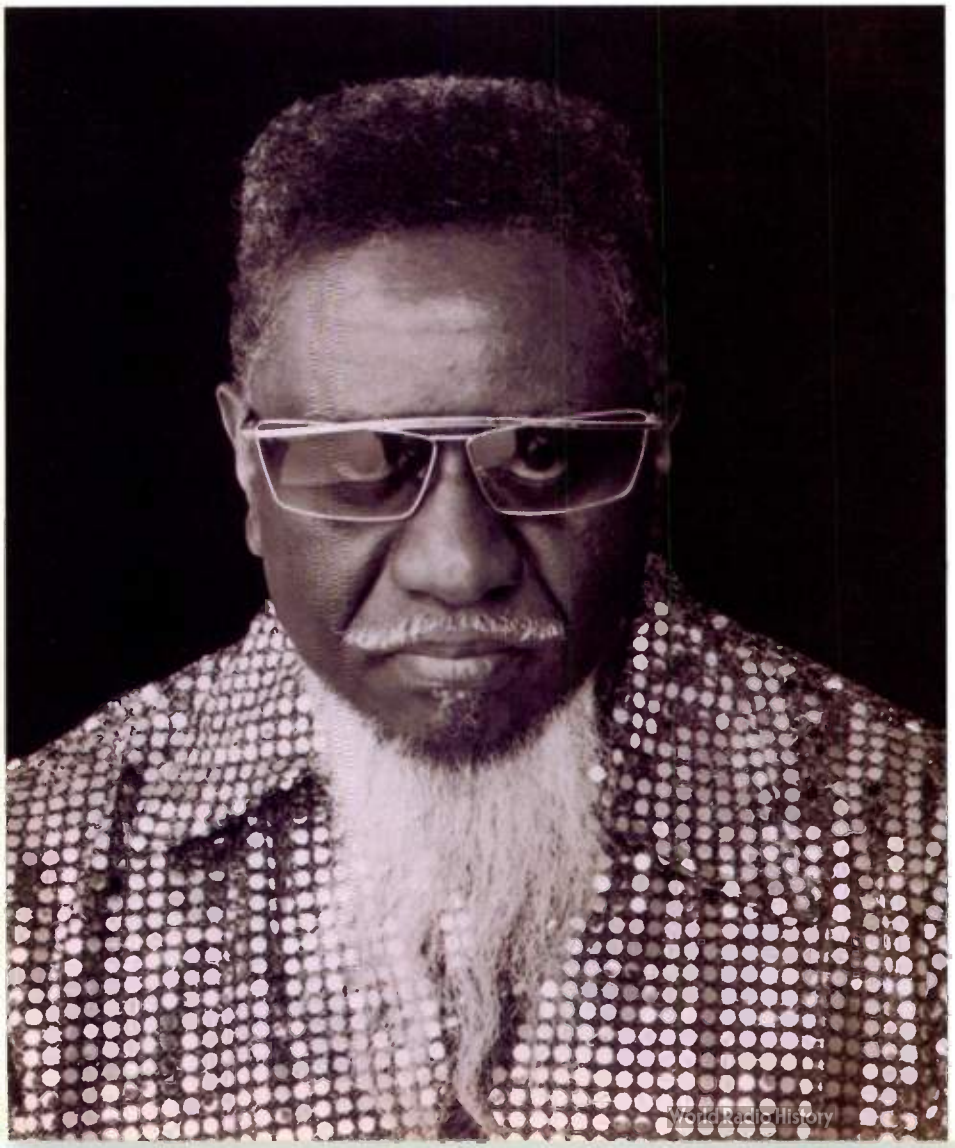
Bits & Pieces

Pharoah Sanders • Saxophone

Michael Molenda, engineer

Jazz legend Pharoah Sanders is one of my musical heroes, so I was delighted to get the call to record a dance score he had composed for Lines Contemporary Ballet in San Francisco. His "Ocean" was a beautiful cross-cultural work that melded divine sax melodies with Moroccan singers, tablas, harmonium, grand piano, synthesizer, rain stick, and trap drums.

Unfortunately, every rosy situation has its thorns. Sanders wanted to record his 8-piece ensemble live and conduct the score's improvisational sections on the fly. From there, things just got scarier. The small, 15 × 35-foot studio soon became more crowded than a downtown bus at rush hour. An attempt at using gobos for sound separation was vetoed when the panels made the musicians feel claustrophobic and obstructed their sight lines. The players didn't want to wear headphones, which meant that the Korg M1 (used for string pads, bells, and special effects) had to be pumped through a Roland Cube 40 guitar amp until everyone could hear it. My dilemma was figuring out how to preserve Sanders' exquisite tone in this acoustical vortex of signal bleed and room reflections.

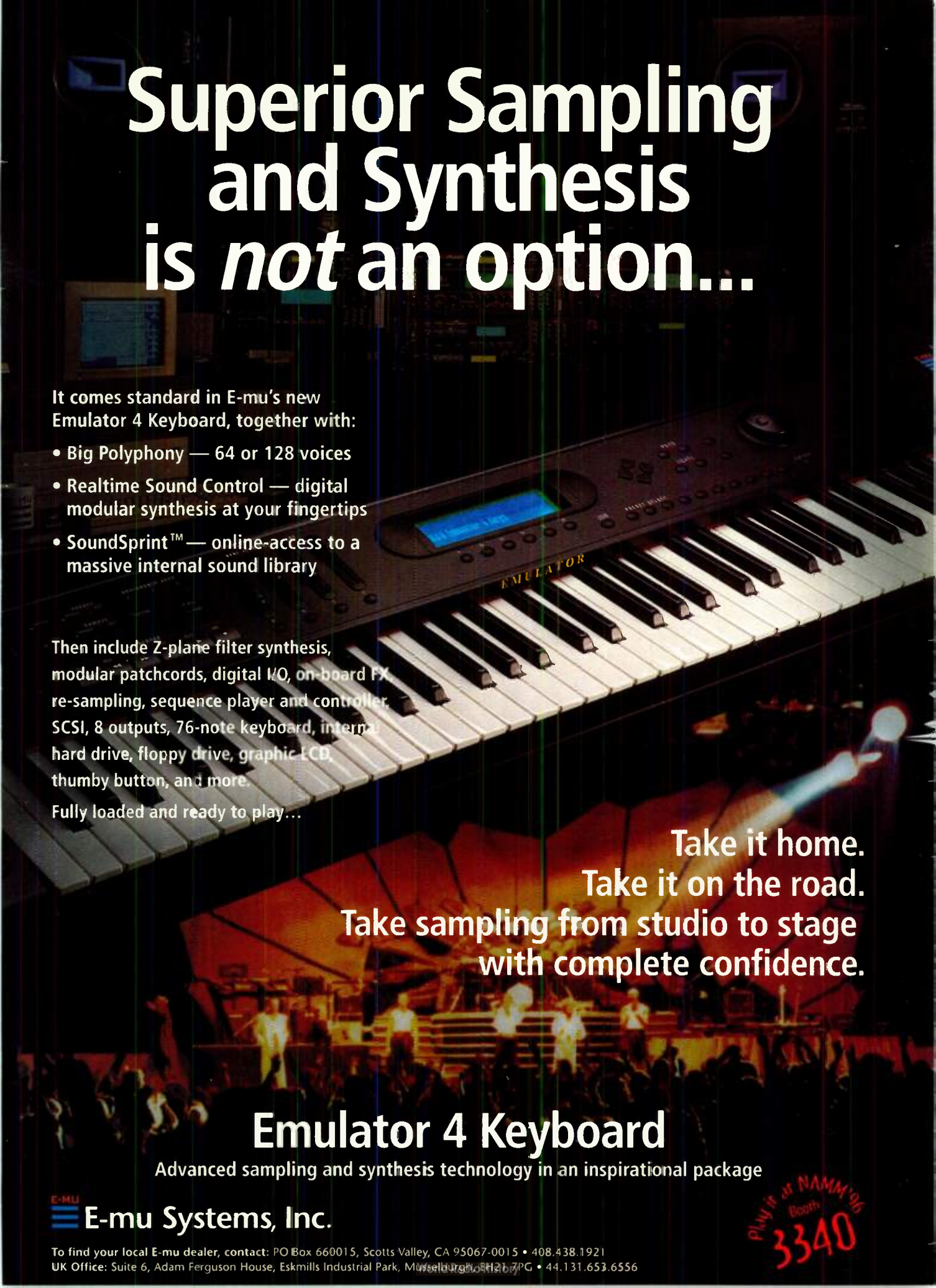


I positioned the musicians in two lines on either side of Sanders, with the four Moroccan singers and the percussionist to his right and the tabla/harmonium player and keyboardist to his left. Sanders stood in the middle of the room, facing a foam-covered wall that I hoped would diminish mid- and high-frequency reflections. An AKG C 414 was placed approximately one yard in front of the sax at chest height.

The polar pattern that captured the most balanced tone with the least amount of signal bleed was hypercardioid. The signal was routed through the onboard preamp of a Trident Model 65 mixer and patched directly to one track of an Alesis ADAT. (The acoustic chaos would have made submixing multiple mic positions a bad idea!) Channel EQ was used sparingly to fight mic bleed problems, *not* to alter Sanders' natural tone. A 7 dB cut at 100 Hz diminished rumble from the piano, drums, and percussion, and a 5 dB cut at 10 kHz calmed some annoying cymbal sizzles.

The relatively unfettered signal path—from mic to mixer to tape, with no compression—left Sanders free to control performance dynamics and timbre. Of course, his technique was flawless. Even with the unavoidable mic bleed, his sax sounded full and robust, from plaintive wails to his signature harmonic warbles. Sometimes, the less an engineer does, the better.

Channel EQ was used to fight microphone bleed, not to alter Sanders' tone.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Bits & Pieces

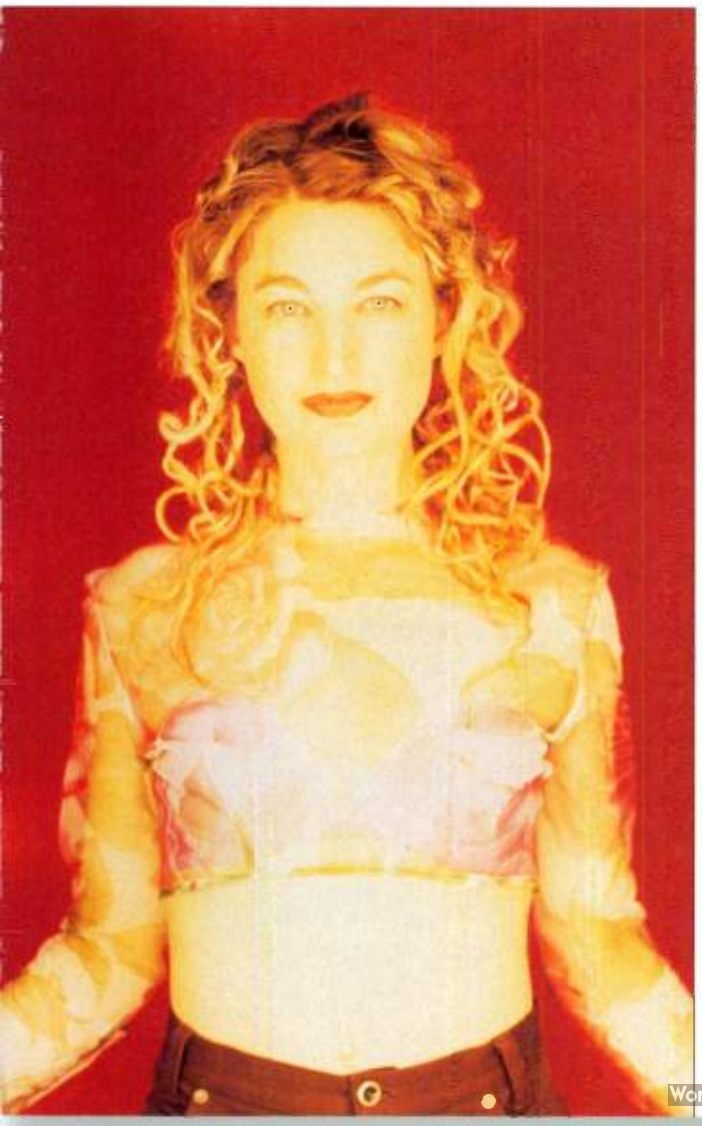
Jane Siberry • Piano

David Travers-Smith, engineer

Jane Siberry follows her muse. In her many guises as a performance artist, composer, record producer, and film director, she has always surrendered to the whims of inspiration. So it makes perfect "Siberry sense" that the intimate, cabaret jazz of her current album, *Maria,* is a stylistic long jump from the synth-and-groove artiness of her previous recording, *When I Was a Boy.*

But a genre shift wasn't enough for Siberry. She also wanted to immerse the *listener* in a different milieu by recording *Maria* from the player's perspective.

"Jane wanted a live, very much off-the-floor type of sound for this record," says Siberry's engineer, production coordinator, and trumpet player, David Travers-Smith. "And she had some definite ideas on how she wanted the piano miked. She really wanted to record the piano from the player's point of view, so we'd be capturing the performance dynamics that the pianist was hearing."



To get inside the player's head, so to speak, Travers-Smith positioned two AKG C 451s on either side of pianist Tim Ray. Each mic was set up approximately a foot and a half from his head, at ear level. The music stand on the 7-foot Steinway was removed, and both mics were pointed directly toward the dampers.

"Of course, the piano top was up, so the sound was very ambient," says Travers-Smith. "This introduced a few problems with mic bleed because Jane, the pianist, and the bassist—and at times, myself and the percussionist—were in the same room. Only the drummer was in an isolation booth. The room at Reaction Studios [Toronto] actually sounded very nice; I wasn't troubled by the blend of instruments leaking into the mics. The main problem was vocal bleed. The pieces on *Maria* are largely improvised, so Jane was directing us as we played. She'd say things like, 'Okay, let's bring it down nice and easy here and open it up' or 'More tension here.' In addition, she had laryngitis, so we ended up reworking a lot of the vocals."

Luckily, most of the vocal bleed was masked by the density and volume of the other tracks. In the few spots where vocal echoes or speech were audible, Travers-Smith had Ray double the passages on another track. During the mix, the automation on an SSL G-series console was used to seamlessly switch back and forth between the original performance and the overdub. Matching the timbres of the two tracks was not a problem because Travers-Smith recorded the piano flat, with no compression or other signal processing. The signal path was AKG C 451 to SSL console/preamp to ADAT.

"It was convenient and inexpensive to use ADATs for this album, rather than 2-inch analog," says Travers-Smith. "We did notice certain variations in sonic quality between tracks during really quiet passages—some tracks had this sort of thermal sound—but the advantages far outweighed the drawbacks. In retrospect, I should have optimized my recording levels more than I did.

Siberry wanted to record the piano so the listener could hear the player's perspective.

"Actually, one of the biggest problems was tape time," he continues. "Because we didn't know how long the improvised songs would be, we basically turned the recorders on and let them run. There were a couple of occasions were the tape ran out before the song was finished, and we had to rerecord sections and piece them together later."

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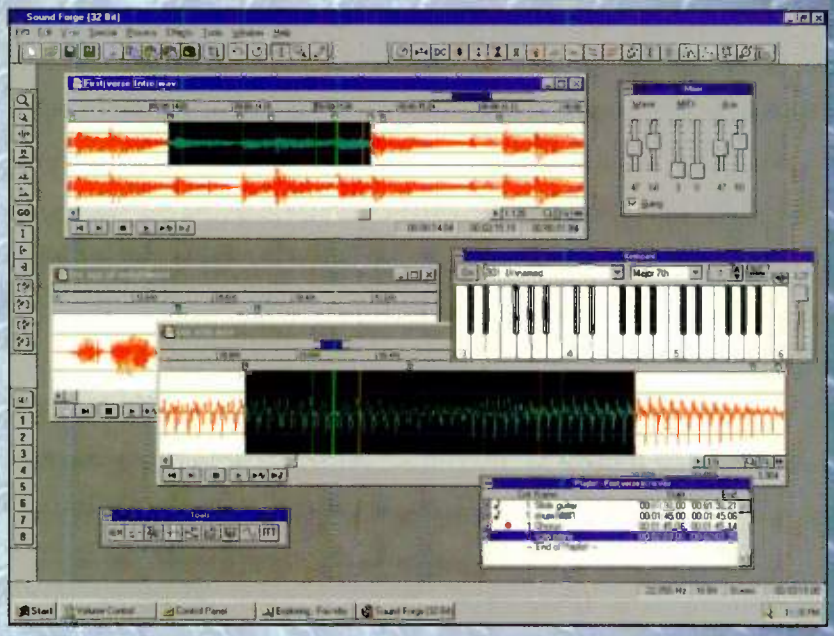

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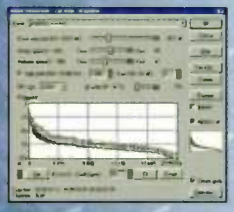

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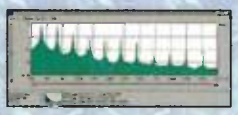

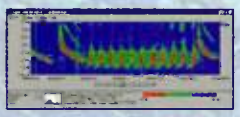

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Home Studio Cheat Codes

CUNNING CRAFT

Okay, most of us aren't blessed with easy access to Neumann microphones, SSL consoles, expensive preamps, or multiroom recording facilities. Denied these audio advantages, you can only beat the pros at their own game by employing ingenuity and deception. The following tips and clues should help you track pro sounds with semipro gear.

RECORDING MEDIA

Most of the projects profiled were recorded on the same MDMs and hard-disk systems that many **EM** readers already own. Today, anyone who applies his or her skills can record sparkling tracks. The caveat, of course, is that you *do* need some recording chops to optimize the medium.

"People buy ADATs and think their records are going to sound great, but the recording format is only as good as the person using it," warns Christopher Fogel, who engineered Alanis Morissette's *Jagged Little Pill*. "If you don't know how to get a sound that works for what you need, it will not make any difference whether you use an ADAT or a cassette ministudio."

NO NEUMANN

Ouch, this is a tough one! The lack of a Stephen Paul-modified U 87 is a major bummer. However, there are many affordable, large-diaphragm condenser mics that can pinch hit. Check out models from AKG, Audio-Technica, beyerdynamic, CAD, Electro-Voice, Groove Tubes, Neumann, Sennheiser, and other manufacturers. You'll still have to pay anywhere from $600 to $1,500 for a fine vocal mic, but that's many pennies less than k.d. lang paid for her Neumann.

It also helps to hedge your sonic bets by recording vocals flat. If you don't like the sound of your board's EQ, don't use it. You'll only compromise the vocal sound on tape, making it difficult to "fix" things in the mix. Renting or borrowing a good-quality, outboard equalizer for your mix session can cure a multitude of tonal sins.

TUBULAR BELLS

Expensive tube gear, such as mics, preamps, and compressors, are the "in things" in cutting-edge pro studios. Ironic, isn't it? Affordable units are starting to trickle into the market, however, so home recordists can now benefit from tube warmth without emptying their bank accounts. (For a look at some tube mic preamps, check out "Hot Stuff" on p. 72.)

MEAN GUITARS

When Kevin Army tracked the guitars for Green Day, the main microphone was a Shure SM57—a mic that probably resides in each and every home studio. You probably won't find his trusty Altec 1567A preamp (it's virtually an antique), but you *can* use any number of the affordable tube preamps we've already discussed. The big problem is firing off a Marshall half-stack in an apartment. That activity could spell e-v-i-c-t-i-o-n very quickly.

The alternative is to use a small tube amp that has a master volume control. By running the amp's input volume full up and turning the master way down, you can produce a blistering wail at "apartment safe" noise levels. Then, just point the SM57 into the speaker cone, and route the signal into the tube preamp of your choice. If you don't want to risk cranking up even a tiny amp, there are numerous guitar-amp simulators, such as Tech 21's SansAmp line, that can emulate a mighty roar.

GO FOR IT

When I was interviewing all the fabulous engineers for this article, I was truly surprised at how much "home studio" gear was being used for major-label sessions. This would not have been the case even five years ago (when MDMs were but a dream). The message is clear: tools aren't stopping home recordists from making absolutely ripping records, lack of *talent* is. So get your chops together and your creative juices flowing and start producing a few masterpieces. We'll be listening.

EM *Editor* **Michael Molenda** *just opened a spanking new project studio (with noted producer Scott Mathews) in San Rafael, California. It's possibly the only facility in the U.S. with a tiki drum producer's desk.*

BITS & PIECES OF INFORMATION

Hungry for more tips on recording hot tracks? EM has published a slew of articles tailored to personal and project studios. To order back issues, call Mix Bookshelf at tel. (800) 839-5977 or (510) 653-3307.

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Assembling comp vocal tracks	"Recording Musician: Composite Vocal Tracks"	April 1994
Recording electric guitars	"Recording Musician: Tracking Guitars"	September 1992
Recording acoustic guitars	"Recording Musician: Acoustic Alchemy"	February 1995
Recording bass	"Recording Musician: Recording Electric Bass"	January 1993
Recording drums	"Recording Musician: Tracking Drums"	October 1992
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Sizzling Sequences

Heat up your MIDI tracks with these way cool tips.

The old saw about sequences being dull and lifeless may have been true in the early days of MIDI, but technology has come a long way since then. Most modern sequencers have enough resolution to retain a rhythmic feel in all but the most critical applications.

Nevertheless, many sequences don't come close to reproducing the realism their creators envisioned. This often occurs because the recordist is not sure how to create convincing parts using synthesizers and samplers, especially when performing nonkeyboard parts (for example, strings and horns) on a keyboard.

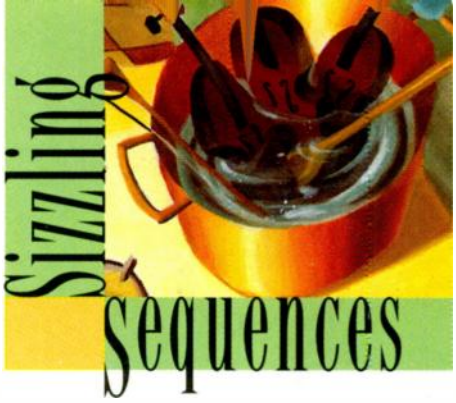
Fortunately, it doesn't have to be that way. You've probably heard sequences that dropped your jaw. Perhaps a factory demo in one of the latest MIDI modules got your toe tapping. Maybe you looked up the credits on an album you like, wondering who played that killer solo or bass part, only to find that the artist sequenced the whole thing.

Recently, I've been involved in a project to create a number of sequenced versions of popular songs, ranging from 1940s big band to 1990s country music. One of the project's most difficult criteria is that the sequences must sound and feel as much like the original as possible.

This isn't easy. However, the project has crystallized a number of techniques for me—and taught me a couple of new ones—that have been tremendously helpful in my quest to produce more expressive and natural-sounding sequences. Best of all, these techniques are easy to master.

By Clark Salisbury

Illustration by Kitty Meek



A CASE OF THE BENDS

Most modern synthesizers are based on sample-playback technology. This produces a realistic imitation of various acoustic instruments, but it suffers from several drawbacks. For example, no matter how you articulate a note, the synth always produces the same sound, more or less. Filters, envelope generators, and other synthesis elements can help provide some expressive control over a sound, but all sampled sounds tend toward the predictable and static. Our intention is to gain a greater measure of control over the articulation of these sounds.

One of the most effective ways to impart a sense of "phrasing" to solo-instrument tracks is to replace some of the notes with Pitch Bend messages. For example, the acoustic-guitar phrase in **Figure 1** sounds a bit stiff when each note is articulated individually using a keyboard. Playing each note in this way results in a graphic-editing window like the one in **Figure 2**.

Rather than playing each note individually, use Pitch Bend messages to articulate the second, third, and fourth notes. However, don't try to play them using the pitch wheel on a synth; instead, insert a single Pitch Bend event for each new note. This will cause the sounding note to jump immediately to the new pitch.

In this example, the synth's pitch-bend range is set to one whole step. (This can be done in the synthesizer's edit mode or remotely via MIDI; see sidebar "To Register or Not to Register, That Is the Question.") The first Pitch Bend goes up halfway to produce a note a half step higher than the first note, while the second Pitch Bend goes all the way down to produce a note a whole step lower. Finally, Pitch Bend is reset to zero, and the final note is articulated in the normal manner. If your sequencer does not offer graphic piano-roll editing, use the event-list editor (see **Fig. 3**). Using Pitch Bend in this way is great for simulating the characteristic hammer-on and pull-off techniques used by guitarists, bassists, banjo players, and other string pluckers.

As a variation, try applying Pitch Bend to one of two notes played as a double stop, which simulates another typical guitar articulation. To pull this off (ahem), put each of the two notes on its own MIDI channel so you can bend one note and not the other. For example, suppose the guitar plays E3 and A3; put E3 on channel 1 and A3 on channel 2. Make sure the two notes are played at the same time with similar Velocity and held for at least four beats.

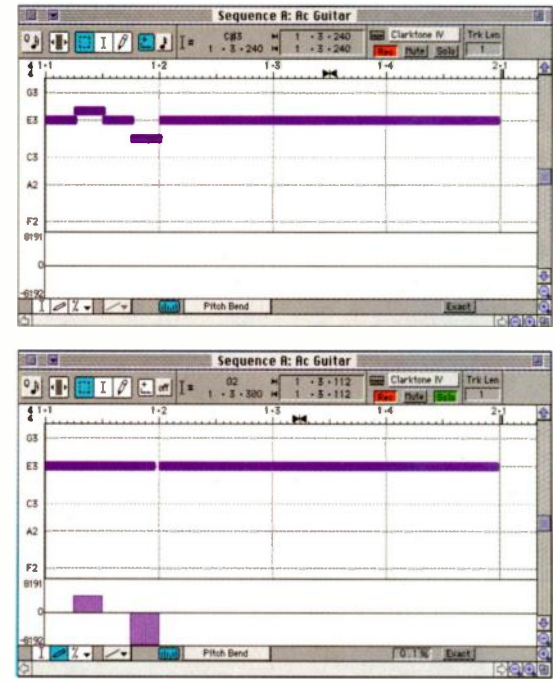


FIG. 2: The first four notes of the guitar lick in Figure 1 can be sequenced by playing each note individually (top) or by applying Pitch Bend to a single note (bottom). The latter approach often sounds more natural.

Now, apply a single Pitch Bend event to the E3 somewhere during the sustain of the note. Bend the note up by a whole step so it lands on F♯3. Don't forget to insert a Pitch Bend of zero after the note is finished so subsequent notes sound at the correct pitch.

The Pitch Bend trick also works well with other solo instruments. For example, **Figure 4** shows a straightforward clarinet phrase played in a straightforward manner. We can simulate a grace note (a quick bend at the beginning of a note) and legato articulation by applying some well-placed Pitch Bends.

Notice how the pitch bends by a minor third in the two middle notes even though the pitch-bend range is set to a whole step. Start with the pitch of the note bent down a half step; then insert a new Pitch Bend message that raises the pitch to a whole step above normal. In addition, Pitch Bend is used to simulate a tongued note in the second measure.

FIG. 1: As we'll see, there's more than one way to sequence this guitar lick.

EXPRESS YOURSELF

Another important ally in the quest for more natural-sounding sequences is the Expression message, which is otherwise known as Control Change 11 (CC 11). In most modern synthesizers, the Expression message can be assigned to control the relative volume of each multitimbral instrument in the sequence.

Of course, you can also use the Volume message (CC 7) to do this, but I don't recommend it. If you use CC 7 to dynamically vary the volume of an instrument and you also want to alter the volume of the overall mix, you have to change all the Volume messages for the entire track. But if you use CC 11 to vary the volume within the track, you can still use a single CC 7 message at the beginning of the track to set its overall volume. This is a much simpler approach to automating the mix of sequenced material.

When you are trying to emulate real instruments in sequenced tracks, keep in mind how the instruments are played in the real world. For example, players of wind instruments (flutes, saxes, etc.) and singers have a finite amount of air for sustaining a note or phrase. As a result, blown and sung notes decay as the performer reaches the end of her breath. You can use CC 11 to simulate this effect and, in the process, go a long way toward creating

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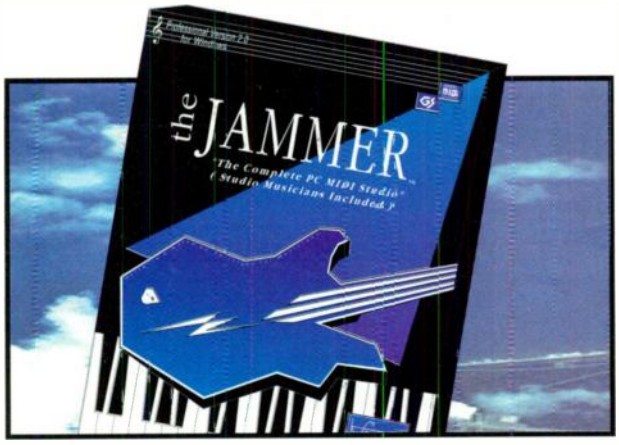

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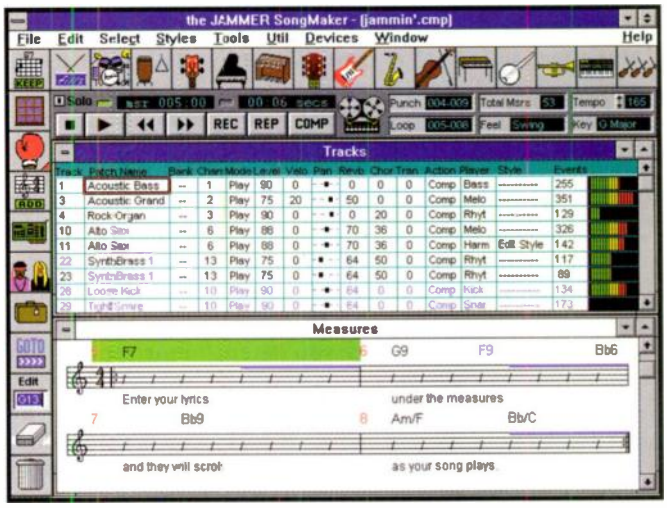

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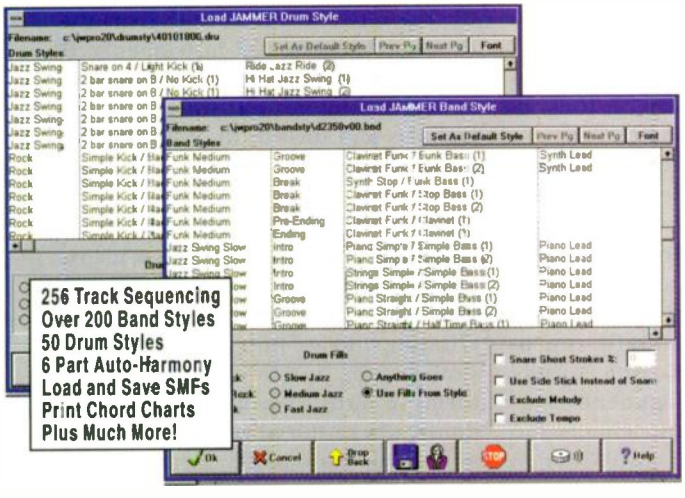

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a more lifelike track. Simply use CC 11 to bring the volume down a bit—say, from 127 to 100—starting at the midpoint of long notes (see **Fig. 5**).

If you want to get fancy, consider this: When the volume is reduced in most instruments, there's a commensurate reduction in brightness. To simulate this effect, use CC 11 to control the filter cutoff in addition to volume.

The exact procedure depends on the synthesizer you're using. Most modern instruments provide some way to assign a MIDI Control Change to control filter cutoff, but others preassign a specific controller (often CC 74) to this parameter. In any case, a brief perusal of your instrument's manual should put you on the beam. Once you determine that, say, CC 74 controls filter cutoff, just copy the CC 11 data from the track in question and paste it back in as CC 74. You might also need to scale the data one way or the other to get it sounding just right.

Finally, to put the icing on the cake, add some "vibrato tails" to sustained notes. As a long note begins to decay, add a little vibrato. This is characteristic of the way many soloists play, and it can add an extra measure of realism to your tracks.

Assuming you use the mod wheel to control vibrato, you can overdub the vibrato tails by manipulating the mod wheel as the track plays back, or you can draw Modulation events at the appropriate places. You can also copy your Expression data and paste it in as Modulation data. However, you must invert the new Modulation data—you want the vibrato to increase as the volume decreases—and scale it to whatever values seem appropriate. Not all sequencers let you perform this kind of operation, but if yours does, this can be an easy way to generate a lot of control data quickly.

A variation on this theme is the "Expression duck." This works especially well with a series of repeated, legato notes (see **Fig. 6**). You can impart a much more realistic feel to this phrase by turning the string of notes into a single note and using CC 11 to articulate the individual notes, thus re-creating the original part. If you want to add more spice, combine this technique with a similar "filter duck" by applying the Expression data to the filter cutoff so the timbre changes appropriately with each articulation.

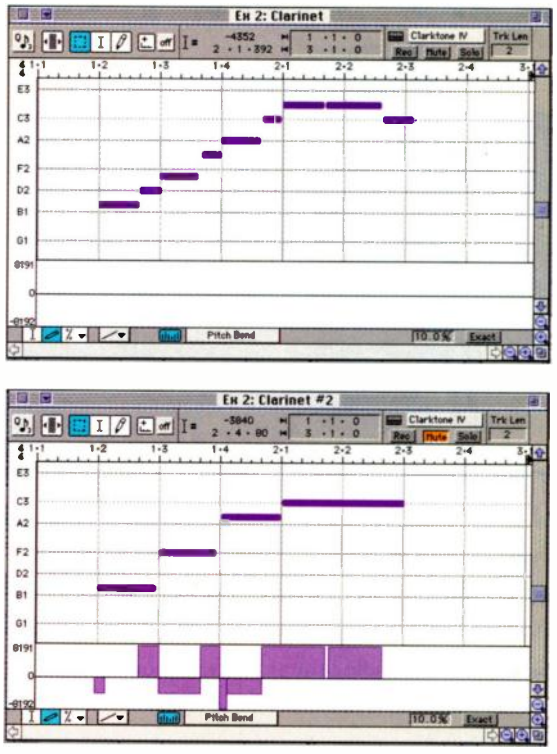

FIG. 4: A clarinet line can be sequenced in the standard fashion (top), but using Pitch Bend (bottom) sounds more realistic and even allows grace notes.

CONTROL FREAK

MIDI defines many Control Change messages in addition to Modulation (CC 1), Volume, and Expression. A number of instruments let you assign any CC message to control various parameters in the instrument.

This approach has the advantage of being completely user definable. If you want to use CC 14 to control tuning, you can make it so. However, if you want to use, say, CC 74 to control filter cutoff in all your programs, you may have to manually reprogram all of your sounds with this assignment.

In some instruments, the expanded Control Change assignments are fixed at the factory. Typically, CC 74 is used for filter cutoff, 71 is used for filter resonance, and 72 and 73 are used for envelope attack and release times, respectively. This makes it easy to apply additional expressive control: simply look up the CC message that corresponds to the parameter you want to control, assign a controller in your sequencer or master keyboard to send that CC, and away you go.

Generally, the more the merrier when it comes to controllers, particularly when you're attempting to emulate the expressiveness of real instruments. If you're serious about accurate electronic expression, get out those owner's manuals and turn to the MIDI implementation section.

GOING THROUGH A PHRASE

It may seem obvious, but I'll say it anyway: your sequencer tracks will sound best when you take the concept of phrasing into account. Within any musical passage, you should be able to determine natural peaks and valleys: points where the phrases seem to require a bit more emphasis and places where they should languish a bit. You can simulate these dynamic eddies in the current of your music with the informed use of controllers.

For example, the next time you're playing a solo horn part, try assigning a controller to filter cutoff and "ride" the control as you play the part. Eventually, you should get the hang of using the filter to emphasize the peaks pretty

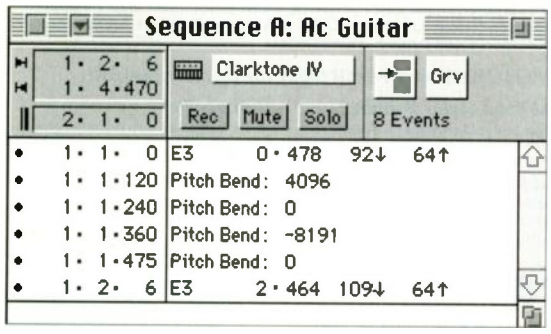

FIG. 3: This is the data from Figure 2 (with Pitch Bend) displayed in an event list.

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We've made selecting sounds a breeze with our proven SoundFinder™ interface – one knob selects the sound type; the other knob picks the sound itself. And with hundreds of great sounds to pick from, you might never need to tweak one. But if you do, we made the most important sound parameters easily available for editing.

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easily, and the results are definitely worth it. If you're working with prerecorded sequences, you can try drawing these Control Changes in the graphic-editing window, but I find it more natural to "play" the controller while recording the track or to overdub it as the track plays back in real time.

DON'T TOUCH THAT SECTION

The techniques I've covered so far work well with solo instruments, but what about instrumental sections? Basically, you do the same thing, only more times. In other words, if you want to create a brass section, don't just dial up a brass-section program and play a bunch of chords. In most cases, this doesn't sound quite natural.

A real brass section (or a woodwind section, string section, etc.) consists of individual players, each of whom has a distinct tone and articulation. Granted, all the players in a section work together to achieve a unified sound. Still, there are inevitable variations in timbre, vibrato, articulation, and dynamics

TO REGISTER OR NOT TO REGISTER, THAT IS THE QUESTION

A few years ago, the MIDI Specification was extended to include the Registered Parameter Numbers (RPNs) and Non-Registered Parameter Numbers (NRPNs). Both types of messages are Control Change messages in disguise, and they work in the same way. The only difference is that RPNs have an agreed-upon function, whereas the function of NRPNs are left up to the manufacturer (and sometimes to the end user).

RPN and NRPN MSBs and LSBs

Control Change Number	Function
98	NRPN LSB
99	NRPN MSB
100	RPN LSB
101	RPN MSB

All RPN and NRPN messages start with two Control Change messages. The first message is the Most Significant Byte (MSB), and the second message is the Least Significant Byte (LSB). (The Control Change messages that correspond to these MSBs and LSBs are listed in the table "RPN and NRPN MSBs and LSBs.") Together, these messages identify which RPN or NRPN you are sending. After the RPN or NRPN is identified, you send the actual parameter value with a Data Entry message (CC 6).

For example, you can change the pitch-bend range of a synth by sending the appropriate RPN and Data Entry messages, assuming the synth's MIDI implementation includes this capability. The RPN for Pitch Bend Sensitivity is defined as MSB = 0 and LSB = 0 (see table "Registered Parameter Numbers"). Start by sending the RPN MSB for Pitch Bend Sensitivity, followed by the LSB, keeping in mind that the order in which they are sent is critical:

CC 101 Value 0, CC 100 Value 0

Then, you can set the pitch-bend range by sending a Data Entry message with the number of half steps you want in the range. For example, if you want to set a pitch-bend range of one whole step up or down, send the following Data Entry message:

CC 6 Value 2

Once you send the RPN or NRPN MSB and LSB, the receiving instrument continues to respond to Data Entry messages in the prescribed manner until you tell it not to. This can be great for adding expression to electric-guitar, violin, and pedal-steel parts for which you might need to accurately produce pitch bends with a bunch of different ranges. Each time you must reset the pitch-bend range, simply send a Data Entry message with the new value; the MSB and LSB need to be sent only once.

Sooner or later, you'll want to tell your MIDI instrument to stop using Data Entry to control pitch-bend sensitivity. RPNs and NRPNs can be turned off by sending an MSB with a value of 127 followed by an LSB with a value of 127. For example, to turn off any RPN you are using, send this string of messages on the appropriate MIDI channel:

CC 101 Value 127, CC 100 Value 127

So far, only five RPNs have been defined as part of the MIDI spec. However, NRPNs are a different story. The function of NRPNs is left to the discretion of the manufacturer, so you might find that your instrument uses a slew of NRPNs. (Or you might find that it uses none at all.) For example, the Yamaha XG instruments use NRPNs to adjust tuning, filter, and volume and to control envelope and effects settings for individual drum sounds within a kit. This provides some excellent options for real-time, expressive control.

Registered Parameter Numbers

MSB (CC 101)	LSB (CC 100)	Parameter
00	00	Pitch Bend Sensitivity
00	01	Fine Tuning
00	02	Coarse Tuning
00	03	Tuning Program Select
00	04	Tuning Bank Select

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NEW MS1402-VLZ

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Studio grade mic preamps (chs. 1-6) with high headroom, low noise (–129.5dBm E.I.N.) and switchable phantom power.

Balanced line inputs. Inputs 1-6 are mic/line mono; 7-19 are line-level stereo.

Low Cut Filter (chs. 1-6) cuts mic handling thumps, pops, room rumble and wind noise. Also lets you safely use Low Shelving EQ on vocals.

Trim control (chs. 1-6) with ultra-wide –10 to 60dB mic gain.

Two aux sends per ch. with 15dB extra gain above Unity.

High shelving EQ. ±15dB at 12kHz.

Peaking midrange with wide, musical bandwidth centered at 2.5KHz. ±15dB.

Low shelving EQ. ±15dB at 80Hz.

Pan control with constant loudness and very high L/R separation.

Four buses on a 2-bus board! Mute switch routes channel output to extra **ALT 3-4** stereo bus. Use it for feeding multitrack recorder inputs, creating subgroups (via Control Room/Phones matrix), monitoring a signal before bringing it into the main mix or creating a "mix minus."

Solo. AFL or PFL via global switching.

60mm logarithmic-taper faders.

Main 1/4" balanced outputs.

RCA tape inputs & outputs.

–10/+4dBu input level switching on stereo channels.

3-band equalization

AFL / PFL Solo

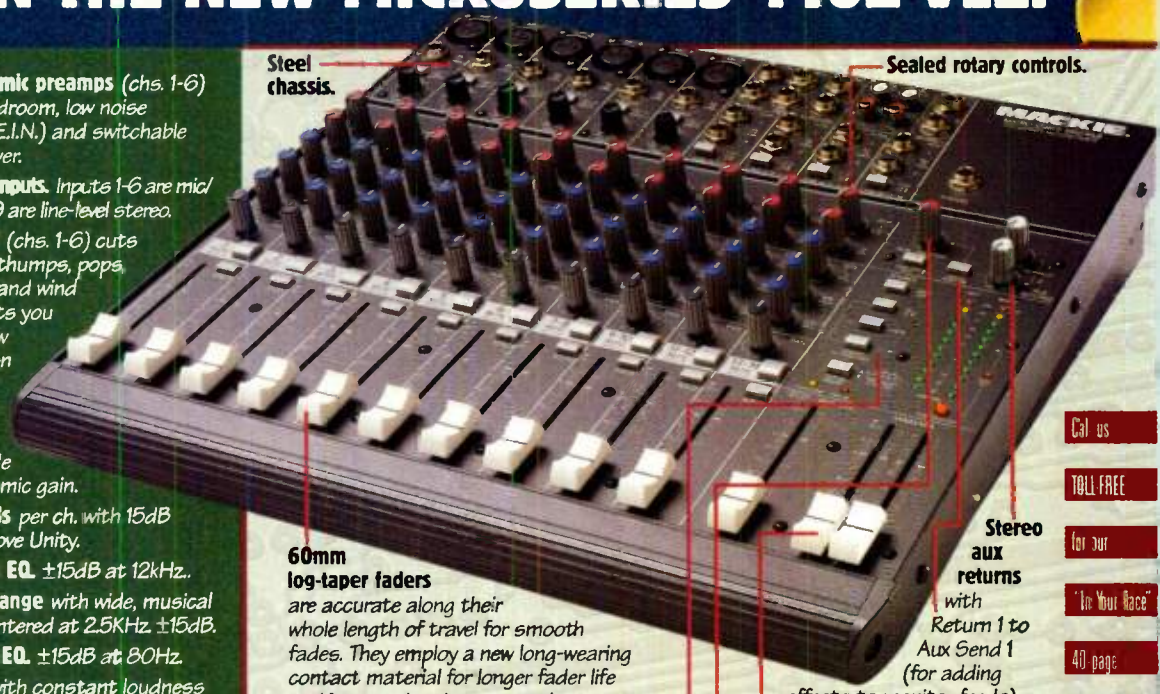
Control Room/Phones matrix

XLR & 1/4" bal. outputs

Rack mountable

Steel chassis.

Sealed rotary controls.



60mm log-taper faders are accurate along their whole length of travel for smooth fades. They employ a new long-wearing contact material for longer fader life and improved resistance to dust, smoke and general schrunge.

Stereo aux returns with Return 1 to Aux Send 1 (for adding effects to monitor feeds).

Separate left & right Master Gain Controls. 60mm log-taper.

Control Room/Phones matrix lets you select any combination of Main Mix, Tape In & Alt 3-4 signals for routing to Control Room, Phones & meters. Includes dedicated fader.

Aux 1 Master with Monitor/Pre-Post switch for live sound mixing flexibility.

VLZ (Very Low Impedance) circuitry for ultra-low noise & crosstalk.

Balanced inputs & outputs (except RCA tape in & out & inserts).

Beefy headphone amp.

Fast, accurate level setting via Channel Solo. As the Rude Solo light blazes forth, a soloed channel's level is displayed on the LED meters. Set the solo mode to PFL, adjust channel trim to 0dB on the meters, and you've optimized the MS1402-VLZ UnityPlus gain structure for maximum headroom & minimum noise.

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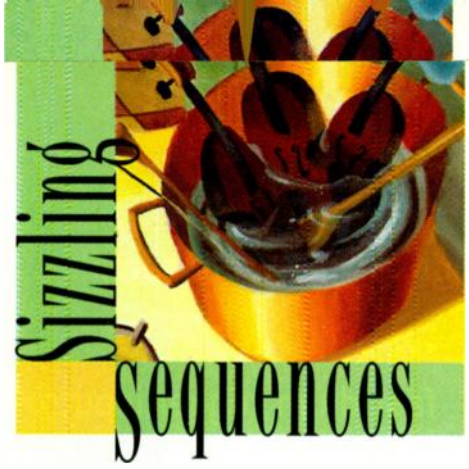
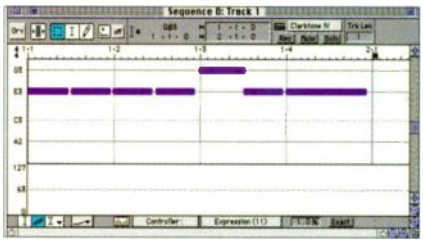


master track, and mix the section and solo tracks to taste.

I often use two or three individual instrument sounds for each section of strings (basses, cellos, violins, violas, cellos, and basses), and I try to use different patches for each instrument. This adds to the overall "size" of the ensemble and helps avoid flanging problems between sounds. In many cases, I also spend time with the original string-section sound to achieve the proper blend with the individual instrument sounds. Often, this includes mellowing it out a bit by reducing the filter-cutoff frequency and increasing the envelope attack time or combining it with a mellower sound, such as synth strings.



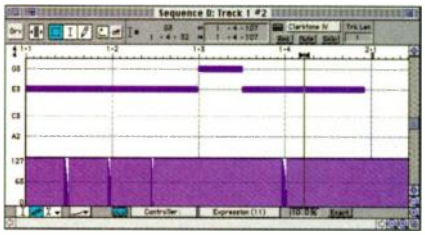


FIG. 6: A series of repeated, legato notes (top) can be made more expressive by using Expression messages to articulate each note (bottom), instead of just playing them individually.

SUM OF THE PARTS

It's helpful to think in terms of parts and to be willing to experiment. You wouldn't normally play a high-pitched string part with a bass sound, but you might find that a violin part actually sounds better when played with a viola or perhaps a cello sound. I often blend a little trombone, tuba, or even French horn with trumpets in a section. This adds a variety of tones that are more characteristic of the real thing. In addition, try thinking in terms of "chair" designations, and make the "first chair" instruments a bit brighter than the "third chair" instruments.

If all this seems like a lot of work, well, it can be. But you can probably save yourself some effort by putting your sequencer's copy and paste functions to work. This is usually most effective if you don't use the copied data verbatim; process it in some way to vary the copy from the original. For example, copy inverted Modulation data to Expression in order to create a little Expression duck when the vibrato kicks in, but scale the Expression data down a bit or offset it slightly in time so the effect remains subtle.

So there you have it: my favorite tricks for creating expressive sequences. If you use only half of these techniques in your next sequencing project, the difference will be apparent.

Clark Salisbury *does composition, technical writing, and studio production and engineering. Thanks to Nathan Tschetter.*

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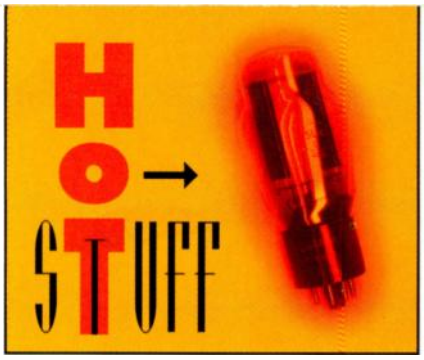

Peavey VMP 2

The typical method for tracking with a tube preamp is to bypass your mixer and route the signal directly to tape or hard disk. You simply connect the output of the tube preamp to the input of your MDM or hard-disk recorder. You don't need the mixer's preamps when you're using an outboard unit, and avoiding the myriad gain stages and circuits of your board ensures a cleaner, more robust signal path. Keep in mind, however, that you're now recording *sans* EQ (unless the preamp offers tone controls). You'll be relying on mic placement—or the timbre of the source sound, if you're tracking line level instruments such as keyboards and "direct" guitars—to capture desired tones. Of course, you can always use EQ during the final mix to tweak any sounds recorded flat through the preamp.

TACTILE UTENSILS

Tube preamps are shamefully easy to use. In fact, all of the models tested were unboxed, plugged in, and doing their thing in less than five minutes. It takes me longer to cook a TV dinner. (Yes, I'm kitchen challenged.) However, although tube preamps are virtually plug-and-play devices, it doesn't mean that they're ergonomic angels. A user-friendly preamp should be almost effortless to set up and transport, with all of its controls readily accessible and tough enough to withstand harried tweaking. Here's how each of the test units fared under some real-world studio bashing.

Aphex Model 107. The Model 107 loads quite an arsenal of features into a svelte, single-rackspace frame (see the "Goodies" column in the "Special Ingredients" table). The 2-channel preamp also includes a very cool input signal mute that is controlled via remote by an optional footswitch. The ¼-inch outputs on the rear panel accept both balanced and unbalanced signals, and you can select between -10 dBV and +4 dBu output levels. The microphone inputs are on the front panel—a thoughtful touch that makes it easy to connect and disconnect XLR cables when the Model 107 is mounted into an equipment rack.

And speaking of cables, the Model 107 is configured for XLR connectors wired with pin 2 positive (hot). If you connect a pin 2 hot device into one channel and a pin 3 hot device into the other channel, the signals may be out of phase. (Listen for wimpy bass, uneven mids, and a narrow stereo spectrum.) Luckily, the Model 107's handy polarity reverse switch can remedy phasing problems.

For input-signal monitoring, you get just two LEDs: OK and Overload. Although the Overload LED illuminates when you're 6 dB from actual clipping, it still doesn't provide ample warning when a vocalist shifts unexpectedly from a whisper to a scream. Every time I lit the Overload LED while tracking a dynamic vocalist, I fried the signal.

A.R.T. Tube MP. I know that the "MP" stands for mic preamp, but this unit's take-me-anywhere design begs for it to be dubbed the "*mobile* preamp." The Tube MP is about the size of a portable CD player, which ensures it can be stuffed into tightly packed gig bags for easy transport. It's also a pretty tough customer. The preamp survived an unintentional tumble down a carpeted stairway with no ill effects.

The single-channel Tube MP is not rack-mountable and is designed to see action on the floor (like a direct box) or to sit atop desks, mixing consoles, and equipment racks. Mic and line inputs/outputs are easily accessible from the rear panel. Speaking of connections, it's a good idea to secure the preamp if a performer is likely to be mobile. When I used the Tube MP to record an electric bass, one particularly funky move from the bassist launched the unit across the console and into the lap of a bandmate. (True story!)

Adjustable input and output levels ensure that the Tube MP can deliver optimal gain stages—a real plus. However, mic input levels were pretty low unless the +20 dB gain switch was activated. In the Norm position, I was always cranking the input gain pot to its maximum setting to get robust signal levels. The preamp's single LED serves as a power indicator and a clip warning (green is good; red is bad). Needless to say, it's not an ideal early warning system for input overloads.

Bellari RP220. Harkening back to the days of do-it-yourself audio components, the RP220 looks like something your father might have built for

TL Audio Dual Tube Mic Preamp/DI

Two Studio Veterans Team Up.

Ed Cherney and the AT4033

Grammy-award winning recording engineer and producer Ed Cherney has worked with some of the most talented people in the business. Bonnie Raitt, Eric Clapton, Little Feat, Elton John, and The Rolling Stones just to name a few. So it was inevitable that he would eventually work with one of the finest microphones. The AT4033.

Here's what Ed had to say about it:

"When I first used the 4033, I was working on a ballad with singer Jann Arden. But I'd always had trouble finding the right microphone to handle the level she sings at in choruses as opposed to lower volumes in the verses. *Until I tried the 4033.*"

"I just put it up with no compression, no EQ, and had her sing into it. And I mean, *it was right there.* The mic handled everything, stayed clear and open all the way through, and ended up sounding great."

For Ed and the AT4033, it sounds like the beginning of a long, successful partnership. But what about you? Just call, write, or fax for details on how you can team up with the AT4033.

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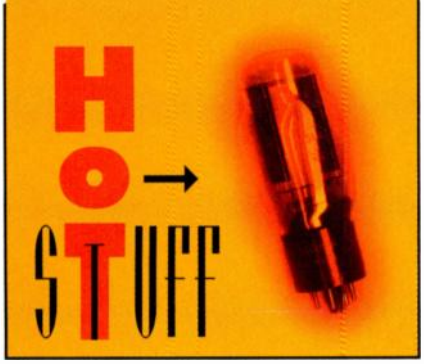


his hi-fi system. It's hip without being ostentatious. The 2-channel preamp takes up two rack spaces and has a ¼-inch instrument input on its front panel. The mic inputs and outputs are on the rear panel, however, which forces you to reach behind your equipment rack if you have to change XLR cables. The RP220 was the only preamp tested that offered 5-segment output-level LEDs. Hooray! It also provides input-gain and (passive) output-volume controls—something else I would have loved to see on all six preamps.

Groove Tubes MP1. A study in classic minimalism, the spartan front panel of the half-rackspace MP1 cuts right to the chase. You get one level knob; one 3-stage input-level LED; a ¼-inch instrument input; and four tiny function switches. The single-channel preamp can be combined with another MP1 to make a 1U, dual-channel unit. Each MP1 has a balanced XLR input and a balanced (+4 dB) XLR output on the rear panel. There are no unbalanced ¼-inch outputs available.

The MP1's 3-stage LED makes signal monitoring a little easier than it is with some of the other preamps because the clip-alert lights progress from green to yellow to red. You actually get *some* warning before the source signal is roasty toasty. Due to the preamp's compact, half-rack design, you can use it much like the A.R.T. Tube MP. I plopped it on the floor of a vocal booth, set it atop a monitor speaker, and placed it on the top of a stool. The MP1 would be imminently accessible and transportable, except for one slight problem: its external power supply is monstrous. The separate power unit is shaped like a brick and is heavy enough to be used as a dumbbell. A locking DB9 cable connects the power supply to the preamp. It should come as no surprise that the MP1 didn't exactly log the fastest set-up time.

Peavey VMP 2. The VMP 2 is retro cool with absolutely flash knobs! My fashion sense was seduced to the point where I almost didn't care how the preamp sounded, I just wanted to see it's 2U majesty beaming from one of my equipment racks. The 2-channel beauty has input-gain knobs, but (unfortunately) no output-level controls. The microphone inputs are inconveniently placed on the rear panel, along with the balanced XLR and unbalanced ¼-inch outputs. Instrument inputs are the only I/O on the front panel.

A.R.T. Tube MP

A somewhat bizarre omission is the lack of any signal monitoring—no clip lights, no multisegment LEDs, no nothing! But in the VMP 2's defense, I couldn't force the preamp to distort with any of my "operator error" drills. The headroom seemed quite vast.

The VMP 2 offers one significant feature that the other preamps do not, however, and that's equalization on each channel. High EQ delivers 10 dB of boost/cut at 10 kHz, and Low EQ provides ± 10 dB at 100 Hz. Although I was looking for any excuse to twist those groovy knobs, I was suitably impressed at the sound of the VMP 2's EQ. It's truly excellent. Frequency boosts were like caresses; rather than clobber you over the head, they were smooth and subtle. Of course, the main preamp testing was done with the VMP 2's tone controls bypassed to ensure a level playing field.

TL Audio Preamp/DI. Many thanks to TL Audio for placing *all* inputs and outputs on the front panel. Those who plan on rack-mounting the 2U, 2-channel preamp will be saved the hassle of reaching behind the rack to trace and exchange problem cables. Front-panel access also makes it easier to audition several different microphones because you can dedicate an XLR cable to each mic and connect them without leaving your listening position. (Be sure to label each cable with the name of its microphone.) Like the Model 107, the Preamp/DI accepts XLR cables wired with pin 2 hot.

In addition to the XLR input/output on each channel, you also get a ¼-inch instrument input with switchable sensitivity for guitar (-35 dBu) and keyboard (-15 dBu). The input gain control seemed a tad lacking in "oomph," as I always seemed to have the knob fully up. I tend to panic when I max out gain pots because audible hiss usually becomes a problem. Thankfully, the Preamp/DI's pots were an exception: they stayed relatively spic and span. A single peak LED monitors output signals. Ick.

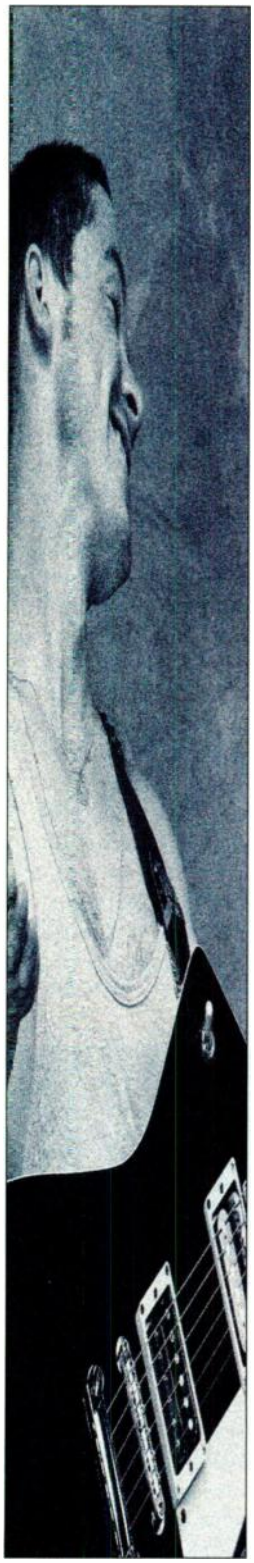
LE CUISINE

Ease of use is dandy, of course, but that wonderfully fat sound is the *real* reason a recordist parts with hard-earned cash to buy a tube preamp. To see how well these units warmed up and nurtured signals, I used them during several recording sessions at Studio 684 in San Francisco and also conducted head-to-head listening tests.

For the listening tests, **EM** Editorial Assistant Jennifer Seidel sang (quite

Aphex Model 107

CD-QUALITY MULTITRACK RECORDING



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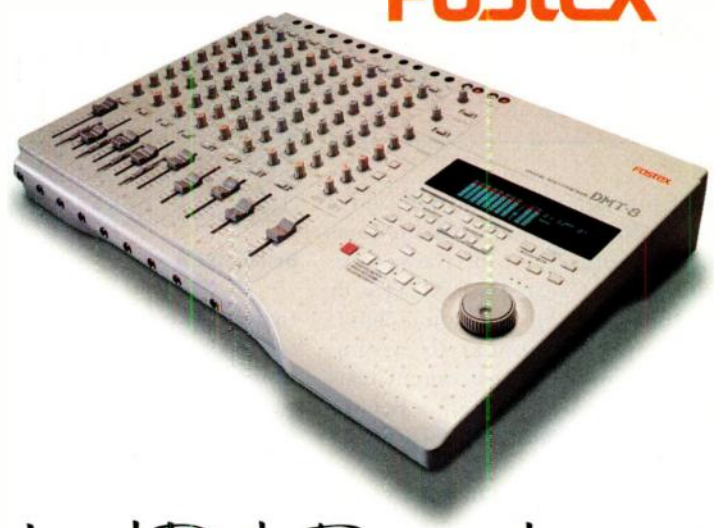

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A familiar, friendly analog in-line mixer is an 8-in, 4-bus out with 16 channel returns for 22 inputs available at mixdown. There's a separate stereo monitor out, a large 2" x 7" fluorescent display with comprehensive status indication--in short, all the flexibility and convenience you've come to expect.

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All this in a package which operates like a snap at a price you can afford. Available at a selected Fostex Dealer . . . today.

INPUTS
The channel strip has two inputs: main and SUB. SUB enables monitoring of recorded tracks during recording or can be used as a line input during mixdown. Channels 1-4 also have the addition of a 'wide-range' trim fader (-10dBV -50dBV) for perfect mic level matching.

EQUALIZATION
Two parametric EQ's. High Mid (1kHz - 16kHz ±15dB) and Low Mid (60Hz - 1kHz ±15dB).

AUXILIARIES
2 AUX sends. Dual-function rotary pots enable SUB or post-fader main input to be selected as send source.

ROUTING
Each channel can be routed to Groups 1/2 or 3/4.

LEVELS
High quality 60mm faders control the channel levels.

NON DESTRUCTIVE EDITING
Backing vocals great on the first chorus, but a bit shaky in the second? Why waste time recording them again? With simple copy and paste editing you can take those great vocals on chorus 1 and paste them over the less than perfect ones in chorus 2.

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The DMT-8 is ready for total integration into your Midi studio. It's all there: Midi Time Code output (with up to 6 hours of offset time between ABS and MTC), MIDI Machine Control (control the transport direct from your software sequencer), non-linear editing based on MTC or MIDI clock and 'after the event' synchronisation of recorded CD-quality audio to sequenced Midi using the built-in tempo map.

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By connecting a DAT recorder to the optical S/PDIF output you can digitally master your recordings ensuring the highest possible quality

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Bellari RP220

nicely) through an AKG C 414 and a Shure SM57 in the studio's foam-lined isolation booth. All of the tracks were recorded direct to an Alesis ADAT with no outboard gear in the signal chain. It was simply microphone to preamp to ADAT. Line-level instrument tests were conducted by tracking a Fender Jazz bass and a Fender Stratocaster direct to ADAT.

Aphex Model 107. On vocals, the Model 107 sounded extremely transparent. Although the isolation booth was rather dead, I could clearly discern reflections from the window and ceiling when the C 414 was in omnidirectional mode. The other preamps didn't exhibit this level of clarity. However, the Model 107 was somewhat edgy in the upper midrange frequencies, and vocal sibilance was pronounced. The tube-warmth factor was rather subtle: the coloration isn't spicy hot, but it warms up signals without imposing drastic tonal changes. As the Model 107 doesn't have an instrument input, I opted not to test line-level signals because I couldn't maintain the instrument to preamp to ADAT signal chain.

A.R.T. Tube MP. Considering its ridiculously low price, the Tube MP sounded surprisingly fat. The preamp produced rich lows, although the mid frequencies were on the thin side. It's certainly not a transparent preamp, but the tube coloration adds a comforting warmth to vocals and electric bass (recorded direct). Using the Tube MP to record the Stratocaster was less successful, as the preamp's ragged mids didn't really enhance the guitar's tone.

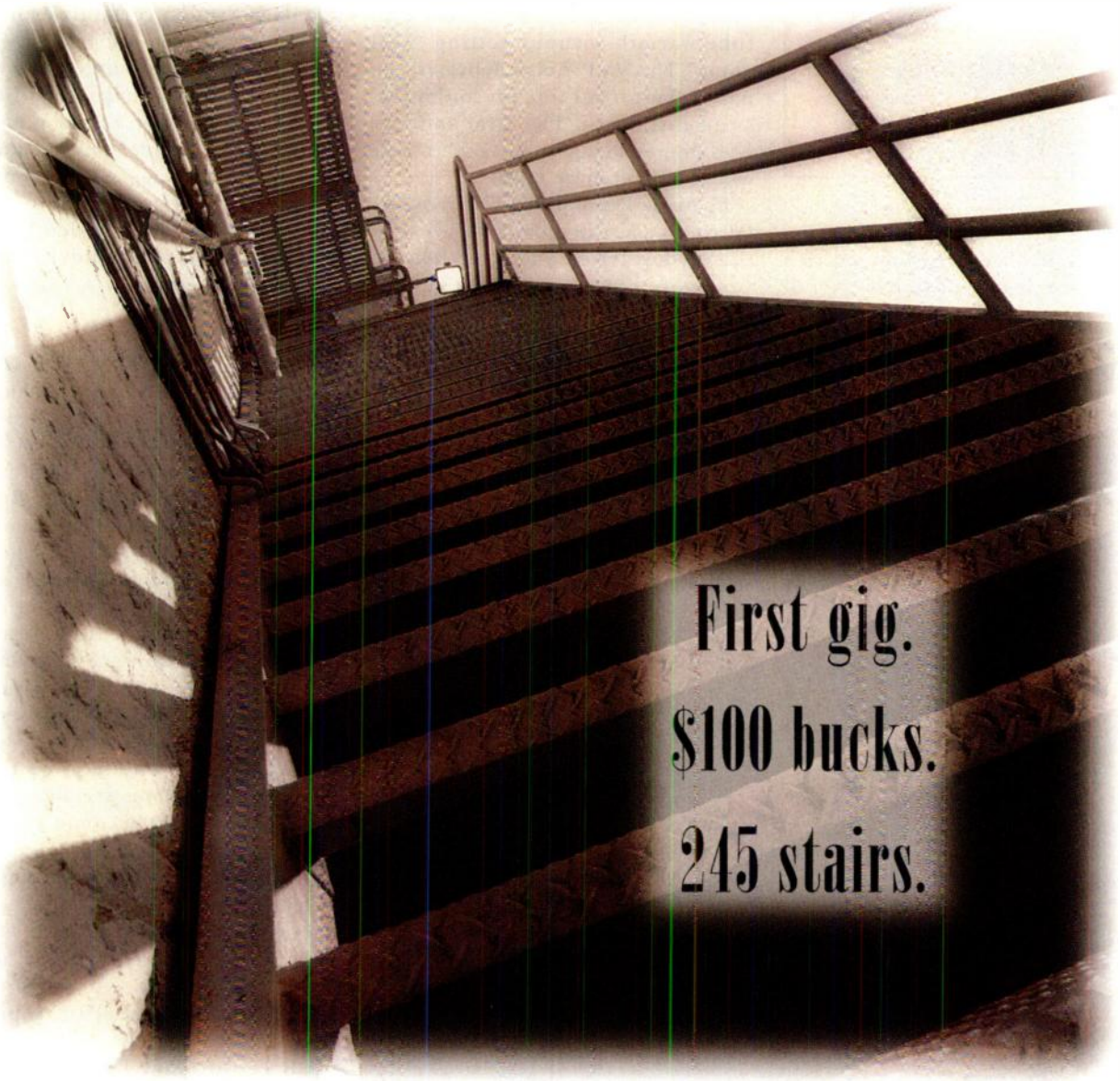
Bellari RP220. The RP220 brought me back to my old analog days. Every signal I recorded through this preamp came back sounding as if I had tracked burning levels to a reel of Ampex 499. It's not a clear or particularly clean sound—and the RP220's "hair trigger" gain stages made it dangerously easy to blister signals—but the timbre evokes a sweet, gentle distortion. Vocals sound fat, if a little edgy, and instruments take on a supple buzziness that adds impact to the direct signal.

Groove Tubes MP1. Somehow the MP1 managed to sound natural *and* produce a truly fat low end. Vocals sounded clear and articulate, but with a lush and fuzzy warmth. The MP1 doesn't punish the mids as much as some of the other preamps, which helps it maintain tonal clarity. The preamp worked best on vocals because it could enhance a singer's timbre without adding sibilance. Direct guitars and bass sounded nice, but the rather stiff tone was nothing to write home about.

Peavey VMP 2. It was a struggle to keep my hands off those excellent EQ knobs, but I managed. The VMP 2 does

Special Ingredients

Make/Model	Channels	Output-Level Control	Instrument/Line Input	Main I/O Access	Fry Warning	Goodies	Price
Aphex Model 107	2	no	no	front/rear panel	OK and Overload LEDs	remote mute, -20 dB pad, 80 Hz cut, operating level, phase reverse	$595
A.R.T. Tube MP	1	yes	yes	rear panel	single, 2-stage LED	+20 dB gain, phase reverse	$149
Bellari RP220	2	yes	yes	rear panel	5-segment LED	-20 dB input and output pads	$499
Groove Tubes MP1	1	no	yes	rear panel	single, 3-stage LED	bass rolloff, -20 dB pad, phase reverse	$870
Peavey VMP 2	2	no	yes	rear panel	none	-20 dB pad, 40 Hz/80 Hz cut, high and low EQ	$799
TL Audio Dual Mic Preamp/DI	2	no	yes	front panel	Peak LED	phase reverse, guitar/keyboard input sensitivity	$595



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an excellent job without the added frequency control. Vocals sounded rich with a nice, even body. The overall timbre was very balanced and natural; it only got a little ragged on the high end, adding a touch of buzziness to sibilants.

Like the MP1, the VMP 2 cooked up tube warmth without getting "well done." The VMP 2 also delivered the most robust tones when recording instruments direct. The Strat and Jazz Bass sounded exquisitely fat and fuzzy with spanking sharp mids.

TL Audio Preamp/DI. The Preamp/DI produced the most coloration of the models tested and a plethora of yin/yang considerations. For example, the lows were flaming hot (very cool), but they also tended to be somewhat muddy (not cool). The overall timbre was dark—which certainly evoked a compelling vintage tube sound—but the mids were often muted and dull. Obviously, the Preamp/DI's distinctive personality didn't make it an "all things for all people" type of unit. It worked great for aggressive, tenor vocals and single-tone guitar runs. However, soft crooners sounded lifeless, and strummed guitar chords just didn't have any shimmer.

TASTE TEST

What good is a cook-off without a blind taste test? I decided to have some fun and play the ADAT tracks for a panel of informed ears that included **EM** Assistant Editor Brian Knave, Jennifer Seidel, and Studio 684 owner Buddy Saleman and staff engineer Dian Langlois. Each preamp was represented by the identical section of Seidel's vocal performance. Immediately after hearing a section, the panelists were asked to describe the nature of the sound.

Although the listening test was hardly scientific, it was a true-to-life example of how many engineers would choose a preamp for a recording project. The following evaluations are an accurate representation of the comments engineers often make when deciding whether or not to use a piece of gear.

Aphex Model 107. The Model 107's low end was described as warm, but its high end was characterized as "a tad brittle." Two of the four panelists remarked that the Model 107 sounded extremely transparent.

A.R.T. Tube MP. There was across-the-board agreement that the Tube MP was a little weak in the low midrange frequencies, but otherwise it sounded warm and smooth.

Bellari RP220. Everyone loved the low-end response of the RP220, calling it "very round" and "ballsy." The high end, however, was described as "crispy."

Groove Tubes MP1. The MP1 was lauded for its round, clean, transparent tone. One panelist knocked the highs, saying they sounded "artificial," but the others maintained that the preamp delivered an extremely natural tone.

Peavey VMP 2. "Natural" and "balanced" were the two words everyone used to describe the VMP 2. The tube coloration was also defined as warm without "going over the top."

TL Audio Preamp/DI. One panelist stated that the TL Audio preamp

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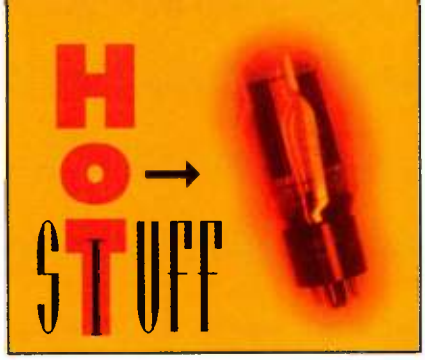

sounded the "most tube-like," but the others characterized the unit's sound as "dark," "dull," and "a little boxy."

CHEF'S RECOMMENDATIONS

No, I'm not abdicating the responsibility of evaluating these fine preamps. The taste test merely provided an opportunity to poll outside ears and compare my perceptions to those of the panel. Here are my own takes on the tube preamp cook-off.

Tasty Value Meal. No surprise here. At $149, the A.R.T. Tube MP is a rockin' good deal. It sounds very good for an inexpensive preamp, producing warm tones with just a touch of grit on the high end. Low frequencies are not enhanced as much as they were by the more costly preamps tested, but the Tube MP pumps out enough tube coloration to make analog aficionados nostalgic. Every recordist working with an MDM or hard-disk recorder should buy this piece of equipment immediately—even if he or she plans to purchase a high-class preamp. Trust me, you'll find tons of uses for the Tube MP, and it never hurts to have a selection of different tube preamps hanging out in your studio.

Big Appetite Plate. Peavey's VMP 2 offers a tasty side dish of low and high equalization controls, which puts it on top of the features race. The sound of

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the VMP 2's EQ is extremely smooth and clean—no obnoxious hiss or bizarre artifacts—and it's certainly a relief to be able to tweak tones when routing the preamp directly to your recorder. In addition, the VMP 2 provides two fixed low-cut frequencies (40 Hz and 80 Hz) to help diminish ambient rumbles and vocal plosives. Of course, the EQ firepower would be worthless if the VMP 2 sounded atrocious. It doesn't. It sounds extremely warm, clear, and natural. And did I tell you how much I love the VMP 2's vintage knobs?

Yummy Yummies. The Aphex Model 107, Bellari RP220, and Groove Tubes MP1 each have their own special flavor—and little quirks—which makes it difficult to say that one model is clearly superior to another. The Model 107 won an **EM** Editors' Choice Award this year, so we obviously believe it's an excellent preamp. The sound is rather transparent, so it's a good choice if you want a little tube warmth without accentuated lows. The MP1 is also a very natural-sounding preamp, but it produces a fat, sensual low end. On the other hand, Bellari's RP220 is *not* a transparent preamp. Its enhanced low end and edgy mids really evoke the glory of analog tape coloration. I'd be ecstatic with any of these preamps, but potential buyers should audition each unit to see which model best fits their sonic requirements.

Needs Salt. TL Audio's Dual Mic Preamp/DI is far from a bad meal, but it doesn't dazzle the audio "taste buds" like the other models. The sound tended to be on the dark side. It's warm, but it's dull.

KITCHEN CLOSED

So there you have it! The glories of analog coloration don't have to be relegated to history books when you move into the digital domain. All you have to do is try a little tube cooking. Most professional engineers swear by some type of tube preamp, tube EQ, tube compressor, or tube microphone. Obviously, there must be a darn good reason for such allegiance to those glowing glass capsules. I suspect it's because tubes really *do* sound absolutely fabulous. So, if your digital masters sound wan and colorless, quit whining and get tubular! ❁

Groove Tubes MP1

Tech War

Just for fun, we pitted the $149 A.R.T. Tube MP against its more expensive kin in a blind listening test. In each one-on-one match, the panel (the same folks who took the "taste test") was asked to pick the warmest, most pleasing timbre.

David	Goliath	Victor
A.R.T. Tube MP	Aphex Model 107	A.R.T. Tube MP
A.R.T. Tube MP	Bellari RP220	Bellari RP220
A.R.T. Tube MP	Groove Tubes MP1	Groove Tubes MP1
A.R.T. Tube MP	Peavey VMP 2	Peavey VMP 2
A.R.T. Tube MP	TL Audio Dual Preamp/DI	A.R.T. Tube MP

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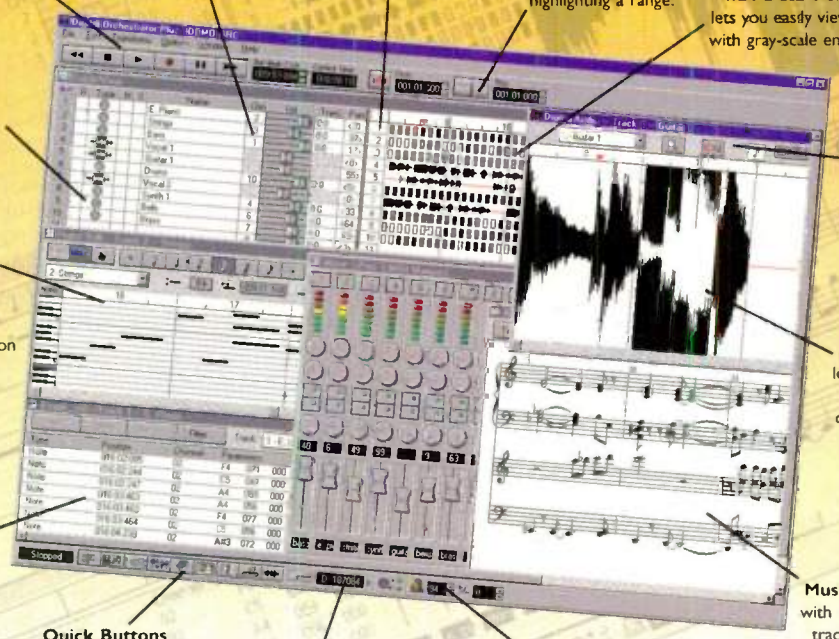

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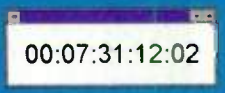

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Build the EM Theremin

This classic electronic instrument gives good vibrations and excitations.

By Robert Moog

Most electronic musical instruments are sonic chameleons that try to sound like a wide variety of other things. However, there is one electronic instrument that makes no apologies for its single, immediately recognizable sound: the theremin. This monophonic instrument has added its distinctive, melodic character to the scores of many horror and suspense movies and made its pop debut on the Beach Boys' "Good Vibrations." It has also appeared on many concert stages, including Carnegie Hall.

The theremin was named after its inventor, Russian physicist and musician Leon Theremin, who developed the instrument in the 1920s. Unlike most musical instruments, the theremin is played with absolutely no physical contact. Players wave their hands in the air near two antennas. As one hand gets closer to the straight vertical tube (called the *pitch antenna*), the pitch rises; as the other hand gets closer to the horizontal tubular loop (called the *volume antenna*), the volume decreases. Because the theremin's pitch and volume are intimately tied to the player's hand motions, the tone has a vibrant, wavering quality, not unlike a human voice or a violin.

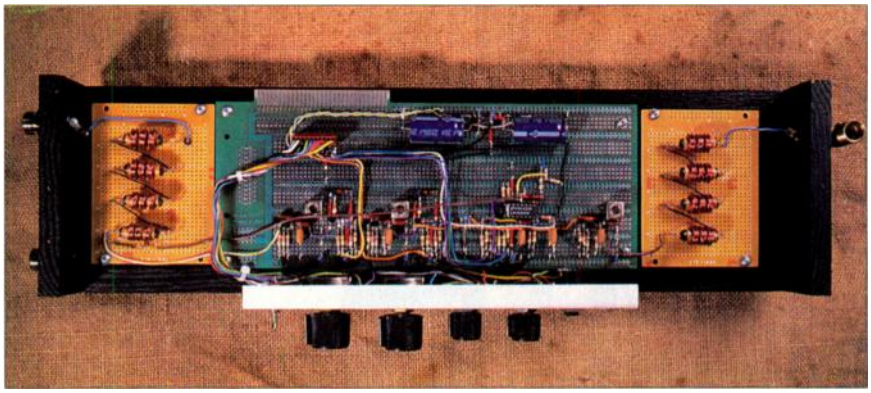
Among the requests for DIY projects that **EM** receives, by far the most common is a do-it-yourself theremin. The instrument presented here is an authentic theremin, with antenna response characteristics, pitch range, and tone color that closely emulate Leon Theremin's original designs. However, it is reasonably easy to build. It uses currently available components and materials that you can buy at your local hardware store or from mail-order electronic-parts distributors. If you know how to read a schematic diagram, solder, and use a voltmeter, and if you're comfortable with basic home tools, you should be able to build and adjust this theremin.

OVERVIEW

When you bring your hand near a theremin antenna, you are actually forming a variable capacitor: the antenna is one "plate" and your hand is the other. With the high frequencies and very low currents used by the instrument, your hand is effectively grounded by being attached to your body, so the antenna and your hand form a variable capacitor to ground. This variable capacitance is called *hand capacitance*. You increase the hand capacitance by bringing your hand nearer to the antenna. During normal operation, the hand capacitance is less than one picofarad, which is a very small capacitance indeed!

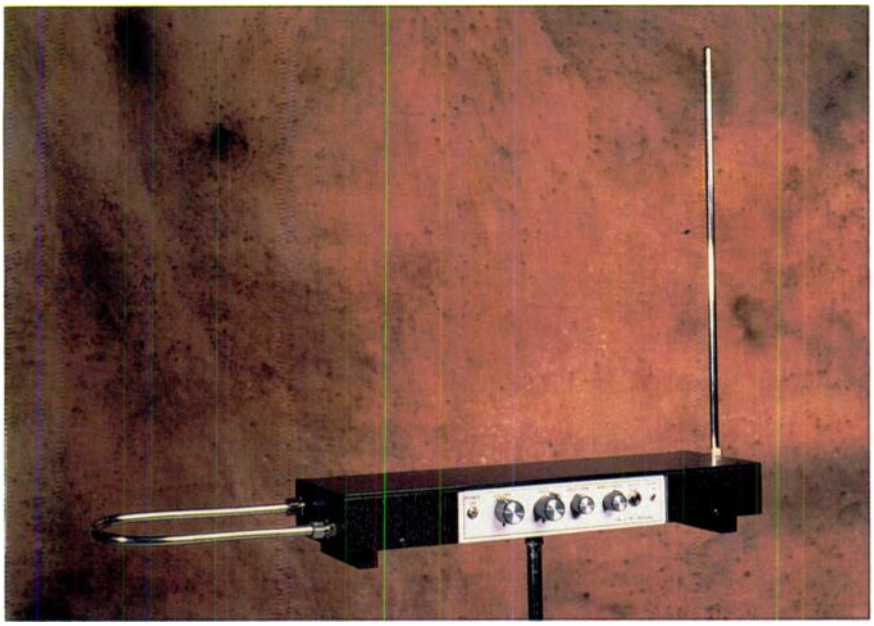
Each antenna forms a resonant circuit with a group of inductors collectively called an *antenna coil*. In this design, the resonant frequencies are about 260 kHz for the pitch antenna and about 450 kHz for the volume antenna. At or near the resonant frequency, a tiny change in hand capacitance results in a larger change in the impedance of the antenna circuit as a whole.

Refer to **Figure 1**, the functional block diagram, and **Figure 2**, the schematic diagram of the entire circuit. The *variable-pitch oscillator* (VPO), *fixed-pitch oscillator* (FPO), and *detector* sections form a *beat-frequency oscillator*. Q1, Q2, and their associated components constitute the VPO, the frequency of which is set



CLAIRE ARNAUD

The theremin's main circuitry is mounted on a single prototyping board, and the two antenna circuits are mounted on their own smaller boards.



CLAIRE ARNAUD

The EM theremin closely emulates Leon Theremin's original design, although it is housed in a smaller cabinet.

slightly higher than the resonant frequency of the pitch-antenna circuit (established by adjusting L5). As a player brings a hand near the pitch antenna, the changing impedance of the pitch-antenna circuit lowers the VPO frequency by about 3 kHz.

Q3, Q4, and their associated components form the FPO, the frequency of which is set equal to the VPO frequency (by adjusting L6) when the player's hand is away from the pitch antenna. The difference, or beat, frequency is extracted by the detector and appears as an audio waveform at the junction of R23 and R24. As the player brings a hand near the pitch antenna, the frequency of the audio waveform goes from 0 to about 3 kHz (3½ octaves above middle C).

Q5 and its associated components constitute the *pitch-tuning circuit.* This circuit presents a variable active impedance that is used to make fine adjustments to the FPO frequency while the instrument is being played. Front-panel potentiometer P1 adjusts the current through Q5, thereby changing its active impedance.

Q6, Q7, and their associated components form the *volume oscillator.* Its frequency is set slightly higher than the resonant frequency of the *volume-antenna circuit* by adjusting L11. As the player brings a hand near the volume antenna, the resonant frequency of the volume-antenna circuit is lowered, and the DC voltage appearing at the junction of D1 and C12 is reduced. The resulting current flowing through R14 is amplified and level-shifted by the VCA processor section (U3-B and associated components) and then fed through R30 to control the gain of the *voltage-controlled amplifier* (U3-A and associated components). The amplitude-controlled audio output is then fed to front-panel jack J1. The maximum level is about 0 dBm (0.8V RMS).

Q8 and its associated components constitute the *volume-tuning circuit,* which is nearly identical to the pitch-tuning circuit. Potentiometer P2 is used to make fine adjustments to the volume-oscillator frequency during performance.

The audio waveform is applied to pin 3 of U3-A at a level high enough to clip it. This has the effect of reshaping the waveform from a skewed sine to a quasi-rectangular wave, which is very similar to the waveform of Professor Theremin's original instruments. P3 varies the input resistance of U3-A, which influences the amount by which the audio waveform is clipped. P4 shifts the bias at the input of U3-A, which changes the waveform width and therefore the output's harmonic spectrum. C24 and C26 roll off the high-frequency harmonics to produce a pleasant, cello-like tonal balance.

ANTENNAS

Making the antennas can be tricky. They should be metallic, rugged, attractively finished, capable of being rigidly mounted, and easy to fabricate by a home hobbyist. I have found that ⅜-inch, soft copper tubing of the sort that plumbers use with bathroom sinks works well. You can buy preplated, straight, short pieces at your local builders' supply or hardware store. You can also purchase a simple tubing bender that will allow you to bend the volume antenna by hand without collapsing the tubing. You'll also need a tubing cutter or hacksaw to cut the tubing to length.

The finished pitch antenna is a straight, vertical tube eighteen inches long and ⅜ inch in diameter, and the finished volume antenna is a horizontal, hairpin loop with a total length of nine inches. The ends of the volume

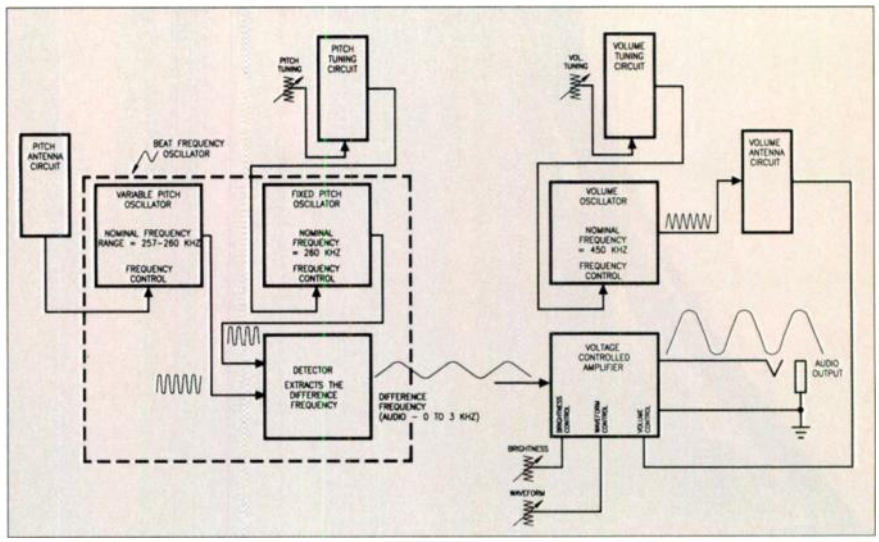


FIG. 1: This functional block diagram reveals how the theremin works.

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antenna should be separated by 3¼ inches, center to center.

I suggest you make the antennas longer than necessary and then cut them to length after they're formed and stiffened (discussed shortly). Start with a straight, 24- or 36-inch length of tubing for each antenna. To form the volume antenna, slip the tubing bender over the tube. Then, starting at the midpoint of the tube, bend it into a semicircular curve. Hold the tube in both hands and push into the curve with your thumbs while pulling down with your other fingers. Double-check to make sure that the two ends of the volume antenna are parallel and are the correct distance apart.

Copper tubing has one drawback: because copper is soft enough to bend by hand, it is easy to put unwanted kinks in the tubing after it has been formed. You can stiffen the antennas by filling them with polyester resin (the liquid-plus-hardener type used to repair car bodies) after you've formed them. This is not particularly difficult, but the potential for making a mess is significant, so be sure you have plenty of time and you're at peace with the world.

The pitch antenna is straight because this configuration is more sensitive to changing hand position when the hand is farther away and less sensitive when the hand is close. The change in hand capacitance is extremely small when the hand is far away, and the change in pitch as a function of distance must be as uniform as possible.

The volume antenna is looped because this configuration is less sensitive when the hand is far away and more sensitive when the hand is close. This gives you greater control over the low end of the dynamic range and lets you articulate notes by quickly dipping your left hand into the loop (more in a moment).

The two antennas are perpendicular to each other to minimize the interaction between them. For example, as you move your left hand up and down above the volume antenna, its motion is parallel to the pitch antenna, which causes little or no change in pitch.

CABINET

The entire cabinet is made of wood. Except for the front panel, large metal cabinet parts should not be used, as they may add unnecessary capacitance to the antennas. My materials of choice are hardwood plywood for the top and solid hardwood for the rest of the cabinet because they are rugged, easy to shape accurately, and can be attractively finished.

The enclosure consists of a base and cover (see **Fig. 3**). The cover should fit snugly over the base. You may fasten the pieces together with any combination of nails, wood screws, and wood glue, depending on how you like to put cabinets together. After the cabinet parts have been assembled, sand them down well and finish them with the wood finish of your choice, except metallic paint.

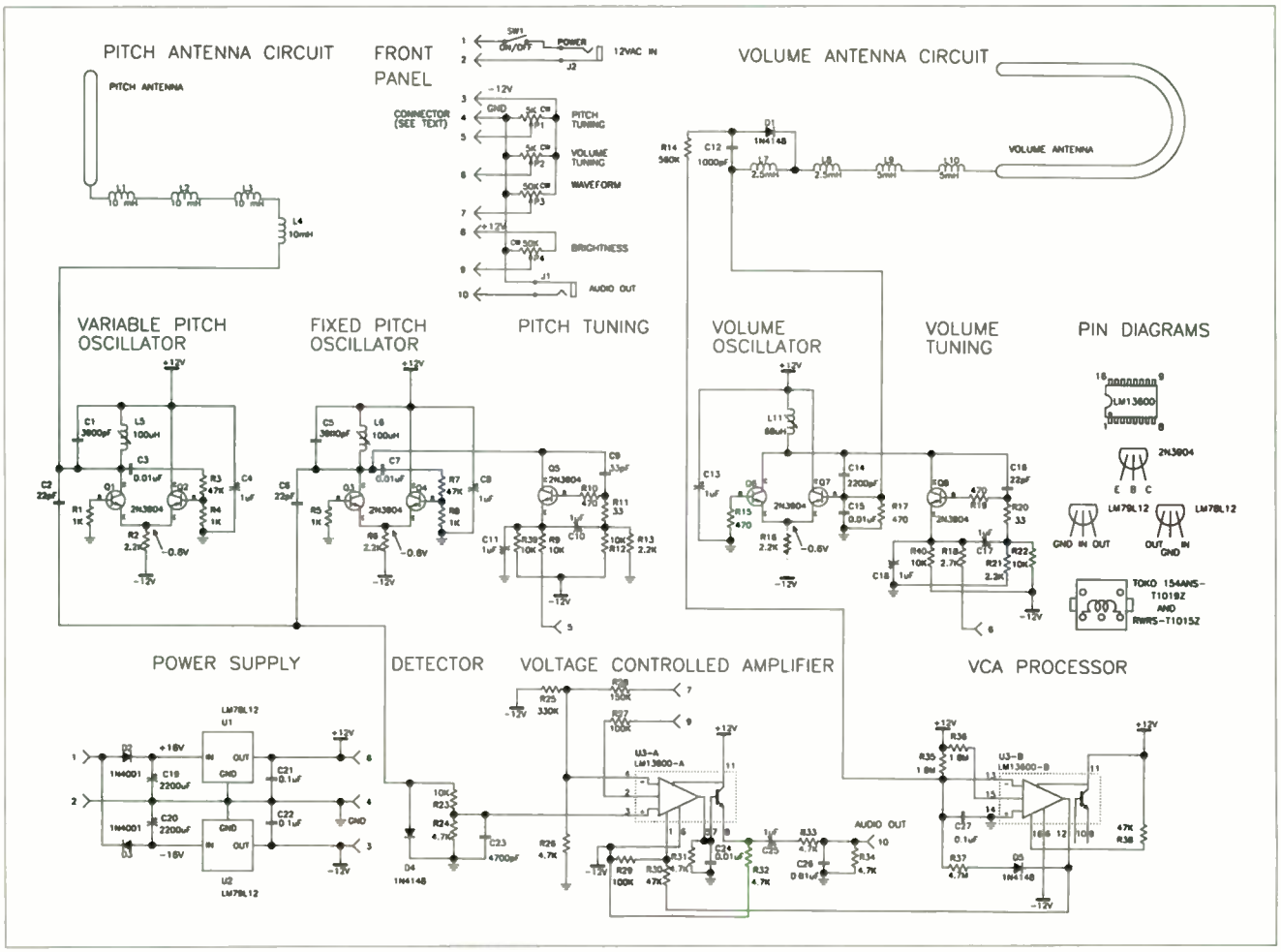

FIG. 2: The schematic for the EM theremin.

The antenna sockets are regular tube-to-pipe connectors that you can get when you buy the copper tubing for the antennas. The volume-antenna sockets are straight ⅜-inch-tube-to-⅜-inch-male-pipe connectors, whereas the pitch-antenna socket is a right-angle, ⅜-inch-tube-to-⅜-inch-male-pipe elbow. Drill ⅜-inch holes for these fittings; then screw them in by hand. If you can't screw the ⅜-inch pipe threads into the wood by hand, don't force it by using a pipe wrench: you may split the wood. Instead, enlarge the hole slightly with a large round file or a ⅜-inch pipe tap.

Once you're sure you can screw in the pipe fittings by hand, unscrew them, put a small amount of epoxy on the threads, and reinsert them by hand. Before the epoxy hardens, verify that the pitch-antenna socket is vertical by inserting the pitch antenna into the socket and adjusting the position of the socket as necessary.

Two ¾-inch × ¾-inch blocks and one microphone-stand mounting flange are attached to the bottom of the enclosure. This lets you set the finished unit on a microphone stand (preferred) or on a wood (*not* metal) table when you play it.

FRONT PANEL

The front panel should be made of 1/16-inch sheet aluminum. It should be about nine inches long and should have bends at the top and bottom for mounting and stiffening. You can either cut and bend the panel yourself or have your local sheet-metal shop do it for you. Alternatively, you can buy a blank, single-space (1U) rack panel, which is 1¾ inches high by nineteen inches wide, cut it to length with a hacksaw, and attach the panel to the base from the front instead of from the bottom. However, that will leave a ¼-inch gap between the top of the panel and the enclosure cover.

Four rotary potentiometers, one ¼-inch phone jack, one ⅛-inch minijack, and one toggle switch are mounted on the front panel. The two tuning pots should be located in the left part of the panel so your hand is as far from the pitch antenna as possible when you tune the antennas. Use high-quality, full-size rotary pots and large-diameter knobs for P1 and P2. P3 and P4 are less critical; these pots can be miniature, and the knobs can be small. I suggest you use an insulated, ¼-inch jack for J1 to avoid a ground loop between the audio and power grounds.

Eight single-conductor wires and one shielded wire connect the front-panel components to the main circuit board. I suggest you use a connector for these wires so you can unplug the panel if you need to work on the main circuit board. Prototyping boards often have provisions for mounting a DB15 or DB25 connector.

MAIN CIRCUIT BOARD

All circuitry (except the antenna circuits and front-panel components) is mounted on one circuit board (see **Fig. 4**). A plug-in prototyping board of the sort used to assemble computer I/O circuits provides the space, connection provisions, and solidity you need. Radio Shack's prototyping board (catalog #276-1598) provides ample space for all the circuitry with extra room to try your own modifications.

The theremin's power is supplied by a ±12 VAC wall wart, which is widely available (see sidebar "Where to Get Parts and Materials"). The AC voltage is converted into DC by two voltage regulators (U1, U2, and associated components). Keep the power-supply circuit components as close together as possible, and keep connections as short as you can. Be *really* sure that C19 and C21 are *very* close to U1 and

THEREMIN: AN ELECTRONIC ODYSSEY

Leon Theremin lived a long, productive, and amazingly diverse life. He developed the theremin during the 1920s, a time when most people had never even heard of radio! He came from Russia to New York City in 1927 and instantly became the darling of the cultural elite. He set up a laboratory and studio in midtown Manhattan, where he developed new instruments and tutored a long string of students. His greatest protégé was Clara Rockmore, a young Russian musician who was originally trained as a classical violinist.

Professor Theremin's tenure in the United States came to an abrupt end one day in 1938, when he was taken back to Russia by Soviet agents under circumstances that are still not fully known. For decades after Theremin disappeared, nobody in the West knew of his whereabouts. Some publications even reported that Theremin had died in a Soviet prison during the Second World War. Fortunately, the rumors of his demise were premature; Theremin actually survived until 1993.

A few years ago, documentary filmmaker Steven Martin (not the comic actor) became interested in Theremin's story. He interviewed people who had known Theremin, located old newsreels and home movies, and dug deep into the life of this amazing man. The result is a film titled *Theremin: An Electronic Odyssey*. If you haven't already seen this movie, watch for it at your neighborhood cinema.

Clara Rockmore was Leon Theremin's greatest protégé.

An amazing array of people appear in the film, including Brian Wilson of the Beach Boys (talking about the use of the theremin in "Good Vibrations"), Clara Rockmore, Jerry Lewis, and Todd Rundgren (doing an on-camera imitation of the theremin). In addition, I discuss the technical side of theremins at several points in the film. But most important, the true story of Leon Theremin is told in a way you won't forget.

—Robert Moog

that C20 and C22 are *very* close to U2. The negative side of C19 and the positive side of C20 should be connected together with a very short lead, and the grounded side of J2 should also be connected to this lead. The voltage regulators are less likely to oscillate if the connections are kept as short as possible.

Be sure to separate the VPO from the FPO by a couple of inches. These oscillators are already lightly coupled through C2 and C6, so they tend to synchronize at low beat frequencies (which is desirable). Placing the oscillator circuits close together increases the coupling, which may result in an excessive tendency to synchronize. In addition, place C4, C8, and C13 very close to the oscillator circuits with which they are associated to maximize the decoupling.

After the main board is assembled and checked, brush the solder side with a small wire brush and inspect for unwanted solder bridges, wiring mistakes, and weak solder joints. Then set the board in the middle of the cabinet base in preparation for final test and tuning.

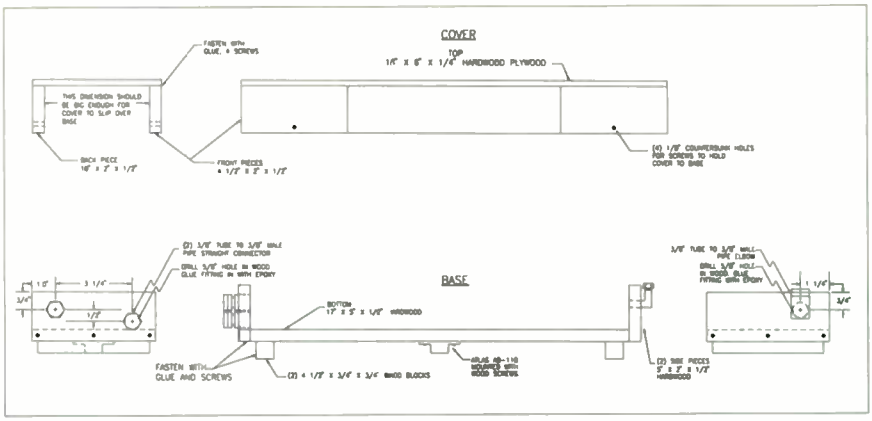

FIG. 3: Fabricating the cabinet requires some basic woodworking skills.

ANTENNA CIRCUIT BOARDS

The inductors and other antenna-circuit components are mounted on two separate, small circuit boards with little or no copper circuit pattern. L1 through L4 are mounted on the pitch-antenna circuit board (see **Fig. 4**). Position the inductors so they are parallel to one another and about one inch apart, center to center. The inductors are not polarized *per se,* but each terminal is distinct: one emerges from the center of the coil and the other emerges from the outer layer of the coil. Arbitrarily select one terminal as the beginning and the other as the end, and connect the inductors in series so the end of one inductor is connected to the beginning of the next.

Position the board on the base next to the pitch antenna. The free end of L4 should be close to the main circuit board, and the free end of L1 should be close to the pitch-antenna socket.

Connect a short wire from the free end of L1 to the pitch-antenna socket using a heavy soldering iron or by drilling and tapping a hole for a 4-40 thread and then mounting a solder lug.

L7 through L10, D1, C12, and R14 are mounted on the volume-antenna circuit board (see Fig. 4). As with the pitch-antenna circuit, position the inductors so they are parallel to one another, about an inch apart, and connected so the windings are end to beginning. Position the board near the volume antenna, and install wires to connect the free end of L10 to the volume-antenna socket. In addition, connect the junction of L7 and C12 to the junction of C14 and C15, and connect the free end of R14 to pin 13 of U3.

CHECKING IT OUT

After you've assembled and cleaned the main board, take a deep breath and check all your connections again. Look

PARTS LIST

Integrated Circuits

U1	LM78L12 12V positive regulator
U2	LM79L12 12V negative regulator
U3	LM13600N dual operational transcondance amplifier (National Semiconductor)

Transistors

Q1-Q8	2N3904 NPN

Diodes

D1, D4, D5	1N4148 signal diode
D2, D3	1N4001 power diode

Capacitors

C1, C5	3,900 pF/50V, 5%, polypropylene or polystyrene
C2, C6, C16	22 pF/50V, 5%, NPO (zero temperature coefficient) ceramic
C3, C7, C15, C26	0.01 µF/50V, 10%, polyester
C4, C8, C10, C11	1.0 µF/35V tantalum
C13, C17, C18, C25	1.0 µF/35V tantalum
C9	33 pF/50V, 5%, NPO (zero temperature coefficient) ceramic
C12	1,000 pF/50V, 10%, ceramic
C14	2,200 pF/50V, 5%, polypropylene or polystyrene
C19, C20	2,200 µF/35V aluminum electrolytic
C21, C22, C27	0.1 µF/50V ceramic
C23	4,700 pF/50V, 10%, ceramic
C24	3,300 pF/50V, 10%, ceramic

Inductors

L1, L2, L3, L4	10 mH, 3-section, RF choke (J. W. Miller #6306)
L5, L6	100 µH, hi-Q, variable inductor (Toko RWRS-T1015Z)
L7, L8	2.5 mH, 3-section, RF choke (J. W. Miller #6302)
L9, L10	5 mH, 3-section, RF choke (J. W. Miller #6304)
L11	68 µH, hi-Q, variable inductor (Toko 154ANS-T1019Z)

Potentiometers

P1, P2	5 kΩ, linear taper, cermet or conductive plastic (Clarostat 53C1-5K or equivalent)
P3, P4	50 kΩ, linear taper

Resistors (¼W, 5%, metal or carbon film)

R1, R4, R5, R8	1 kΩ
R2, R6, R13, R16, R21	2.2 kΩ
R3, R7, R30, R38	47 kΩ
R9, R12, R22	10 kΩ
R23, R39, R40	10 kΩ
R10, R15, R17, R19	470Ω
R11, R20	33Ω
R14	560 kΩ
R18	2.7 kΩ
R27, R29	100 kΩ
R24, R26, R31	4.7 kΩ
R32, R33, R34	4.7 kΩ
R25	330 kΩ
R28	150 kΩ
R35, R36	1.8 MΩ
R37	4.7 MΩ

Switch

SW1	SPST miniature power switch

Connectors

J1	Insulated ¼-inch phone jack (Switchcraft N-111 or equivalent)
J2	3.5 mm phone jack (Switchcraft 41 or equivalent)

Parts Not on Schematic

- 16-pin IC socket for U3
- Connector set with at least ten conductors for connections between the main circuit board and front panel
- Wall-wart transformer to provide 12 to 15 VAC with at least 200 mA (Cui-Stack DPA120020-P1-SZ)
- Two large knobs for P1 and P2
- Two small knobs for P3 and P4
- Two 24- to 36-inch x ⅜-inch straight copper tubes for antennas
- Tube bender for volume antenna
- Atlas AD-11B microphone-stand mounting flange
- 10-inch x 4-inch prototyping circuit board
- Two 4-inch x 3-inch prototyping boards for the antenna circuits

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Jacks Belo

And Other Truths About 8-Bus Recording Consoles

Get Back Jack. Get Real.

Have you ever seen a pro-studio recording engineer mess with the cables on a console? Of course not. That's why true recording consoles have their jacks in back. Look at any console in any serious studio. Truth is, once the console is installed there's no need to change the setup. Like the TASCAM M2600MKII — the next-generation 8-bus. Available in 16, 24 and 32 input models, it looks clean, sounds sweet and works the way you want it to.

All Your AUXes. All The Time.

With 6 AUXes *(2 are stereo)*, the TASCAM M2600MKII has more AUXes than any other console in its class. But the best part is — you can use all six — all the time. No other console in its price range can make that claim. That means you can use more effects, set up multiple independent stereo headphone mixes and have more flexibility. No limitations. And no repatching.

Get Out! Direct or With The Group.

A true sign of a recording console is direct/group switching. That's what makes recording with the TASCAM M2600MKII so smooth. Think about it. Send any signal direct to tape or disk by pressing one button. Or, send a group of signals direct to tape or disk just as easily — no patching here! You'll never have to crawl around or mess with your cables again. Spend more time recording and less time figuring out how.

The Features Demanded by Pros.

The M2600MKII has everything a great recording console should have — and more. It's an In Line configuration with flip switches. And you get your choice of balanced (+4dBm) and unbalanced tape ins and outs. Phantom power (48V) switchable in banks of 8 channels. And an optional multi-process meter bridge so you can keep your eyes on the board — and not your recorder. Plus, a semi-parametric split EQ on every channel and it's ready for automation using any of a number of third party packages.

Watch it. Do Those Switches and Knobs Wiggle?

Before you buy an 8-bus console check out the quality. Knobs and switches that wiggle are going to be a problem. For example, check out the controls and faders of the M2600MKII. No play, no wiggling. You can feel the quality. Feel those smooth long throw 100mm faders. Clean. And check out the ergonomics. Even the largest fingers will fit between the knobs. Try that on others!

Use A Solid Heavyweight.

TASCAM has built more recording consoles than any other manufacturer in the world. We know how to build a quality product that will last. The M2600MKII is a solid console. You can feel the difference just trying to lift it. Just compare it to the less serious lightweights on the market. Plus it comes with an extra heavy external power supply that delivers more headroom than anything else in its class. Just what you expect from the leader in multitrack recording.

Get Smart. SmartSwitches.™

The difference is in the design. This is a serious console. Take a look and you'll notice the design touches that distinguish the M2600MKII as the next-generation 8-bus console. Like TASCAM's exclusive self canceling and two-tone SmartSwitches — for protection from redundant operations and visual confirmation of all button positions at a glance. Quite a hassle on others!

Great Sound. The Next-Generation 8-Bus.

The real truth about a recording console is sound. With Absolute Sound Transparency™, high-end mic pre-amps, ultra low-noise circuitry, and high-output op amps, the M2600MKII is amazingly quiet, absolutely transparent and perhaps the best sounding console under $20,000. And starting at only $3,199, it's truly the sound decision for a next-generation 8-bus recording console. Put it on your shopping list today.

Maximum Headroom

Increased range of mic amp trim control down to OdB accommodates +4 signals without using the pad– improves signal to noise ratio.

Double Reinforced Dual-Ground System

Wider ground line patterns on the PCB, extremely heavy gauge wiring, and enhanced electronics yields greater headroom and improved sound quality.

Dedicated Indicator Lights

Each SOLO and MUTE switch includes individual indicator lights so you are assured of their postion at all times. No second guessing.

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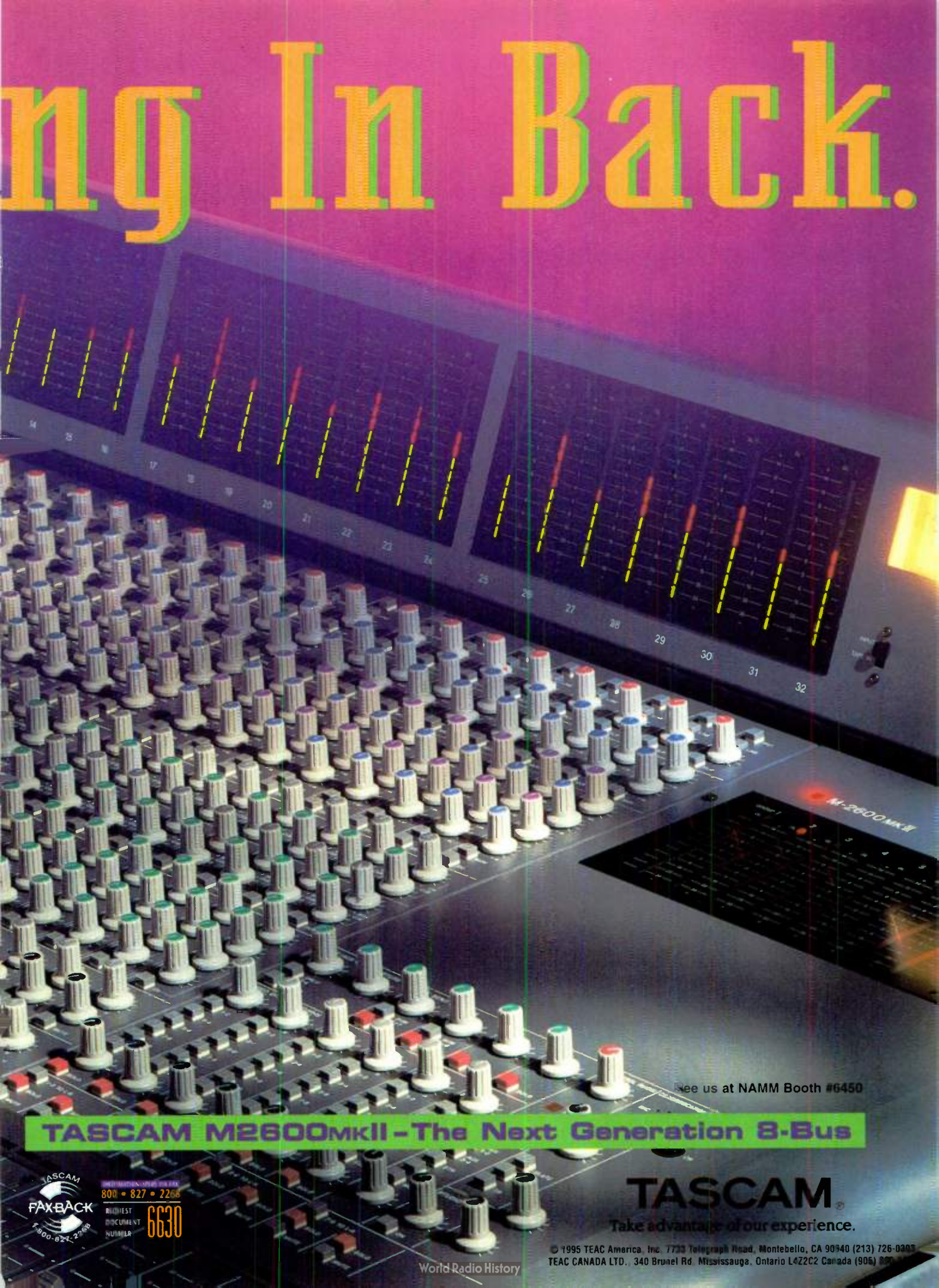
A more expensive, higher quality semi-modular design with 8-channel modular sections makes the M-2600MKII easier to service.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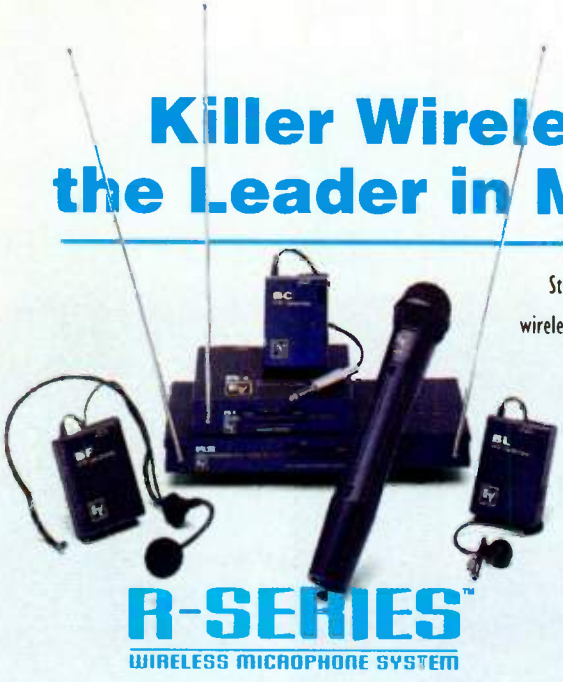

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for shorts, mistakes, missing connections, etc. Then connect the front panel to the main board, plug in the power supply, and turn the power switch on.

Use a voltmeter to check the voltages at the inputs and outputs of U1 and U2 (see **Fig. 2**). Then check the DC voltages at the collectors of Q1 through Q8 (they should all be about +12V); the emitters of Q1 through Q4, Q6, and Q7 (about 0.6V); and the emitters of Q5 and Q8 (about -2.6V). If you don't observe *all* these readings, check everything until you find the problem.

Next, verify that all three oscillators are working. Read the AC voltages across L5, L6, and L11. If you read about 10 VAC, then the corresponding oscillator is producing a waveform. If you don't read any voltage at all, the oscillator is not working. To check the detector, measure the DC voltage across R24. If it's -0.5V or so, the detector is working.

Temporarily connect a pair of headphones or a small powered speaker across R24. Turn the tuning slugs in L5 and L6 counterclockwise until the tops of the slugs hit the shield cans. *Be careful. Do not force the slugs farther than they want to go!* Turn L5 exactly two turns clockwise. Then turn L6 clockwise slowly until you hear a high-pitched whistle. Keep turning until the tone is in the mid range (about 1 kHz). Now, turn P1 in either direction. You should hear the pitch change markedly. If you observe all these things, then the entire beat-frequency oscillator circuit is in good shape.

To check the VCA, temporarily connect pin 12 of U3 to ground. (This should turn on the VCA.) Connect your headphones or monitor amp across R34. You should hear a somewhat louder tone. Now, disconnect the temporary ground connection to pin 12 of U3, and connect that pin to -12V. The audio across R34 should disappear. If it does, the VCA is working properly.

While pin 12 of U3 is connected to ground, you can also check the Brightness and Waveform controls (P3 and P4). Use the Pitch Tuning control (P1) to set the tone's pitch to approximately middle C. Then turn the Brightness and Waveform controls. The Brightness control should change the sound from muted to bright, and the Waveform control should change the sound

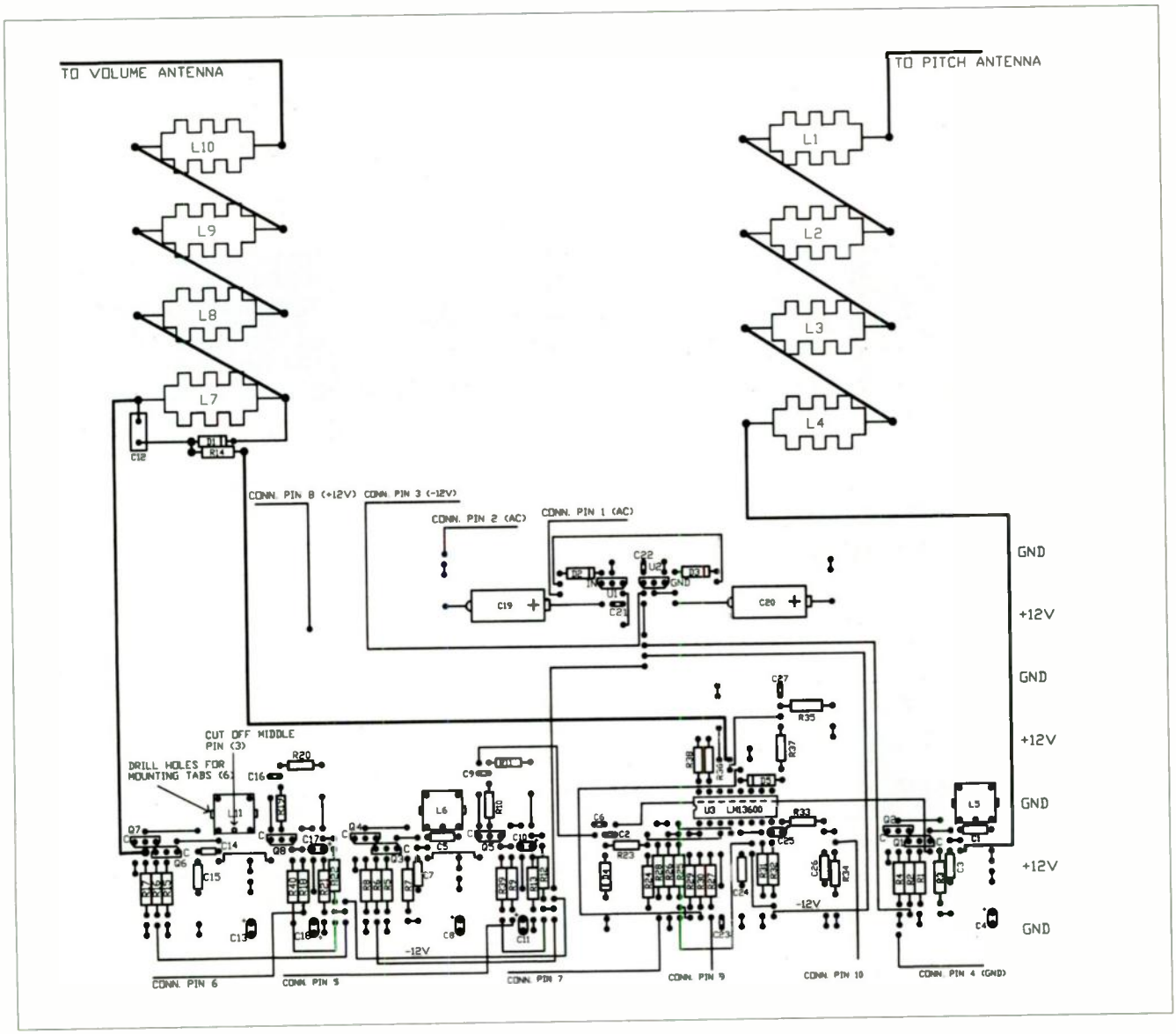

FIG. 4: The position of certain components is critical to minimize unwanted oscillations and capacitances.

from "reedy" (narrow waveform) to "full" (wider waveform). After you have checked all of these controls, remove the temporary connection to pin 12 of U3.

TUNING

Before tuning, clean off your workbench and move aside any large, conductive objects such as desk lamps and test gear. Leave a clear space of two or three feet around your work area. Place the cabinet base in the middle of the cleared space, put the pitch antenna in place, and connect the pitch-antenna circuit board between the antenna and the main board. On the main board, temporarily connect pin 12 of U3 to ground and connect the instrument's audio output to headphones or a monitor amplifier. Now follow these steps to adjust L5 and L6:

1. Set P1 (the Pitch Tuning control) to its middle position.

2. Grasp and hold the pitch antenna with one hand. With the other hand, adjust L6 until the beat frequency is zero. Then carefully turn L6 *counterclockwise* until you hear a pitch of about 3 kHz (3½ octaves above middle C).

3. Let go of the pitch antenna. Slowly retract your hand from the vicinity of the antenna. You should hear the pitch go down.

4. If the pitch does *not* go down to zero when you've retracted your hand completely and stepped back, the inductance of L5 is set too high. Advance the slug in L5 *clockwise* by a small amount, perhaps 1/10 turn or so, and repeat steps 2 and 3.

WHERE TO GET PARTS AND MATERIALS

Most of the electronic parts for this project can be purchased from Digi-Key (tel. 800/344-4539 or 218/681-6674; fax 218/681-3380; Web http://www.digikey.com). Other suppliers include Allied (tel. 800/433-5700 or 817/595-3500; fax 817/595-6404; BBS 800/433-5003; Web http://www.allied.avnet.com), Mouser (tel. 800/346-6873 or 817/483-4422; fax 817/483-0931), and Newark (tel. 800/463-9275 or 312/784-5100; fax 312/907-5378). Radio Shack is a good place to shop for prototyping boards. You should be able to get wood for the cabinet and all the materials to make the antennas at your local hardware superstore.

A complete kit and many of the individual parts are available from Big Briar, Inc. (tel. 800/948-1990 or 704/251-0090; fax 704/254-6233; e-mail bigbriar@aol.com). The kit includes an assembled and tested circuit board (with antenna circuits), completely fabricated front panel and antennas, and precut cabinet parts. Also included are *The Complete Theremin Video* starring Lydia Kavina, Clara Rockmore's *The Art of the Theremin* CD, and Bob Moog's detailed and illustrated booklet on theremin technology and history. The price of the kit is $229, including shipping within the United States.

5. If the pitch goes to zero and then begins to ascend as you retract your hand, the inductance of L5 is set too low. Turn the slug in L5 *counterclockwise* by a small amount, and repeat steps 2 and 3.

6. If the pitch jumps abruptly as you retract your hand, the inductance of L5 is set far too low. Turn the slug in L5 *counterclockwise* approximately a quarter-turn and repeat steps 2 and 3.

Eventually, you will converge on the proper settings for L5 and L6. The idea is to find the settings at which the frequency (a) is zero when you've stepped away from the theremin, (b) begins to ascend when your body is about two feet from the pitch antenna, and (c) reaches about 3 kHz when your hand touches the pitch antenna. Tap lightly on L5 and L6 as you converge on the proper settings, which will stabilize the tuning-slug positions.

This completes the tuning of the pitch oscillators. In performance, the exact tuning is established by adjusting the pitch-tuning control (P1).

Now, remove the temporary ground connection to pin 12 of U3. Connect a voltmeter from pin 12 of U3 to ground, install the volume antenna, and connect the volume-antenna circuit card between the antenna and the main board. Follow these steps to adjust L11:

1. Set P2 to its mid position.

2. Carefully turn the slug in L11 *counterclockwise* until it is out as far as it will go. The meter should read about -12V.

3. Slowly turn the slug *clockwise*. At some point, you will see the voltage begin to rise from -12V. Stop when the voltage passes through 0 and becomes positive. At this point, bringing your hand near the volume antenna lowers the voltage; the meter should read about -12V when your hand is two or three inches from the volume antenna.

This completes the tuning of the volume oscillator. In performance, the exact volume is established by adjusting the volume-tuning control (P2).

PLAYING THE THEREMIN

You are now ready to try your theremin. Place the instrument (with antennas installed) on a microphone stand that is set about 40 inches high. Connect a small monitor amplifier and speaker to J1 and the 12 VAC wall-wart power adapter to J2. Turn on SW1 and touch the pitch antenna. Set P2 so the tone is loud when your left hand is well away from the volume antenna and the volume begins to decrease noticeably when your left hand is brought within ten to twelve inches of the volume antenna. Then set P1 so the frequency is zero when your right hand is well away from the pitch antenna and the tone becomes apparent when you bring your right hand within 18 to 24 inches of the pitch antenna. Your instrument is now ready to play.

As with any expressive musical instrument, playing the theremin takes some practice. You can start by following these simple exercises:

1. Stand slightly left of the center of the instrument with your right shoulder about 24 inches from the pitch antenna. Relax your wrists. Think of a note and hum it to yourself. Then move your right hand toward the pitch antenna until the theremin pitch coincides with the pitch you're humming. Now hold the note. This is not as easy as it sounds, but it's an important technique to learn. At first, you will find it difficult to stand still, but a few hours of practice will work wonders.

2. Hum two different notes, one after the other. Find the first note on the theremin, hold it, and then slowly glide to the second note.

3. Repeat the above exercise, but bring your left hand near the volume antenna while your right hand glides from one note to the next. Move the left hand slowly at first and then more rapidly as you learn to move your left hand independently of your right hand. This exercise teaches you to "feel" where the notes are and to impart expressive dynamics.

4. While playing a note, introduce vibrato by moving your right hand back and forth from your wrist several times a second. Concentrate on making the vibrato even and steady.

These exercises address the basic skills of theremin playing: finding notes, playing intervals, articulating notes, and introducing vibrato. With these basic skills, you can play slow melodies. Practicing regular scales and arpeggios will increase your proficiency. Focus on accuracy of pitch and precise control of dynamics.

Once you've mastered the basic moves, it's time to develop your own style. Pay particular attention to shaping envelopes and dynamics with your left hand. The left hand can also be used to articulate discrete notes by momentarily dipping into the volume antenna as the right hand quickly moves from one pitch to another. Try combining audible glides and discrete pitch changes within a musical phrase. In addition, avoid constant vibrato in the right hand. Instead, impart expressive nuance by shaping the amount and rate of vibrato. These considerations are important components of theremin musicianship.

The theremin presented here is designed to meet the needs of musicians who wish to explore the artistic resources of this unique instrument. Build your instrument carefully, and it will provide many years of reliable service. Practice with diligence, and you will provide enjoyable music for yourself and your audiences. Finally, be sure to give an occasional thought to the spirit of Leon Theremin, to whom we owe so much.

Robert Moog *was a pioneer in the early development of commercial synthesizers and currently serves as Grand Poobah of Big Briar, Inc.*

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Interactive Resumes

Open your Windows and put some life into your life's story.

By Scott R. Garrigus

Multimedia musicians should *never* stray too far from the cutting edge. So if you're still hawking your scoring talents with archaic cassette demos, please stop. Right now.

Although the conventional demo package remains a viable means of presentation, it's hardly bustling with pizzazz. An interactive resume is a much hipper way of introducing yourself to multimedia producers, agents, and label executives who are seeking innovative artists. Why sell yourself into the "pass" bin with a static paper biography when you can make your career come alive with hyperlinked text, sound, graphics, and even video? Get with the program and prove to your future employers that you understand the promise of the multimedia industry by *using* the medium.

You don't have to be a major tech head or code writer to produce an interactive resume. If you've mastered sequencing, basic multimedia authoring shouldn't cause you to panic. Just fasten your seat belt and follow my lead. I'll walk you through the production of my own interactive resume on the Windows platform.

FIG. 1: The opening page of author Scott Garrigus' interactive resume.

STARTING FROM SCRATCH

Because my petty-cash account (a plastic toy safe filled with change) couldn't fund a CD-ROM venture, I decided to use the 3½-inch floppy disk as the storage medium for my resume. Floppies are compact and easy to mail, and they usually cost less than 40 cents each. Unfortunately, they are only capable of holding approximately 1.4 megabytes of data. Considering the vast sizes of most graphic and sound files, this isn't a lot of space. So with memory conservation as a major consideration, it was essential to find an authoring tool that would occupy tiny chunks of disk space. I chose Windows Help.

WinHelp, which is a standard feature of the Windows operating system, is a

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Polyphony	28	32
Parts	16	16
Keyboard Modes	Dual, Split and X-Dual	Combi
Wave Memory	8 Mbyte	6 Mbyte
Tones	338 preset 256 user	128 preset 100 user
Rhythm Kits	16 preset 20 user	8 preset 0 user
Arpeggiator	Multifunction	No
Realtime Controller	PB/Mod lever, 2 sliders	PB/Mod wheels
Computer Interface	Yes	Yes

Prices and specifications may vary. Specifications drawn from manufacturer's literature or customer service personnel.

Roland Corporation U.S., 7200 Dominion Circle, Los Angeles, CA 90040 (213) 685-5141
Roland Canada Music Ltd., 5480 Parkwood Way, Richmond, B.C. V6V 2M4 (604)270-6626. COMPUSERVE℠ GO ROLAND

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hypertext environment used mainly to provide online documentation for Windows-based software programs. However, the program also has support for graphics, sound, and video (depending on the configuration of the host system), and any PC running either Windows 3.1 or Windows 95 can read WinHelp files.

But the primary reason for choosing WinHelp was that it uses precious little disk space. Other, more powerful authoring tools—such as Macromedia *Director* and Asymetrix *Multimedia ToolBook*—require a run-time (or player) program to play back any files created with them. The run-time program must be included with your multimedia production, which means valuable disk space is sacrificed simply for playback. Because WinHelp's player is already built into the Windows OS, it frees up space for actual content.

The essential tools used to create a WinHelp production are an HPJ (Help Project) file, an RTF (Rich Text Format) file, the HAG (Help Authoring Guide), the HCP (Windows Help Compiler), and any word processor that supports the RTF format. Everything you need to know about constructing a project is included in the HAG and HCP, both of which can be downloaded for free via the Internet (see sidebar "Tools of the Trade"). However, WinHelp rules and commands can still be rather unwieldy, so I opted to produce my resume with the aid of a development tool.

ForeFront's *ForeHelp* let me develop WinHelp files in a WYSIWYG (What You See Is What You Get) environment, much like a conventional word processor. Without this tool, I would have been forced to input a slew of arcane commands and work directly with HPJ and RTF files. *ForeHelp* automated the authoring process to the point where I never had to look at an HPJ or RTF file or type command strings. I could build my resume graphically and actually see the elements come together as I assembled them.

▼ WinHelp was the best choice for an authoring tool because it uses precious little disk space.

POINTS OF INTEREST

The four basic components of a WinHelp file are the topic, pop-up, jump, and macro. Topics are the main elements of a WinHelp file. One topic is always designated as the Contents Topic, and it is the first screen that the user sees when a WinHelp file is opened.

I wanted a graphical overview of my resume for my opening topic (see **Fig. 1**), which required inserting a picture. Using *ForeHelp*'s Text Insert Picture command, I imported a picture file (CONTENTS.BMP) into the WinHelp file.

WinHelp accepts three types of graphics files: Windows Bitmap (BMP), Windows Meta File (WMF), and Segmented Hypergraphic (SHG). A Segmented Hypergraphic is actually a converted BMP or WMF, but it has one very important difference: an SHG file

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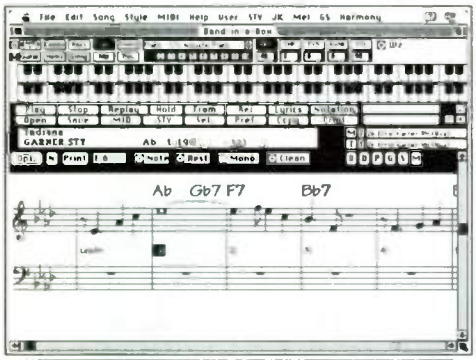

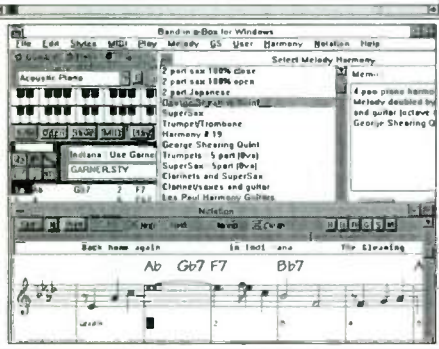

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MEMORY REQUIREMENTS: DOS (640K), Windows (3mb), Macintosh (4mb), Atari (1040)

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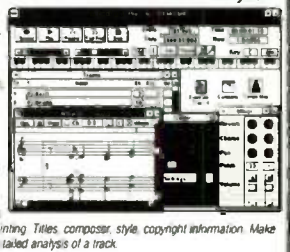

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***POWERTRACKS FOR DOS VERSION INCLUDED FREE.** Yes! We include the DOS version for FREE in the same package. NOTE: The DOS version doesn't support music notation, or other graphical features.*

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***MACINTOSH** versions require 2mb RAM, system 6 or 7*
***ATARI** versions require 1040ST or better*

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allows the inclusion of hotspots (or hyperlinks) within the picture. Another bonus of SHG images is that they support 256 colors within the Windows default color palette; WinHelp can usually only import 16-color images. In order to create an SHG you need a Segmented Hypergraphic Editor (SHED), which is included in *ForeHelp*. You can also download a freeware version online (see sidebar "Tools of the Trade").

I wanted to include hotspots in my picture file to direct viewers to more information about me and my work. Using *ForeHelp*'s SHED, I created hotspots on the imported Contents graphic by simply pressing the left mouse button and drawing a rectangular outline around each area of the picture where I wanted to place a hotspot.

I wanted my first hotspot, Education, to access a pop-up screen because I was only going to display a small amount of information. To create the pop-up, I selected one of the rectangular outlines I had made in the SHED and clicked on *ForeHelp*'s Text Make Pop-Up command. This automatically created a pop-up screen into which I typed the information I wanted to be displayed (my college education). That's basically all there was to it. Whenever a user clicks on the Education hotspot, the pop-up screen will appear.

I decided to make my Work Experience hotspot a pop-up screen as well, but I added a bit of a twist. Instead of just displaying information, the screen would also display a menu of jumps that lists my past and present occupations on which the user could click to get more information (see **Fig. 2**). A jump is just what it sounds like: clicking on a jump hotspot makes WinHelp "jump" to the selected screen (or topic). To create the list of topics for the Work Experience Pop-Up, I typed in each of my occupations on separate lines and highlighted them with the mouse just like in a word processor. Then I chose the Make Multiple Jumps option in the Text menu, and *ForeHelp* automatically created new topics for each entry in the list.

FIG. 2: The Work Experience Pop-Up offers "jumps" to more in-depth information on each project.

MAKING BOBBY BIGGER

One of my past projects was producing music and sound for a shareware game titled *Bobby's Big Adventures* (Valley ComputerWorks). For this entry in my Work Experience Topic, I desired more than just a text explanation of the gig. I wanted the user to be able to see some colorful screen shots from the game and hear samples of the sound effects and music (see **Fig. 3**).

Producing the text was just a matter of choosing the fonts, typing in the information, and formatting the words as boldface, italic, and/or underlined. Obviously, this procedure is no different from using any word processor, but I made sure to use only standard Windows fonts—such as Times New Roman—so that the text would display correctly on all PCs.

Importing the screen shots from *Bobby's Big Adventures* was also a snap. I just imported the images the same way I produced the Contents graphic with *ForeHelp*'s Text Insert Picture command. Although there would be no hotspots within the screen shots themselves, I still imported the screens as SHG images because these take up less space than images saved in the other available graphic formats. Saving space here ensured that I had ample room for sound.

For each of the sound-effects hotspots, I typed some text describing the sound and highlighted the text. Then I used *ForeHelp*'s Text Make Macro command to assign a macro to the selected hotspot. Macros are special functions built into WinHelp that are used to add options to WinHelp files, one of which is the ability to play sound files in the Windows WAV format. To produce my sound-playback macro, I had to register the sound-playback function with a Dynamic Link Library (DLL) file, MMSYSTEM.DLL, which Windows uses to control all of its multimedia functions. This required using a RegisterRoutine (RR) Macro as follows:

```
RegisterRoutine(`mmsystem.dll',
`sndPlaySound',`Su')
```

The first parameter in this example tells the RR Macro which DLL file to access in order to register the function sndPlaySound (which is also the second parameter listed). The third parameter, Su, specifies the formats that

TOOLS OF THE TRADE

Here is contact information for some of the products I used when producing my interactive resume:

ForeFront, Inc. (*ForeHelp* 2.0 WinHelp authoring tool) tel. (303) 499-9181; fax (303) 494-5446; e-mail support@ff.com

Syntrillium Software Corp. (*Cool Edit* 1.50 sound-file editor) tel. (602) 941-4327; fax (602) 941-8170; e-mail syntril@aol.com

Ulead Systems, Inc. (*MediaStudio Pro* 2.0 multimedia tool kit) tel. (310) 523-9393; fax (310) 523-9399; e-mail debbye@ulead.com

WinWare, Inc. (*Visual Help Pro* WinHelp authoring tool) tel. (714) 586-4492; fax (714) 586-9792; e-mail 70272.1656@compuserve.com

For WinHelp tips, the following information is available online:

Help Authoring Guide (HAG.ZIP) and Segmented Hypergraphic Editor (SHED.ZIP) Web http://www.microsoft.com or ftp.microsoft.com

Paul Arnote's WinHelp World (WINAPI3.ZIP) Web http://www.sky.net/~parnote/

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Front Row Left to Right:
A-206; QL-640; A-343; BS-619; QL-691; Z-725

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But don't just take our word for it, listen to what the experts are saying. Such as EQ Magazine, "*Sound quality that's better than expected for the price... smooth reverbs, digital clarity but with a warmth that sounds distinctly undigital.*"*

Yes, the Sony HR-MP5. It's versatile, convenient, affordable, and great sounding. In conclusion, allow us to leave you with some quotes from Keyboard Magazine, who wrote, "*...clean and smooth presets...the display is big, bright and packed with information ...friendly, easy-to-understand icons at every turn...this user interface is one of the best we've seen,...A+ for Sony.*"**

What more can we say? For more information, call 1-800-635-SONY, ext. MP5.

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*"EQ, August 1994." **"Greg Rule, Keyboard Magazine, April 1995."

command. The second command plays the MIDI file and waits until it is finished. The third command closes the MIDI file and allows the user to continue exploring the rest of the resume.

FINISHING TOUCHES

After the sound and music files were finished for my Work Experience Topics, I created my remaining topics: Personal Organizations and Achievements and Contact Information. I also added one last Project Macro. This macro added a jump shortcut to the WinHelp button bar (which is available at all times), providing instant access to the Contact Information Topic from any area of my resume. This type of command required a nested macro:

```
CreateButton(`BTN_CONTACT',
`Contact &Info',`JumpId(`',
`Contact_Info')')
```

The first command is the button ID that WinHelp uses to identify the button, the second command is the text that appears on the button, and the third command is the macro that tells WinHelp to jump to the Contact Information Topic.

FILE EXIT

When I was satisfied with the contents of my resume, I activated *ForeHelp*'s Build process, which automatically creates the necessary HPJ and RTF files needed to compile the final WinHelp project file. Then I copied the file, along with all the necessary WAV and MIDI files, to a diskette using Windows File Manager. I printed a nice little label and—presto—an interactive resume was born!

By watching my disk space and planning out my graphic and sound elements, I was able to fit a pretty fine interactive experience onto a common floppy disk. And trust me, multimedia presentations soar above the conventional paper resume. There's really no contest. If you want to snatch those lucrative multimedia gigs, it pays (literally) to meet the industry on its own terms. Showcase your talents with an extravaganza of audio and graphics and stop being so one-dimensional!

Scott R. Garrigus *invites readers to check out the rest of his interactive resume by downloading it from his homepage at http://users.aol.com/scottg68/.*

RECORDING MUSICIAN

One Room

Don't let space limitations spoil your shot at a Grammy.

By Brian Knave

Most personal and project studios are loaded with racks of hip gear; usually it's the physical space that's scarce. Yes, for many of us, a single recording area does triple duty as a live studio, isolation booth, *and* control room.

Now, four walls are plenty if all the sounds you work with are stored in samplers and sound modules. But if you record live musicians, the headaches and limitations of the one-room recording studio are legion. The recordist must battle noisy equipment, ambient noise, sound bleeding into mics, and the fact that he or she can't move or even breathe while the Record button is engaged.

Fortunately, many of these problems can be easily overcome, and you can transform one room into an extremely viable tracking environment. You don't need to lock out Studio A, B, and C at a large commercial facility to produce clean, quiet tracks that bristle with personality and punch. You do, however, need to approach recording in a single room with some preparation, ingenuity, and an open mind. There *will* be compromises, but if everything works out, you'll be the only one able to identify them.

LEE SANFORD

When the Rembrandts recorded their debut album in a bedroom, they used mattresses for sound absorption to silence the squeaks and rattles from a reel-to-reel multitrack.

POWER DOWN

In pro recording studios, the whir of tape transports, power-amp fans, and computer hard drives is not audible beyond the sealed confines of the control room and machine closets. But in the one-room studio, the sounds of all these motors and circuits, however subtle, are sure to find their way onto your tracks. One easy solution is to turn off every piece of gear that isn't required for a given track.

For example, your power amp doesn't have to be on while you record because you can monitor through headphones. For solo recording sessions or individual overdubs, you can use the headphone outputs on your mixer, but when recording an entire band, you'll need a

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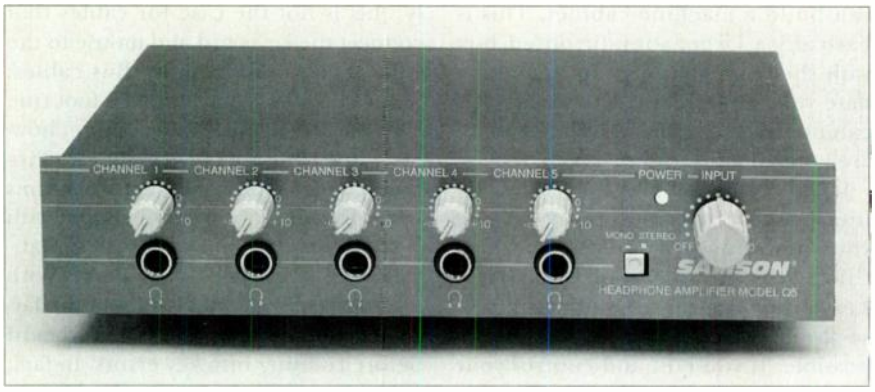

FIG. 1: A headphone distribution amp, such as the Samson Q5 pictured above, is a necessity when recording bands in a one-room studio.

headphone distribution amp (see **Fig. 1**) to handle multiple headsets. These are available commercially, or you can construct your own. (See "Build the EM Headphone Distribution Amp" in the December 1992 **EM**.) A cheaper solution is to use a stereo splitter box, but this is practical only when you can get by without individual volume controls for each musician.

To seek out which pieces of gear are best eliminated during tracking, listen through headphones as you switch off each unit. It should be easy to determine how much noise a particular device contributes to the system. If you don't need the noisemaker, shut it down. But beware: sometimes results run contrary to expectation. For example, you may shut down a rack-mounted processor only to hear noise levels *increase*. This would most likely indicate the existence of a ground loop somewhere in the rack. (For more information on grounding problems and contaminated AC, see "On Solid Ground" in the September and October 1992 issues of **EM**.)

Once you've identified the expendable processors, dedicate a power strip to them so you can eliminate a rack full of potential noise with the simple flip of a switch. Power strips also allow you to shut off units that don't have on/off switches.

SQUELCH IT

Of course, one piece of gear you won't be shutting off is the recorder itself. With multitrack cassette recorders, not only are transport motors often audible, but cassette tapes frequently squeak or rattle while being played. A simple remedy to this problem is to place a small pillow or folded towel over the unit's cassette tray once the tape is loaded. For a noisy ADAT or DA-88, try taping a pillow over the tape-load door. However, do not cover the tape-load door if your DA-88 is rack-mounted, because the DA-88 vents through the tape door when its side vents are obstructed.

Unfortunately, a rumbling reel-to-reel deck is not so easily subdued. The Rembrandts, who recorded parts of their debut album in a bedroom, had to construct a barricade of mattresses to stifle the bleating of their ancient Fostex B-16. Whatever measures you take to mute the subtle din of equipment, it's a good idea to record a bit of "room silence" afterward, to determine whether any equipment is still audible during playback.

DRIVE RACKET

By far the biggest noisemaker in home studios is the computer. It is also the most difficult to silence. Obviously, you can't shut down your computer if you're playing back a sequence or recording directly onto the hard drive. The best solution is to relocate the CPU and any outboard hard drives into a ventilated closet, leaving only the monitor, keyboard, and mouse on your desktop. It is important, however, that the closet be ventilated to an area *outside* your studio so noise doesn't leak back into the room. If there isn't a closet nearby, you can build a machine cabinet. This is basically a large, soundproofed box with shelves big enough to accommodate your equipment. Of course, this cabinet must also be ventilated to an area outside the studio.

If you decide to build a machine cabinet, make it big enough to enclose your power amp, samplers, and anything else with a fan or disk drive. Leave room for any SCSI devices, too, so the SCSI chain is kept as short as possible. If you edit and control your synths and signal processors with software or MIDI controllers (such as fader boxes), you can stash the synths and processors in the cabinet, as well. However, if you take this route, beware of unacceptably long, high-impedance, audio-cable runs.

Another solution—which entails boring holes through your walls—is to put your CPU, disk drives, and all the rest in an adjacent bedroom or hallway closet. (Don't forget to keep audio cables separated from data and power cables.) You can usually run serial and monitor cables up to 300 feet. Unfortunately, this is not the case for cables that connect the keyboard and mouse to the CPU. For Apple Desktop Bus cables, Apple specifies a maximum 50-foot run. This may be a conservative figure, however. Russell Bond of Digital Audio Productions in Cupertino, California, runs his ADB cables more than 70 feet with no modification and no loss of signal.

IBM PC users are not so lucky. With standard cable, ten feet is about the farthest away you can locate your keyboard before running into key errors. In fact, IBM supports only the standard 3-foot cables that come stock with their computers. If you need longer cable runs, Network Technologies Incorporated (tel. 800/742-8324 or 216/562-7070; fax 216/562-1999) makes various hardware boxes that allow you to extend a keyboard, monitor, and mouse up to 250 feet from your Macintosh and 500 feet from your PC.

HOT SEATS

Other sounds to be on guard against come from noisy furniture and the need to occasionally shift in one's seat.

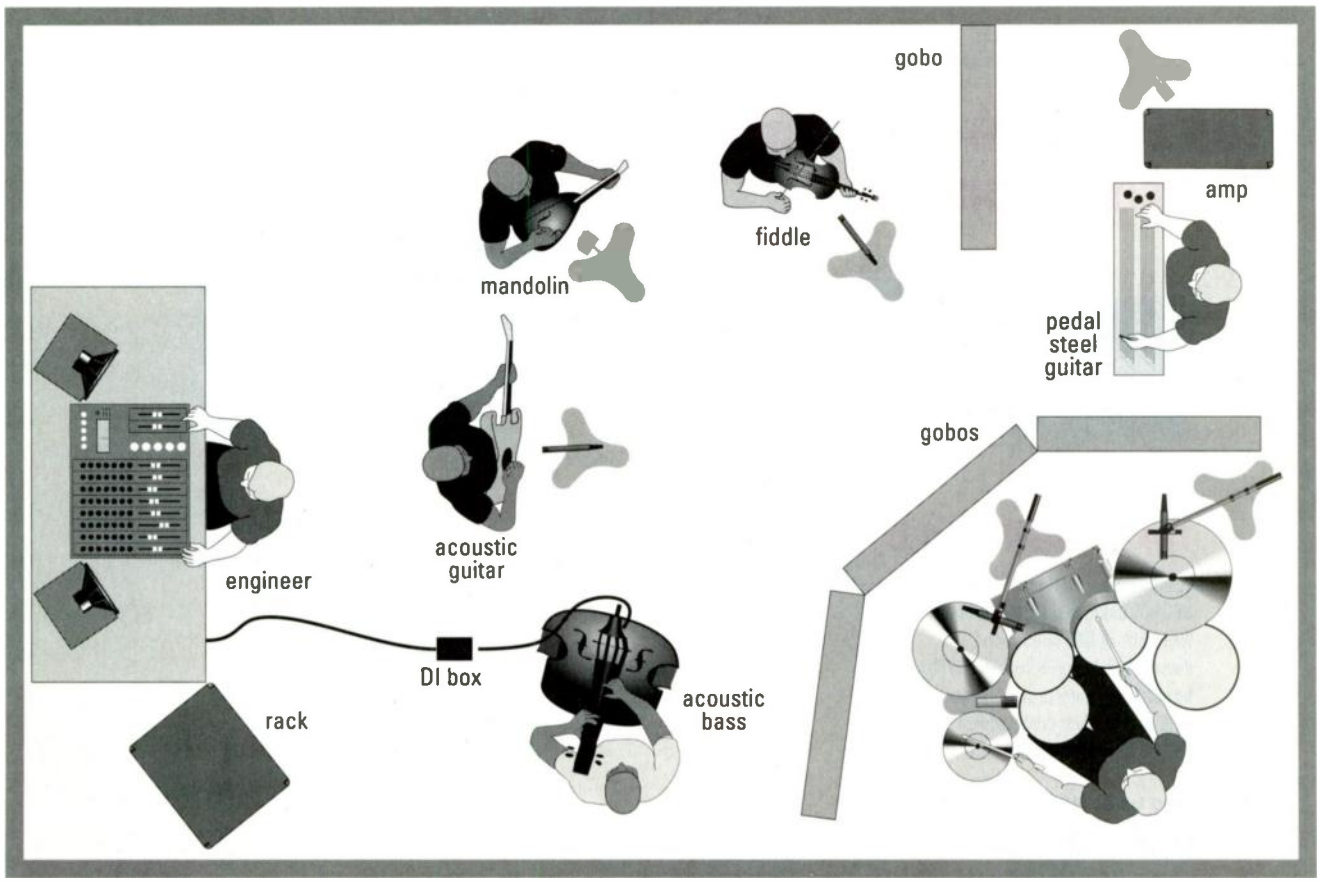

FIG. 2: Recording acoustic instruments and live drums in a one-room studio can be very challenging. Pointing the microphones away from the kit and using cardioid patterns help decrease the level of drum sounds that leak into the instrument mics. Well-placed gobos can further diminish mic bleed.

There's nothing more frustrating than having a dazzling acoustic-guitar track spoiled by a creaking chair. You may have to audition several seats before finding a quiet one. When I record musicians who typically sit to perform, such as string players, I put them on stools or well-lubricated drum thrones. Finally, when it's time to roll tape, be sure you are comfortably situated and quiet in your seat, with hands ready on the faders.

CIRCUITRY

Ideally, home-recording gear should be plugged into its own electrical circuit, free from the energy drain and potential noise introduced by household appliances. If you are serious about your productions but don't have an isolated circuit for your equipment, hire a qualified electrician to install one.

If you live in an apartment where rewiring is out of the question—or if you are a songwriter with a 4-track cassette recorder who just wants to reduce noise cheaply and easily—your best bet, again, is to power down. This time, however, it's the *apartment* that you're switching off. It's okay to leave small things like electric clocks and incandescent bulbs on, but make sure that major appliances, fluorescent lights, and dimmer packs are turned off while you are recording.

Of course, even if your AC is squeaky clean, the sound of a refrigerator motor kicking on in the next room can spoil a pianissimo flute passage. It may seem like a drastic measure, but until your walls are soundproofed, you might want to get in the habit of unplugging the refrigerator, water heater, and/or air conditioner immediately before you start recording.

Needless to say, if your recording space is not acoustically isolated from the rest of creation, your condenser mics will document leaf blowers and low flying helicopters as well as your Martin guitar. In this case, your best bet may be to wait until the wee hours to record critical vocal and acoustic-instrument tracks.

For information on how to soundproof your one-room studio, check out "Sound Sanctuary" (in the June 1991 issue of **EM**) and "The Taming of the Room" (August 1991) by Peter Elsea. You can also call Mix Bookshelf (tel. 800/233-9604 or 908/417-9575) to order a studio-design manual.

MIX FIXES

Some sonic aberrations can be successfully treated in the mix. For example, let's say you finally drag a stellar vocal take out of a singer, only to discover a low-frequency hum when you critically audition the track. On top of that, you hear the singer's feet shuffling between verses.

Luckily, a few careful tweaks of a graphic or parametric equalizer can locate and cut the frequency of the hum without sacrificing the quality of the vocal track. In addition, a noise gate can cut out the singer's little tap-dance recital—as well as any coughs or rustling clothes—between vocal passages. If the shuffling is still audible during the vocal, try using an expander to diminish the level of the singer's dancing feet. Provided that the foot sounds are at a lower signal level than the voice, you should be able to dial in a threshold that "pulls" the shuffling

far enough below the vocal to mitigate the distraction.

If you don't have a gate or expander available, it pays to take the time and trouble to erase all the noise between performances. Be careful, however, as you don't want to erase part of an incendiary vocal or guitar solo along with the noise. Timid recordists should just clean the track up to five or ten seconds before a performance begins. Any additional noise can be killed with manual muting during the mix. Of course, if you're lucky enough to have an automated mixing system, simply program your mutes so that each track is silenced until the exact point where a performance kicks in.

PLAN YOUR TRACKS

Mic leakage is a fundamental problem in one-room studios, but you can keep things clean with judicious use of headphones, overdubs, and scratch tracks. For example, let's say you're doing a demo with acoustic guitar, rhythm and lead electric guitars, bass, keyboards, acoustic drums, and vocals. For the first pass, simply ensure that the drums are the only live instrument in the room. Run the bass, electric guitar, and keyboards direct into the board. The goal is to record the final drum, bass, and keyboard parts (though bass and keys can be re-recorded if necessary); the guitar part is intended only as a scratch track to cue the musicians.

After tracking a smoking rhythm track, overdub the acoustic-guitar part. Now, mic the guitar amp and record over the original scratch guitar track. Finally, record the lead and backup singers—one at a time or together—saving the lead guitar track for last so the soloist can play off the vocal melody.

Obviously, a well-rehearsed rhythm section is essential to this style of recording; the musicians need to know the song well enough to perform confidently *without* a vocal cue. I usually set up lyric sheets for each player, and, if necessary, have the singer silently mouth the words for everyone to see. This type of overdub approach allows complete track separation yet maintains a realistic band sound.

Some artists, of course, dislike overdubs. But this doesn't mean you can't record them in a one-room studio. One of the most difficult sessions I engineered was for an acoustic country/bluegrass group *with drum set*. The other instruments were acoustic guitar, upright bass, mandolin, fiddle, and pedal-steel guitar—all of which were crowded into my 10-foot by 14-foot studio. Leakage was a given; the question was how best to minimize it.

Fortunately, I was able to persuade the bandleader to overdub the vocals after the band tracks were recorded. It also proved necessary to use a pickup for the acoustic bass. Happily, because the acoustic bass was audible in the room, the musicians didn't have to wear headphones.

The most critical task was isolating the drums from the other room microphones. I took advantage of cardioid, supercardioid, and hypercardioid mic patterns to reject as much drum sound as possible (see **Fig. 2**). I used AKG C 460 condenser mics on the guitar and fiddle and an AKG C 414 on the mandolin, which I placed farthest from the drums. I faced the pedal-steel amplifier into a corner and miked it slightly off-axis with a Shure SM57. The drums were miked with an SM57 on the snare,

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Frank Serafina, Sound designer on Star Trek, Virtuosity, Lawnmower man, VR5, Hunt for Red October.

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an AKG D 112 placed inside the kick drum, and two AKG C 451s employed as overheads. To increase isolation, I arranged gobos around the drums and pedal-steel amp. I also further isolated the bass drum by shrouding it—and the D 112—with a heavy blanket.

Despite all the precautions, the drums were still audible on the guitar, fiddle, and mandolin tracks. Now, there's nothing inherently *wrong* with mic bleed. For this bluegrass session, the drum bleed actually added a nice natural room sound to the final mix. However, mic bleed can hamper stereo placement (the signals smear into the right and left channels) and signal processing (a reverb used on one track will also be audible on whatever other signals are leaking into the microphone). You be

▼

Nothing is more frustrating than a dazzling acoustic-guitar track spoiled by the creaking of a chair.

the judge. If you determine that *any* amount of mic leakage will compromise your tracks, you may have to book time in a professional studio with multiple rooms to get the strict isolation you desire.

FOUR WALLS

Okay, so you don't intend to record in one room for the rest of your life. Well, neither do I. But the next time a fit of control-room envy overtakes you, stop and think about all the great records that were made in one-room studios such as Stax, Sun, and Motown. Ultimately, it's not a spacious, well-equipped studio that makes a great recording: it's a pair of good ears and a bit of brain between them.

Assistant Editor **Brian Knave** *records and mixes in a soundproofed, one-car garage. He still hasn't explained to his landlady why his car is always parked on the street.*

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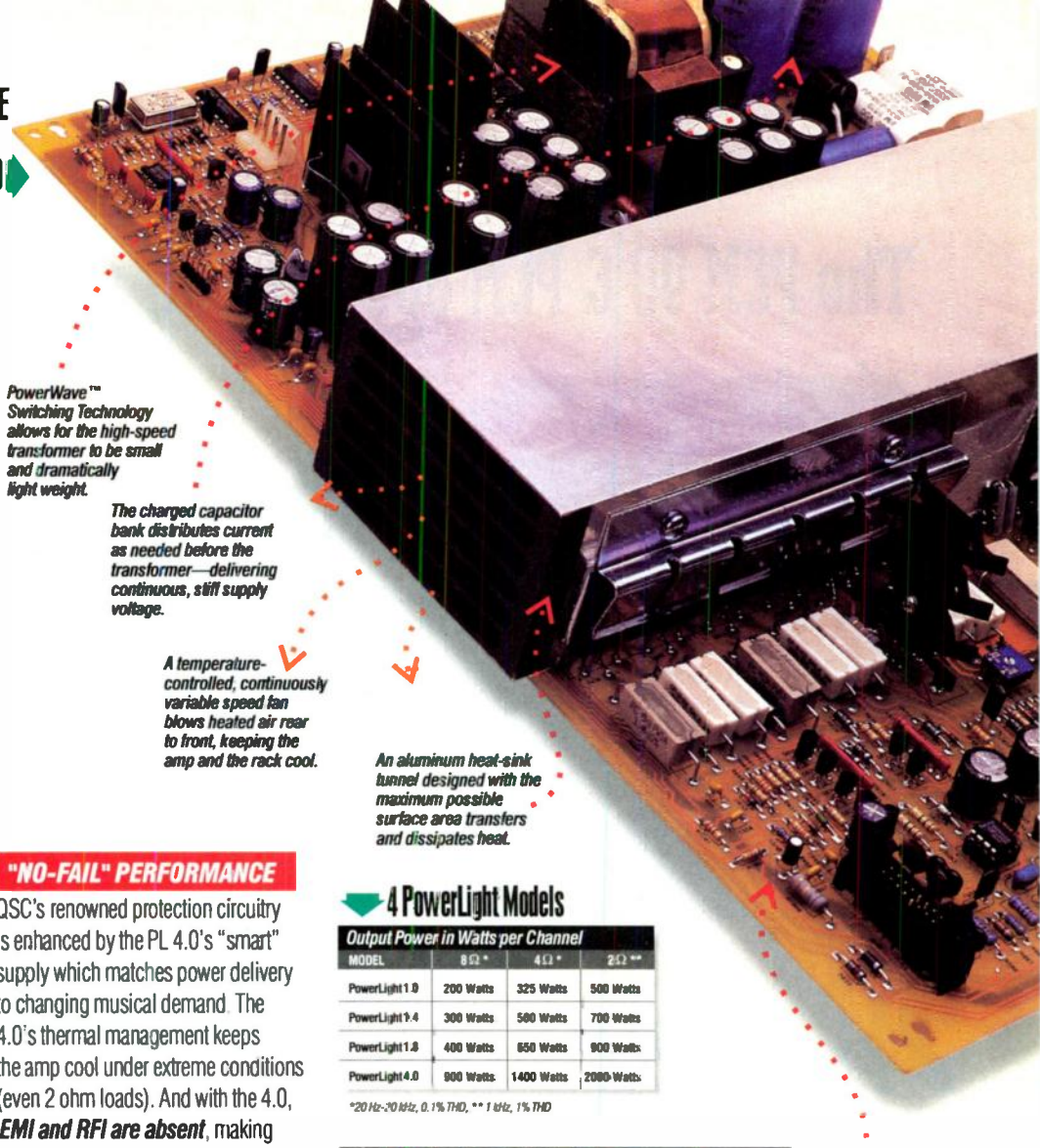

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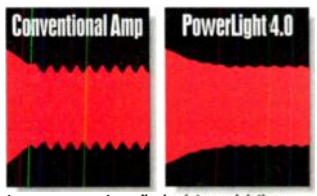

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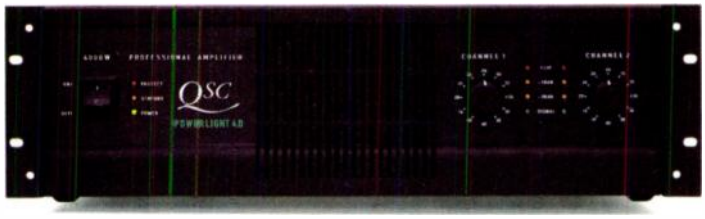

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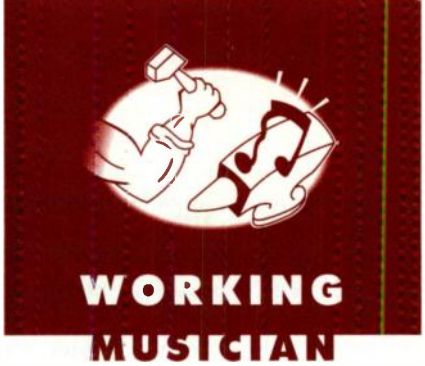

The Fine Print

Don't let dicey legal agreements haunt your indie release.

By Michael A. Aczon

After countless hours of writing, rehearsing, raising money, and recording, you're ready to hit the market with your independently produced album. You've already given careful consideration to the technical and creative aspects of your album, but have you accorded the same scrutiny to the legal agreements related to the production and release of the record?

Unless you happen to live on Mars, chances are that you worked with other people while making your album. Even if you recorded and produced the entire album yourself, you may have enlisted the aid of a graphic artist to design the CD cover or borrowed money to get the project off the ground. These contributors could lay legal claim to some of your album's profits. And don't forget that any samples incorporated into your production may put you at risk for copyright infringement. Securing all the proper legal agreements up front can save you from any nasty surprises in civil court.

Little Richard acted too soon when he sold off his catalog's publishing rights, which are now owned by Michael Jackson.

ESTABLISHING YOUR RIGHTS

The initial step in the legal process is filing an SR (Sound Recording) copyright registration form with the Register of Copyrights. This document establishes your ownership rights in the master recording, signifies your exclusive right to make copies and derivative works, allows you to play the record in public, and lets you deal these rights to others. Remember that the rights to the master recording are separate and distinct from any rights to the *compositions* used on the master. So if you also wrote all the songs, be sure to register those as well with copyright form PA. For forms call the Copyright Office hotline at (202) 707-9100.

PERSONNEL ISSUES

If you hire any artist to work on your album, a written agreement is a no-brainer. The following types of legal arrangements should be considered before you start recording.

Musician-release forms. These are releases that session musicians, background vocalists, and additional production personnel sign acknowledging that they have been paid for their services. The release also states that the individual has no ownership claim to the recording and that he or she allows you to use his or her name and likeness in connection with selling the record. Many records have been held up from release because hired contributors felt that their compensation was unfair or that they deserved royalty payments instead of a one-time fee for their services. Be forewarned that if your record is picked up by a major record label, the services of musicians or vocalists may come under the jurisdiction of the American Federation of Musicians' or the American Federation of Television and Recording Artists' collective bargaining agreements—regardless of the set fee you paid.

Independent-producer contracts. In today's music market, the career of a producer can be launched by the success of one act. Likewise, the success of an act can be launched by its alliance with a "hot" producer. Because of this, producer agreements are no longer the same as the musician contracts mentioned above. These agreements have evolved to full-blown negotiations over producer advances, royalties (also known as *points*) from sales of records, as well as what type, size, and frequency of credits the producer will receive in connection with the project.

Graphic artist/design agreements. This is a legal area that seems straightforward, but there are several aspects of the agreement you might not have thought about. Are you paying a flat fee for the design and production of the cover artwork for your project? Who eventually will own the artwork? Is the graphic artist doing the work as a "work for hire"? Can you use the artwork for posters, T-shirts, and other promotional materials? Can you alter the artwork? Be sure to address all of these issues at the outset of your collaboration with an artist or designer.

SONGWRITING & PUBLISHING

If any of the material on your release was written by a third party, whether or not they have previously recorded it, you are well advised to stick to the law regarding issues of copyright, mechanical licenses, and sample clearances.

Mechanical licenses. According to the copyright law, anyone wishing to include a musical composition on a medium that requires a mechanical device, such as a CD or cassette player, to play the song must obtain a mechanical license from the copyright holder. (A historical aside: The original mechanical device that prompted these licenses was the piano roll of yesteryear.) This mechanical license includes details such as the express permission of the copyright holder for the manufacturer and distributor to include the song on a release, the amount of royalty to be paid, and when it is to be paid. Accordingly, it is imperative that this license be obtained by you prior to release, especially if yours is the first recording of the song.

If you are covering previously released material, you can track down the copyright holder by checking out the publisher credit on the original album. You can also contact the research department of one of the major performing-rights societies, such as BMI or ASCAP, and request the current publisher of a song. BMI even has a homepage on the World Wide Web (http://bmi.com/) that lets you search through their 7.5-million-song database by title, writer, or publisher.

However, if the songs on your album are self-published, keep in mind that your rights as a publisher are separate from your rights as an artist and record company. It's good practice to issue a mechanical license from your publishing company to your record company. That way, if you license or sell off the rights to your record, your publishing and administration rights to the compositions will be clearly defined.

Sample clearances. The letter of the law is simple: Thou shalt not sample and make derivative works of others' copyrighted works without their express permission. Trade publications and legal journals are full of copyright-infringement cases involving multi-platinum-selling artists who have to pay out big dollars because they didn't bother to clear samples. Remember that clearing a sample requires the permission of two separate copyright holders: the owner of the copyright of the composition (a publishing company) and the owner of the copyright of the master (a record company).

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Article	Issue
"Comprehending Copyright"	February 1992
"Music Contracts"	June 1992
"Let's Make a Deal" (mediation and arbitration)	August 1992
"Performing Rights Societies"	October 1992
"Getting Down to Business" (legal issues in forming a band)	January 1993
"The Management Dossier" (personal managers)	April 1993
"Contract Combat"	November 1993
"Musical Monopoly" (how to finance your band)	February 1995
"The Face Behind the Curtain" (personal managers)	March 1995
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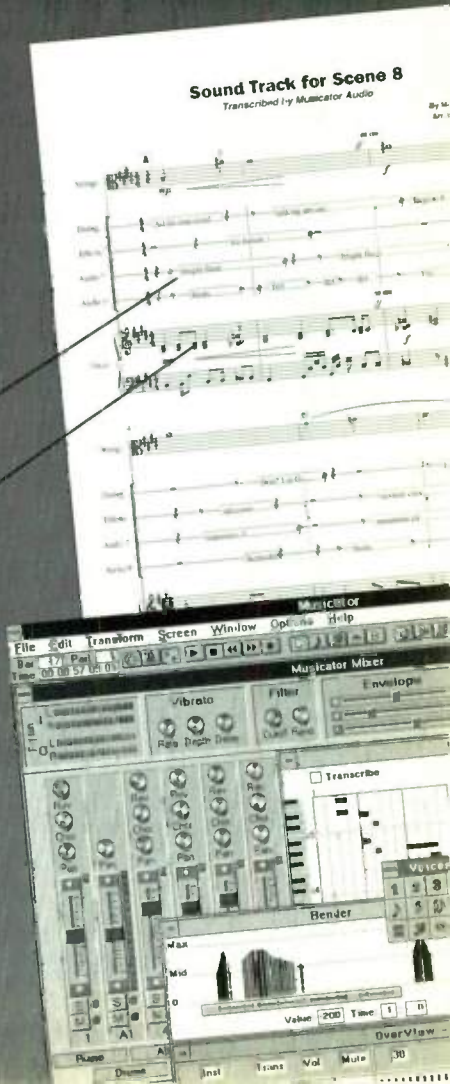

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A project can come to a standstill over the issue of whether the principals can agree to a 50/50 songwriting split instead of a 60/40 split.

In addition, many independent labels seek to participate in the publishing rights to songs. These valuable rights require publishing agreements that spell out what the publishing splits will be, who is entitled to administer those rights, and what should happen to those rights if the act subsequently takes off on a major label. Music history shows that the premature selling of publishing rights to independent companies in the early stages of a writer's career can result in a multimillion dollar return for major corporations later. In short, don't be pressured into signing a bad deal that may haunt you forever. The publishing rights that Little Richard sold off in the 1950s, for example, are still generating income for their current owner, Michael Jackson.

MONEY, MONEY, MONEY

Everything we've discussed so far has dealt with money: who gets how much and when. Now we need to deal with the procurement and disbursement of the green stuff itself. Investors and creditors may not contribute artistically to your project, but they do make it financially possible for you to record and release your album. And, more often than not, these folks aren't just doing this out of the goodness of their hearts. They want their cut, too.

Studio "spec" agreements. One of the most misunderstood and abused principles in the recording industry is the spec (short for *speculative*) agreement. Basically, these agreements allow an artist to use a recording studio and its personnel for cheap—or even for nothing—in exchange for payment later, when "something happens." It is wise to negotiate and agree upon specific occurrences and dollar figures, including the number of hours being allotted to the project, what the premium studio rate is going to be, and exactly what events trigger the eventual payment (e.g., a major label picks up the project for distribution).

Investment and/or loan agreements. When dealing with financial supporters—especially family, friends, and fans—be sure to secure written agreements that set forth the terms and conditions of the loan or investment. These agreements should include how the money will be used, what the repayment scenario will be, and what the risk is for the creditors/investors. Working out these issues before you go and spend the money is the best way to ensure a civil relationship if your record doesn't go multiplatinum as you promised it would.

If someone loans you money for your project, look at commercial loan rates (to determine a reasonable repayment rate), the sources you will be using to repay the money, and when you will be expected to pay back the loan. This way, the deal is more business-like and straightforward—which in the long run is a much less stressful scenario than dealing with excessively high loan-shark rates or relationship-testing "friend and family" rates.

AND SO ON

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and you've worked out your investor-repayment scenario. You're all set to release your record, right? Not so fast. You also need to consider the people who make it possible to get your music out to the masses.

Promotion agreements. In general, promoters work to generate sales for your record via retail, radio, and "street" promotions, such as fan clubs and other grassroots, go-out-and-get-your-audience schemes. They often do give-aways at concerts, clubs, schools, and anywhere else they can generate a "buzz" about an act.

When hiring an outside promoter, be very clear about the terms of your agreement. Important points of your agreement should include how long the promoter will work your record, what geographical region his or her efforts will encompass, what kind of reports you will be provided to help you track the album's progress, how involved he or she will be in scheduling promotions and tours, and what the fee will be for all of this work.

Agent agreements. An independent record is often released as part of a larger plan to get the attention of a major record label and secure a deal. Part of this process is hiring an agent to shop the deal for you. Decide the limits of the agent's authority, what his or her fee will be, and whether he or she will remain involved in your career after a major-label deal is made.

Lawyer-engagement agreements. With all of these contracts to be negotiated, you might want to consider hiring a lawyer. Lawyers can also take on the role of shopping deals, as described above. Fee arrangements range from hourly fees to working for a percentage of your record deal. Again, attention should be given to detailing the lawyer's duties and what any royalty percentages will be based on.

Band agreements. A difficult task is determining how the members of the act will be compensated when the record (hopefully) takes off. For example, are all the members of a group going to participate equally in the "record company" share of the release? Perhaps only one or two members have taken on the administrative and business responsibilities of getting the record out and expect to be compensated accordingly. And what if one of the band members owns the studio where the album was recorded? What happens with the

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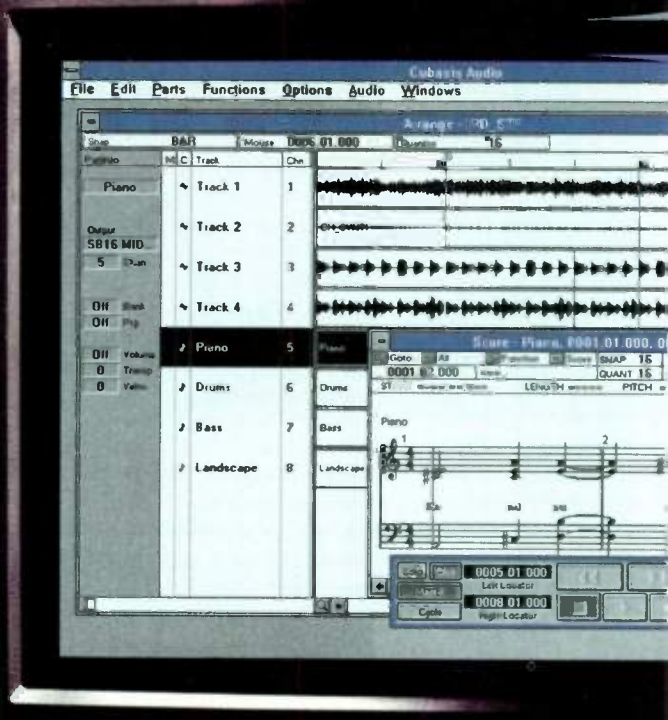

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royalties or the record company if the group breaks up? All of these details should be worked out by the group in band-partnership agreements.

Trademark issues. As you are probably distributing your record under a label name, it is important that releasing the record will not infringe upon any other company's trademark. If you receive a cease-and-desist letter from a company across the country and your record is only intended for a limited geographical release, perhaps you should consider negotiating a "use" license of the name for your specific purpose and geographical area.

License and tax issues. Depending on your local and state laws, you may be required to obtain a reseller's license in order to sell your product. Additionally, you may be required to charge and pay taxes for doing business as a record company. Any and all monies made from the sales of records are subject to federal, state, and local taxation, so be sure to keep your books accurate and stay on top of the appropriate laws. You should also familiarize yourself with the tax laws concerning the hiring of independent contractors (e.g., session musicians). You may be required to file federal tax forms, as the independent contractor is responsible for paying taxes on his or her income.

CHECKMATE

Daunting as it may seem, releasing an independent record shouldn't be a drag. If you are concerned about the amount of paperwork involved, retain the services of a well-trained entertainment lawyer (or other advisor) to handle the documentation of your various deals.

But if you want to extend the DIY approach to your deal making, just make sure you provide a detailed roadmap for future, more formal documentation by professionals. Simple written agreements that cover the major points I've discussed in this article should do the trick. By handling your business affairs with the attention and detail you give to your song arrangements and recording sessions, you can ensure that your deals will last as long as your masters.

When not tending to his law practice, San Francisco Bay Area entertainment lawyer **Michael A. Aczon** *listens to Beatles songs with his kids.*

SERVICE CLINIC

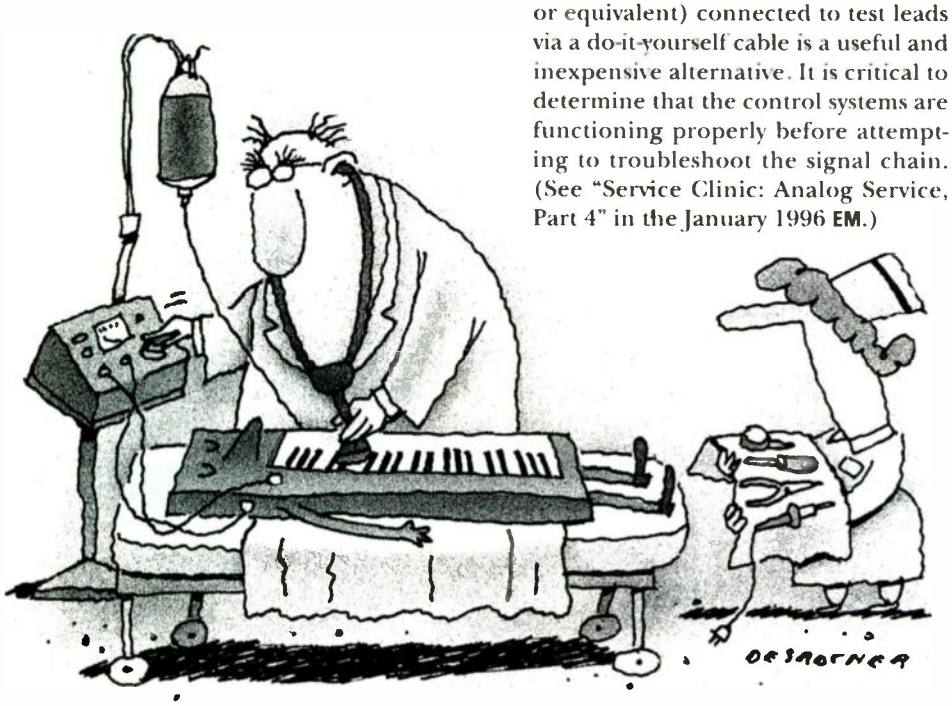
Analog Service, Part 5

Diagnostic tips for what ails your synth's signal chain.

By Alan Gary Campbell

Troubleshooting the signal chain (i.e., the audio sources, processors, and ancillary circuits) of an analog synth can be challenging, as several failure modes have similar symptoms. To help you comprehend the basic signal flow and control scheme, we return to the generic voice-architecture block diagram (see **Fig. 1**).

Signal tracing and analysis are greatly facilitated by an oscilloscope, but a simple, amplified, miniature speaker (Radio Shack catalog number 277-1008 or equivalent) connected to test leads via a do-it-yourself cable is a useful and inexpensive alternative. It is critical to determine that the control systems are functioning properly before attempting to troubleshoot the signal chain. (See "Service Clinic: Analog Service, Part 4" in the January 1996 **EM**.)



JACK DESROCHER

ENVELOPE GENERATORS

Proper VCF and VCA operation depends on envelope-generator operation, so the EG should be checked before other circuits are tested. Envelope-generator output can be monitored on an oscilloscope if the 'scope time base allows very low frequency measurements (more common on older, vacuum-tube, "room heater" designs, such as the venerable Tektronix 535), though it can be difficult to obtain sync. EG output can also be monitored using the DC volts function of a DMM or, better yet, using an FET-input analog voltmeter with a fast meter ballistic. Do *not* monitor EG output with a conventional analog multimeter or VOM. The comparatively low input impedance can affect circuit operation.

Most analog envelope generators are based on straightforward, resistor/capacitor timing circuits. The basic but fully functional attack/sustain/release (ASR) EG shown in **Figure 2** illustrates this concept. When the Gate goes high, C1 charges at a rate determined by the R/C time constant set by potentiometer R1. This provides the attack segment of the envelope and the familiar, logarithmic envelope shape. When C1 is fully charged, the output is constant. This provides the sustain segment of the envelope. When the Gate goes low, C1 discharges at a rate determined by the R/C time constant set by R2, which provides the release segment of the

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envelope. This is an entirely gate-driven circuit and therefore produces only single-trigger envelopes. When the gate is interrupted and then reinitiated, the attack segment begins at the current voltage level (if any), and the attack time is proportionately reduced.

Steering diodes D1 and D2 prevent interaction of the attack and release controls. Op amp IC1 forms a unity-gain voltage follower that buffers the output. Because the sustain pot is placed after the buffer and is therefore isolated from the timing circuit, the sustain level can be adjusted without affecting the envelope times. (By the way, this straightforward ASR circuit forms a great, minimum-parts-count, spare EG for a DIY modular synth.)

To make this simple ASR circuit a multitrigger type, an NPN switching transistor is added in parallel with C1 (see **Fig. 3**). The base of the transistor is driven by the keyboard voltage trigger, or V-trigger. (See the December 1995 "Service Clinic" for a discussion of gates and triggers.) When a trigger is present, the transistor conducts and rapidly discharges C1. With each trigger, the envelope-attack segment starts from zero, regardless of whether the gate is held or the release segment of the envelope is completed. This provides envelope initiation for each new key press, even if the playing style is legato or a drone key remains down.

Further steering logic in the form of transistors or simple gates can be added to produce the attack/decay/sustain/release (ADSR) EG or even more complex types. Regardless of the number and type of segments, at the most basic level, the timing functions are similar.

Envelope generators typically show either complete failure (pinned output or no output) or failure of a single function or group of related functions. When troubleshooting EGs, it will usually be quickly apparent whether the output is pinned (i.e., latched a diode drop or two below the positive or negative rail) or zero. In this case, check the output-buffer circuit first. If the buffer appears functional but the EG has no output, check the gate-input and trigger-input circuits. When a defective EG is stuck in the sustain segment, the symptom is different from that of a pinned buffer in that the sustain control still affects the level.

Occasionally, an output buffer will have increased offset but remain functional. Affected modules show specific symptoms, depending upon whether the offset is positive or negative. VCF cutoff will be higher or lower than normal, and the VCA will either stay on at a low level or not reach maximum amplitude. Offset at the EG buffer output can be detected with a DMM.

Sloppy attack and decay curves or a low, wavering sustain level may indicate a leaky timing cap. Replacement caps should be low-leakage types only, preferably tantalum. Be sure to get the polarity right!

Loss of individual envelope segments is usually easily traced to a specific component or subcircuit. In cases where EG operation is uncertain, you can check for response by using a test lead with a 4.7 kΩ series resistor to jumper the positive supply voltage to the VCF and VCA control-voltage inputs. This will drive the VCF and VCA, respectively, wide open, but be careful. If you inadvertently jumper the supply voltage to a current node and not to a CV input, you can fry a subcircuit.

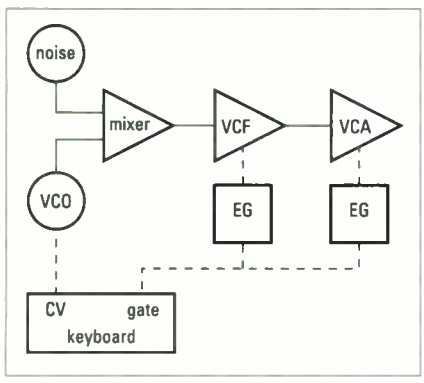

FIG. 1: Understanding the synth's audio-signal flow is critical to troubleshooting. This block diagram shows a typical analog-synth voice architecture.

TROUBLESHOOTING

The signal chain (see **Fig. 1**) is a lot like the food chain: whatever "bites" at the "top" (in our case, the output) pretty well obliterates what comes before. This establishes a hierarchy for troubleshooting. If a synth has no output and the control systems and EGs appear to be working, start at the output stage and work backward.

The final output element in many designs, and the first to check, is a simple op-amp buffer, which provides impedance matching, improved drive, and a measure of protection from ground loops and electrostatic discharge. Rarely do the final stages of the processing circuits "talk" to the outside world. It is far cheaper to replace a fried op amp than to rebuild a VCA.

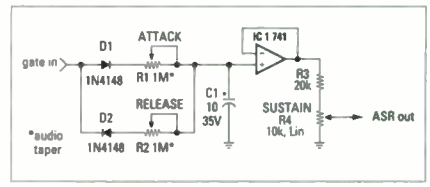

FIG. 2: The simple resistor-capacitor timing circuit is the heart of this basic ASR envelope generator.

In cases of severe failure, an op-amp audio buffer will exhibit the typical "pinned" output or no output. An op amp that is marginal may have increased DC offset or higher-than-normal harmonic distortion. A DC offset greater than a few millivolts is abnormal and can cause "thumps" or "pops" in the output or "scratchy" sounds from volume pots downline. Increased harmonic distortion is often more easily detected by listening than by viewing on a 'scope. However, you should check for offset and pinned output with a DMM before you apply an amplified speaker or other audio-signal tracer. Following severe failure, the resistors and capacitors in the output circuit should be replaced, as failure-related overcurrent conditions can affect them.

VCA CIRCUITS

The most common VCA circuit type is based on the RCA 3080 Operational Transconductance Amplifier, or OTA. Transconductance is the basis for many voltage-controlled devices: VCFs and VCOs, as well as VCAs. Prior to the introduction of the 3080 family, such circuits were formed from numerous, often ill-behaved, discrete transistors. An OTA, however, is not quite as robust as a conventional op amp, and failures are common. The typical symptoms are significantly reduced output and a mild

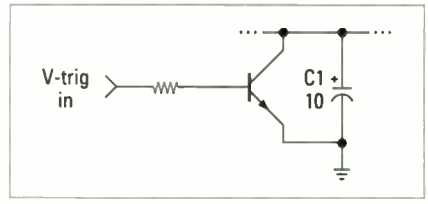

FIG. 3: With this multiple-trigger implementation, each trigger causes the transistor to conduct and discharge the timing capacitor, resetting the envelope.

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"thump" on key down. The 3080s also have higher offset voltages and more offset drift than most op amps. Many VCA circuits provide offset trims, which should be checked and adjusted according to the manufacturer's specifications before it is assumed that the OTA is bad. Often this adjustment can be done by ear: the offset trimpot is adjusted until any output "thump" is minimized.

Because OTAs are prone to failure, it is a good practice to install a socket when you replace an OTA. The now-standard configuration for the RCA 3080AE OTA is an 8-pin plastic DIP. It can be difficult to obtain the alternative version, configured as a multilead "can," that was used in such early analog synths as the Moog Sonic VI. In this case, it is possible to breadboard an adapter composed of a standard DIP socket, some perf board, and hookup wire, with no loss of performance.

For early analog synths that use VCAs consisting of epoxy-encapsulated modules, no direct replacements are readily available. A common practice is to breadboard a substitute module based on a 3080.

A NOTE ON THIS SERIES

The analog-service series has received an enthusiastic response, which is gratifying. The letters praise the coverage in general, but some go on to comment on one or more specifics that "although true, could use amplification." Your letters are invaluable because they reveal what we're doing right and where we need to improve. Perhaps most importantly, your letters verify that someone is reading this stuff!

Please keep in mind, though, that this series is designed to present a basic overview of an incalculably complex subject. Many concepts must be oversimplified and many others omitted in this context. I beg the technically sophisticated reader's indulgence and remind everyone that it is really quite remarkable that a venue such as **EM** exists to carry this series in any form.

Next month: Build your own Moog filter.

EM *Contributing Editor* **Alan Gary Campbell** *is owner of Musitech, a consulting firm specializing in electronic musical instrument design, modification, and service. He is also publisher and editor of the* New Music Journal.

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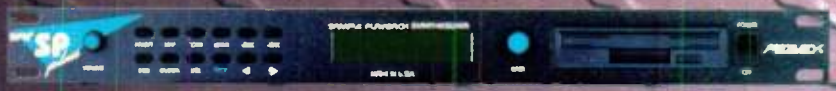

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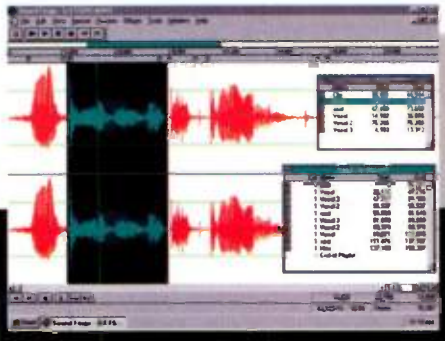

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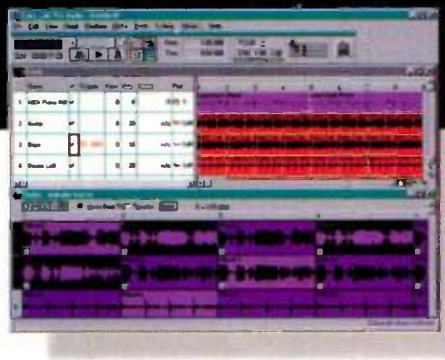

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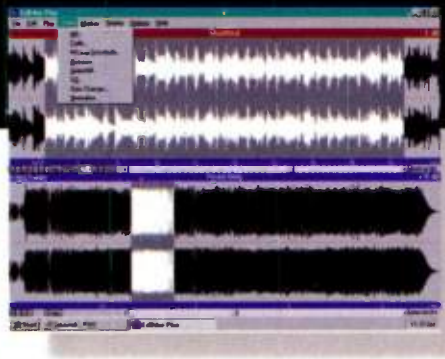

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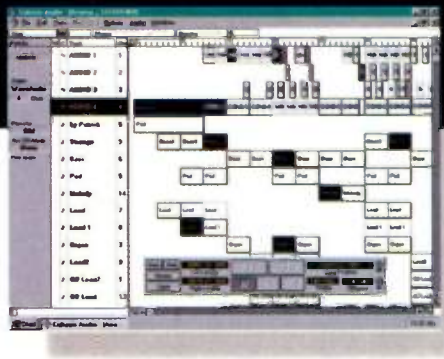

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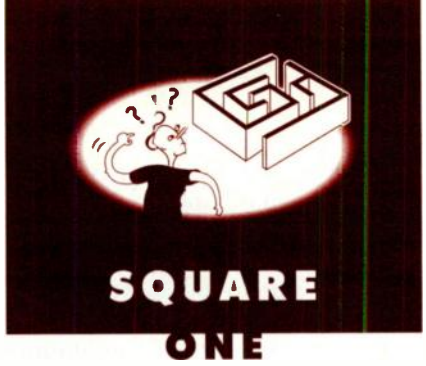


Digging into Digital Audio

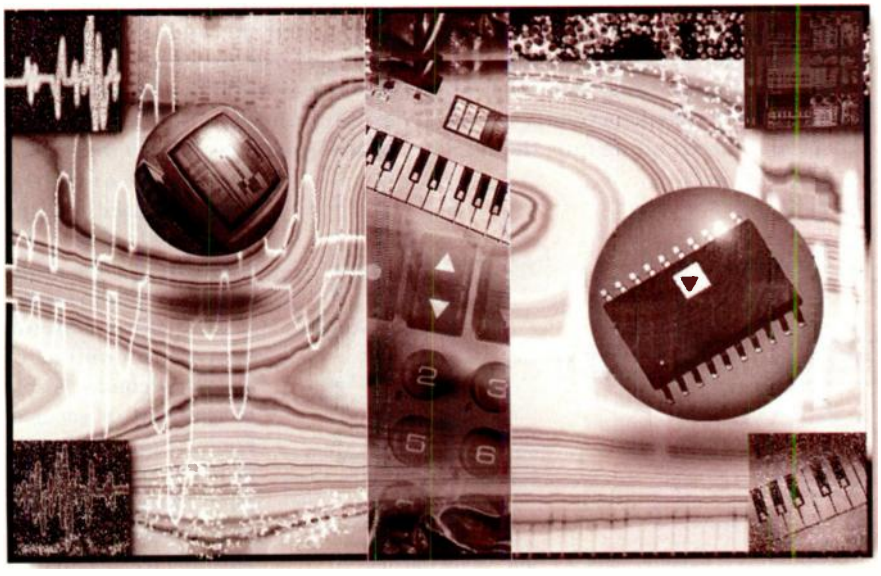
Binary digits are fundamental to most forms of electronic music.

By Scott Wilkinson

Sound is an analog phenomenon. The changing air pressure that pushes and pulls on our eardrums varies smoothly rather than jumps discretely from one pressure to another. Most electrical audio signals are also analog: the voltage in a cable varies smoothly in a way that mimics the changing air pressure created by the sound represented by the signal. In fact, the audio signal's changing voltage is *analogous* to the changing pressure of the sound it represents, hence the term *analog audio.*

Recently, however, the landscape has been altered somewhat. Audio signals are now commonly stored and transmitted as digital information. This offers several advantages over analog audio. For example, there is no loss of audio quality as you make copies of the data. In addition, it is much easier to edit and assemble digital audio information. Finally, there is virtually no tape noise when recording digital audio.

Fortunately, the same basic principles apply to all forms of digital audio recording, storage, and playback. This includes samplers, digital multitrack tape decks, DATs, hard-disk recorders, and CDs. If this realm remains foreign to you, read on.



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DIGITAL BASICS

Humans use ten digits—0 to 9—to express all numbers; this is called the *decimal* number system. The decimal system was probably invented because we have ten fingers (which are also called *digits*). To express numbers larger than 9, we combine two or more digits. For example, with two decimal digits, we are able to express 100 numbers from 0 to 99. With three decimal digits, we can express 1,000 numbers from 0 to 999.

Computers use only two digits: 0 and 1. This is called the *binary* number system, and binary digits are called *bits* (short for Binary digITS). Like humans, computers combine two or more bits in order to express larger numbers. For

example, with two bits, you can express four numbers: 00, 01, 10, and 11. With three bits, you can express eight numbers, from 000 to 111.

Are you starting to see a pattern here? Following is the pattern for the number of numbers you can express *(n)*:

$n = 2^{(\text{number of bits you combine})}$

So, if you have eight bits, you can express 2^8, or 256 numbers; with sixteen bits, you can express 2^{16}, or 65,536 numbers.

Computers almost universally combine eight bits into what is called a *byte;* a group of four bits is half a byte, which is called a *nibble.* These days, most computers also work with larger groups of bits called *words.*

A/D CONVERSION

The starting point of most digital audio systems is an analog audio signal from a microphone or other analog source. (Some systems can generate digital audio from scratch without an analog source, but I'm going to put this idea aside for now.) The goal is to convert the analog audio signal into a series of discrete digital numbers that a computer can deal with.

A *sample-and-hold* circuit measures, or samples, the instantaneous voltage, or amplitude, of an analog audio signal and holds that value until an *analog-to-digital converter* (ADC) converts it into a binary number (see **Fig. 1**). The sample-and-hold circuit then reads the next instantaneous amplitude and holds it for the ADC. This occurs many times per second as the signal's alternating voltage rises and falls. As a result, the smoothly varying analog waveform is converted into a series of "stair steps" (see **Fig. 2**).

In some systems, the lowest possible instantaneous amplitude is represented by a string of 0s (zeroes), and the highest possible instantaneous amplitude is represented by a string of 1s (ones). In other systems, a string of 0s represents the middle of the possible amplitudes. Values with a 0 as the first bit represent amplitudes above the middle (positive), whereas values with a 1 as the first bit represent amplitudes below the middle (negative). This is called *two's-complement representation,* which allows for positive and negative numbers.

Stereo signals are converted separately and then *multiplexed,* or combined, into a single stream of binary numbers. The numbers representing the right and left channels are *interleaved,* or alternated, in the stream.

The most common technique for encoding each instantaneous amplitude is called *pulse-code modulation* (PCM). Each bit is a code for an electrical or optical pulse: 1 = high-level pulse, 0 = low-level pulse. For example, if an instantaneous amplitude is represented by the binary number 1101, four pulses are sent: high, high, low, high. The rate at which the measurements are taken and the number of bits used to represent each measurement are the two most fundamental concepts in digital audio.

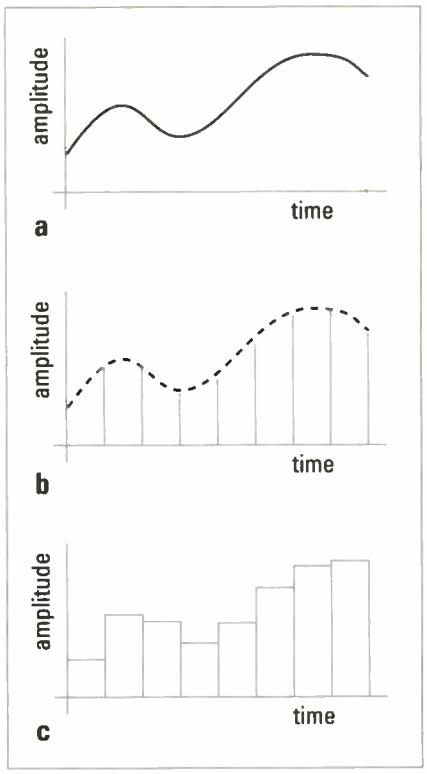

FIG. 2: The instantaneous amplitude of an analog waveform (a) is measured many times per second by a sample-and-hold circuit (b), resulting in a stair-step representation (c).

SAMPLING RATE

The rate at which the instantaneous-amplitude measurements are taken is called the *sampling rate,* and the time between measurements is called the *sampling period.* The more often measurements are taken, the higher the frequency that can be accurately represented (see **Fig. 3**). However, more measurements require more room for storage.

If the frequency of the analog signal is low compared with the sampling rate, you get an accurate representation of the signal. If the frequency of the signal is over half the sampling rate, though, some weird things start to happen (more in a moment). The frequency that corresponds to half the sampling rate is called the *Nyquist frequency* after American engineer Harry Nyquist. For example, if the sampling rate is 48 kHz (48,000 measurements per second), the Nyquist frequency is 24 kHz.

The Nyquist frequency is the maximum frequency that the system can accurately represent and reproduce. This is called the *audio bandwidth* of the system. For example, if the sampling rate is 48 kHz, the system can represent and reproduce audio signals at frequencies from 0 to 24 kHz. In other words, the audio bandwidth of the system is 24 kHz.

By contrast, the *digital bandwidth* of the system is determined by the maximum number of bits per second it is able to transmit or receive. For example, if the system's maximum sampling rate is 48 kHz and each instantaneous-amplitude measurement is

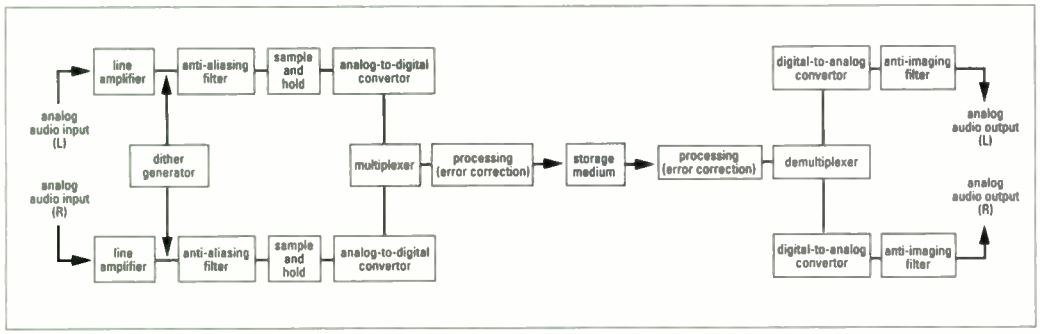

FIG. 1: All digital audio systems include these basic components to capture, store, and play audio signals.

represented with sixteen bits, the digital bandwidth is 48,000 × 16 = 768,000 bits per second, or 768 kbps. However, in a stereo system, this digital bandwidth would double to 1.536 megabits per second (Mbps).

When digitizing a signal with a frequency greater than the Nyquist frequency, you run into a problem called *aliasing*. In this case, the measurements of instantaneous amplitude don't accurately reflect the shape of the original signal's waveform (see **Fig. 4**). The measurements are taken at disparate points along the waveform. When these measurements are reconstructed into an analog signal, it has a lower frequency than the original. (In fact, several alias signals appear above and below the original frequency.)

As a precaution against aliasing, the input signal is sent through an *anti-aliasing filter* before it reaches the sample-and-hold circuit (see **Fig. 1**). This lowpass filter blocks any frequencies that are greater than the Nyquist frequency of the system while passing all frequencies below the Nyquist limit. The slope of the filter is very steep, which leads many people to call it a *brickwall filter*.

All CDs use one sampling rate—44.1 kHz—which is also common among samplers, DATs, hard-disk recorders, and digital multitracks. This rate was adopted as a standard because its Nyquist frequency is 22.05 kHz, which is just above the top of the human hearing range. As a result, all frequencies we can hear are accurately represented. However, there is much debate in the audio industry about whether or not overtones above 20 kHz make an audible contribution to the entire signal. In fact, some DATs are now available with a sampling rate of 96 kHz to address this issue.

Many professional systems offer a sampling rate of 48 kHz in addition to 44.1 kHz. Multimedia titles often use lower sampling rates of 11 kHz or 22 kHz to reduce storage requirements. This yields lower audio quality, which isn't considered critical because most computer audio-playback systems have relatively low fidelity anyway.

In many samplers, it's possible to use different sampling rates to conserve storage requirements. For example, you might sample the lowest notes of a bass at 11 kHz; there are probably no overtones above 5.5 kHz, so you don't lose anything by sampling these notes at a lower rate. Higher notes can be sampled at 22 or 44.1 kHz and combined with the low notes to form an entire sampled bass.

In some systems, the input is sampled at a higher rate than will be used to reproduce the signal; this is called *oversampling*. As you might imagine, this increases the Nyquist frequency and reduces aliasing. After the signal has been sampled, a digital filter removes any frequency components above the final Nyquist frequency, and the data is output at the final sampling rate.

RESOLUTION

The number of bits used to represent each instantaneous measurement is called the *resolution* or *word length*. The greater the resolution, the more accurately each measurement is represented (see **Fig. 5**). However, the more bits you use, the greater the storage requirements (more in a moment). Until very

recently, the most common resolution for digital audio was sixteen bits. However, many digital audio products use eighteen bits, and some professional systems use 20 or 24 bits, whereas multimedia titles often use eight bits to conserve storage.

The resolution determines the number of steps between the lowest and highest instantaneous amplitude the system can represent. With 16-bit resolution, there are 65,536 steps between the lowest and highest amplitudes. This defines the *dynamic range* of the system. Theoretically, the dynamic range of a 16-bit system is 98 dB, but various factors reduce this figure to about 90 dB for practical purposes.

No matter how many bits are used to represent each instantaneous measurement, the representation is not always completely accurate. In most cases, the actual measurement value must be rounded to the nearest binary number. This is called *quantization;* the difference between the actual measured amplitude and the quantized binary representation is called *quantization error.*

Quantization error can lead to audible *quantization noise,* which is more apparent in signals of low amplitude because only a few bits are used to represent the entire signal. As a result, you should try to keep the input signal's overall amplitude as close as possible to the maximum level that the system can accommodate. Optimizing the gain structure of your audio system can be a big help in this regard (see "Recording Musician: Gain Stages" in the November 1993 **EM**.)

However, you must be careful not to exceed the system's maximum signal level. If the instantaneous amplitude of the input signal rises above the highest point that can be represented by the binary numbers, the signal will be *clipped* (i.e., the top of the waveform will be chopped off, forming a horizontal line). This makes a very unpleasant noise. With digital recording, the input-signal level must not exceed 0 on the VU meter in order to avoid clipping. Some manufacturers of digital recorders actually calibrate the 0 VU point a few dB below the actual clipping point so users can exceed this level without clipping, as if they were using an analog recorder.

The most common solution to quantization noise is called *dithering.* In this process, a small amount of noise is added to the input signal before it is measured and quantized (see **Fig. 1**). This randomizes the quantization error, reducing its audible effect. For this reason, it is particularly important to apply dithering to minimize audible artifacts that arise when the resolution of a digital audio signal is reduced, which is a common procedure in multimedia production.

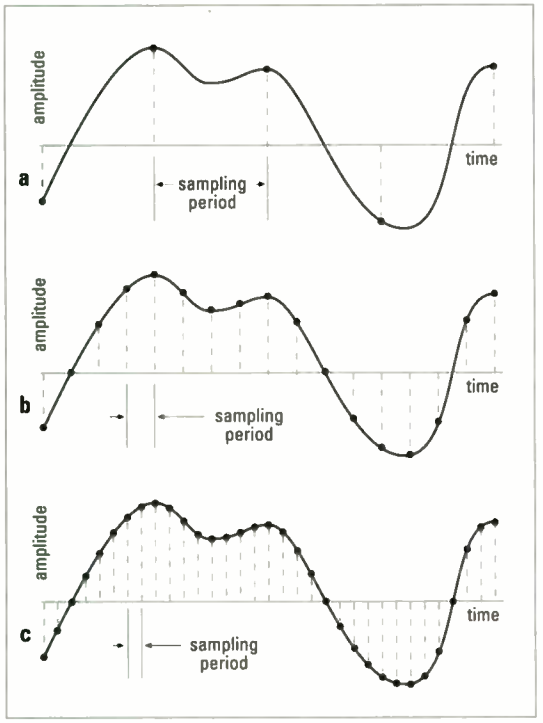

FIG. 3: As the sampling rate increases, the sampling period decreases and more of the high harmonics in the original signal are accurately represented.

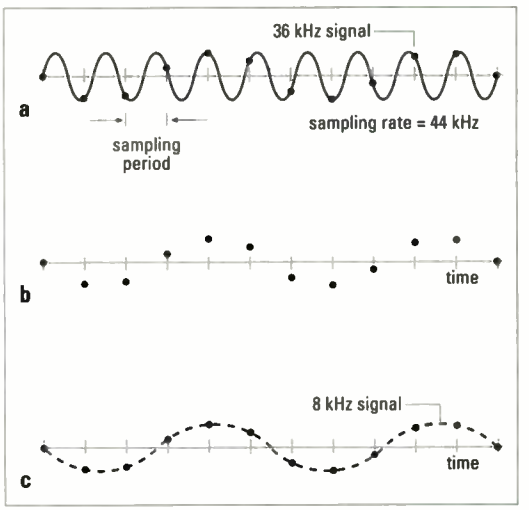

FIG. 4: If the frequency of the input signal is more than half the sampling rate, a lower-frequency alias signal appears. In this example, the sampling rate is 44 kHz and the input signal's frequency is 36 kHz. The resulting alias signal is 8 kHz.

STORAGE

Once the signal has been digitized into a stream of binary numbers, it is stored in one medium or another. Common media include magnetic tape or disk, optical disc, RAM, and ROM. At a sampling rate of 44.1 kHz and a resolution of sixteen bits, digital audio data consumes over 5 MB per minute for a monaural file or 10 MB per minute for a stereo file. Digital audio data stored in this manner is referred to as being *linear.*

To reduce storage requirements, you can reduce the sampling rate and/or resolution, but this also reduces audio quality. Another option is called *compression,* which is often used in multimedia titles. In this process, the digital audio data is compressed to reduce storage requirements by as much as 4:1 or 5:1. In other words, a given amount of compressed digital audio data requires ¼ or ⅕ as much storage as an equivalent amount of linear data.

There are many types of digital audio compression, which can be divided into two broad categories: lossy and lossless. Lossy compression provides the greatest storage reduction, but some of the information is lost forever. As a result, lossy compression schemes are designed to lose information that theoretically represents sound we wouldn't hear anyway due to masking and other psychoacoustic effects. (However, with most currently available compression schemes, you can actually hear the difference.) Lossless compression retains all the information in a file, but the storage reduction is not as dramatic as the reduction that results from lossy compression.

D/A CONVERSION

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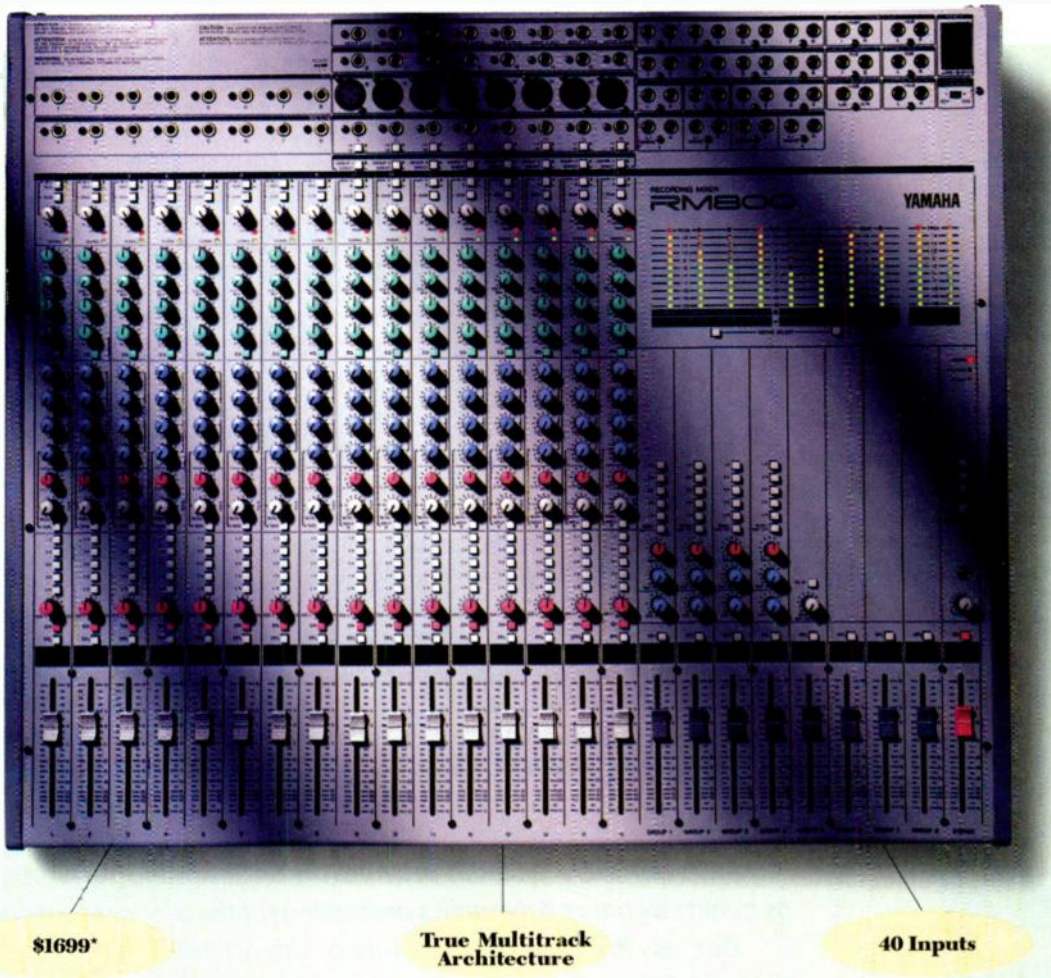

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is sent to a *digital-to-analog converter* (DAC). If it's a stereo signal, it is first demultiplexed to separate the right and left channels (see **Fig. 1**).

The analog output of the DAC still has a stair-step shape, which introduces high-frequency artifacts into the signal. In addition, the process of digitization creates *images* of the original waveform's harmonic spectrum centered at multiples of the sampling rate. For example, if the sampling rate is 44.1 kHz, images of the original spectrum appear centered at 88.2 kHz. You might think that there is no need to bother with these images, which lie outside the human hearing range. However, these frequencies can cause audible problems in other audio components. And if the sampling rate is relatively low (e.g., 11 kHz), the images can be audible.

To solve both problems, another brickwall lowpass filter, called an *anti-imaging filter,* is traditionally placed after the DAC to remove any sonic components above the Nyquist frequency and smooth out the stair steps (see **Fig. 1**). These days, many systems use a digital anti-imaging filter before the DAC, which reduces the phase anomalies that are so problematic with analog brickwall filters.

In many modern systems, the digital filter uses oversampling to create a smoother, more accurate output. In this process, the filter interpolates between the original sample points.

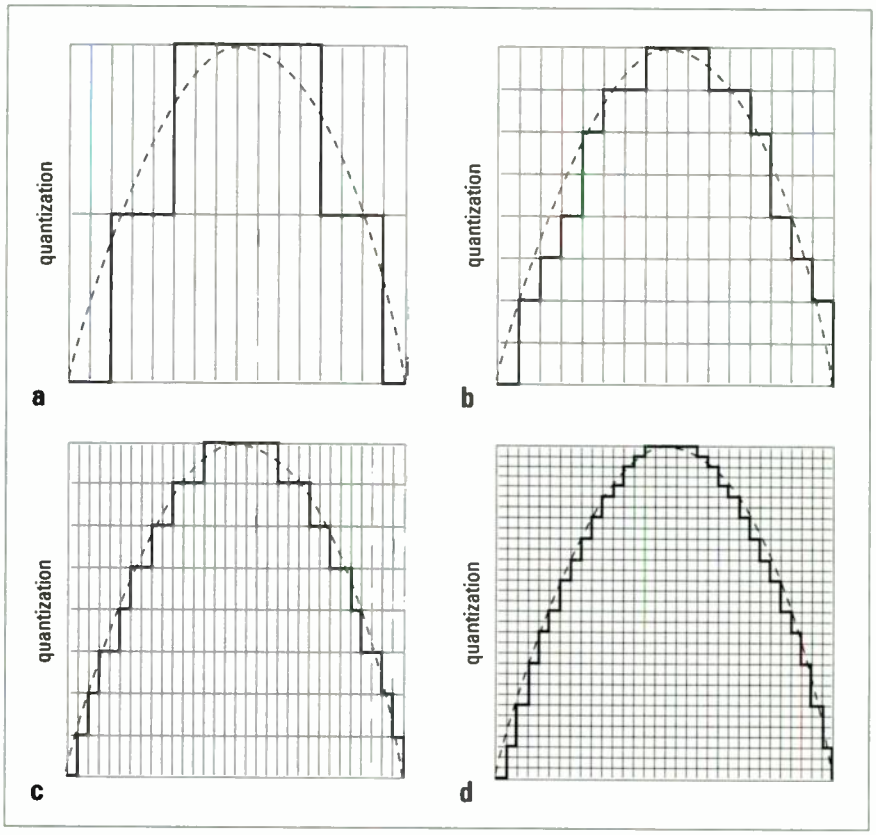

FIG. 5: If the resolution is low (a), the signal is poorly represented with large stair steps. If you increase the resolution (b), the approximation is more accurate. If you increase the sampling rate (c) and the resolution (d) even more, the approximation is very close to the original waveform.

LOW-BIT SYSTEMS

Although many systems use sixteen bits or more to represent each instantaneous measurement, another approach is gaining popularity. This approach is called *low-bit conversion* because it uses only a few bits, sometimes even a single bit, to represent the audio signal.

How is this possible? Consider the following analogy. Traditional digital audio systems are like a row of sixteen light bulbs, each controlled by its own switch. There are 65,536 possible on/off combinations, which determine the room's brightness. Room brightness is analogous to the instantaneous amplitude of an audio signal. However, each bulb has a different inherent brightness, which introduces error into the system. This is analogous to the error introduced by high-bit converters.

You can also control the brightness in the room with a single light bulb by switching it on and off at a high rate. The brightness is determined by how long the light is on relative to how long it is off. This is analogous to a 1-bit converter. When the instantaneous amplitude is high, the converter sends mostly 1s; when the amplitude is low, the converter sends mostly 0s. Low-bit converters are inherently more accurate than high-bit converters, but their sampling rate must be much higher than that in high-bit designs.

One way to use fewer bits is called *differential coding.* This technique is based on measuring the difference between one instantaneous amplitude and the next rather than the amplitudes themselves. It generally requires fewer bits to accurately represent the differences, which are smaller than the actual amplitudes. For example, *delta modulation* quantizes the difference (which is often represented by the Greek letter delta) between consecutive amplitudes.

A more sophisticated variation is called *delta-sigma modulation.* (This is sometimes called *sigma-delta modulation,* although some audio professionals make a distinction between these terms, using them to describe slightly different techniques.) This process takes the difference (delta) between the current instantaneous amplitude and the integral of the quantized previous difference. (Integrals are mathematical operations related to sums, and sums are often represented by the Greek letter sigma.) Delta-sigma converters provide excellent sound quality at a lower price, which is why they are used so much these days.

Digital audio systems are difficult to design and build, but the basic concepts are relatively easy to understand. Once you grasp these concepts, you can optimize your use of samplers, DATs, digital multitracks, and hard-disk recorders and enjoy high-quality audio for relatively little monetary investment. Also, digital products always improve their performance while falling in price, so the future looks bright for all forms of digital audio.

EM *Technical Editor* **Scott Wilkinson** *digs digital audio. Thanks to Ken Pohlmann for his help with this article.*

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Research references: *A study to determine the effectiveness of the David L. Burge technique for development of Perfect Pitch,* M.E. Nering (1991), The University of Calgary; *An experimental investigation of the effectiveness of training on absolute pitch in adult musicians,* Rush (1989), The Ohio State University. *You'll receive research summaries with your Perfect Pitch SuperCourse or info request!*

Reviews

Korg Prophecy

By Geary Yelton

Korg makes a comeback in the world of single-voice synths.

Once the Yamaha VL1 let the modeling genie out of the silicon bottle, it was inevitable that other manufacturers would develop their own versions of this exciting new technology. Since then, Korg, Roland, Clavia, and Technics have released modeling-based products, and several other manufacturers will soon join the party.

Korg's Prophecy offers seven types of synthesis based on DSP models. This monophonic instrument includes 37 keys, a unique ribbon controller, and a superb arpeggiator.

Korg's first modeling synth was the WD1 WaveDrum (reviewed in the April 1995 **EM**), an innovative percussion instrument. The WaveDrum is very cool, but its sounds can't be triggered via MIDI, so it can't be sequenced. With the new Prophecy, however, Korg brings its modeling technology to the world of MIDI keyboards.

Like the VL1, the Prophecy is a monophonic instrument intended for leads, solos, and bass parts. It offers seven different types of synthesis, all of which are mathematically modeled using digital signal processing (DSP). Why a mono synth? Simply because a mono synth is far less expensive to manufacture than a polyphonic synth of the same type.

FIRST GLANCE

The Prophecy is an odd-looking beast that resembles a 1950s fantasy of a twenty-first-century instrument (that is, futuristically retro). Children love the way it looks. I wonder whether the synth will appear quaint twenty years from now.

Like many mono synths, the Prophecy has fewer keys (37) than we're used to seeing on today's polyphonic instruments. However, the Prophecy can be used as a controller to play external sound modules polyphonically. Although there are no pegs on the sides for a strap, the Prophecy weighs just under thirteen pounds, making it light enough to strap on occasionally. Give me pegs!

To the left of the keyboard, three assignable controllers beckon. Two controllers are traditional pitch-bend and modulation wheels, but the other is a barrel-shaped cylinder with a ribbon controller mounted on top. Located above the wheels, the barrel/ribbon controller (labeled Wheel 3) is about four inches wide and has a center detent. You can roll it as your thumb slides along the ribbon, or you can put your whole arm into motion by rocking it with the heel of your hand. You can also roll it with up to five fingertips as you work another wheel with your thumb.

Above Wheel 3 are the arpeggiator controls, Octave Up/Down buttons, Portamento On/Off button, main volume knob, and Wheel 3 Hold button. The Hold button is especially handy: When you move Wheel 3 and hit the Hold button, it locks in the current value. To disengage it, you can either push the button again or simply move the wheel beyond the current value.

The 40-character × 2-line LCD display is a bit small by today's standards. To the left of the display are the page

and cursor navigation buttons; the Value Up/Down, Enter, and Exit buttons are found to the right. Beneath the display are five Performance Editor knobs that can be assigned to control up to four parameters simultaneously in real time. The parameters are selected in Define mode. In Edit and Define modes, the knobs move the cursor and enter parameter values.

In the rightmost portion of the front panel are the Write and Compare buttons and two rows of additional buttons. The upper row of buttons provide access to various parameters in Performance or Edit Mode, depending on the state of the Performance/Edit button. The lower buttons are used to select Programs or arpeggiator patterns, depending on the state of the Pattern/Program button. They can also be used as numerical buttons in Edit or Define mode.

The back panel includes MIDI In, Out, and Thru ports and connectors for an optional EC5 external pedal controller, standard volume pedal, and sustain pedal. Two ¼-inch audio outputs round out the back-panel connections. There is also a ribbon-controller sensitivity knob, which is a nice touch. The unit has an internal power supply with a standard IEC connector and rear-panel power switch.

Up to 128 Programs are stored in two internal RAM banks of 64 each. An optional RAM card stores 64 more patches. All of the memory locations can be overwritten by the user.

SOUND GENERATION

Although Korg's WaveDrum uses modeling technology, the Prophecy is the first synthesizer to use the company's Multi Oscillator Synthesis System (MOSS). MOSS is a combination of seven modeling-based synthesis techniques. (The Prophecy does not use samples.)

The Prophecy's single voice begins with two main oscillators, a sub oscillator, and a noise generator (see **Fig. 1**). Each of the two main oscillators can be assigned to perform one of the seven types of synthesis. Three of these simulate acoustic instruments: the Brass model, Reed model, and Pluck (plucked-string) model. The other four models simulate what Korg calls Standard synthesis (traditional analog waveforms), Comb Filter synthesis, Variable Phase Modulation (VPM) synthesis, and Cross/Sync/Ring Modulation synthesis.

However, you can't simply assign any type of synthesis to any oscillator. You are given a choice of nine preprogrammed pairs of synthesis types. If you select one of the models, the other oscillator is unavailable. Each oscillator has its own pitch envelope and other modulation parameters.

The sub oscillator plays a sine, sawtooth, square, or triangle wave and tracks either oscillator 1 or oscillator 2. Unlike a traditional sub oscillator, which plays one or two octaves below the main oscillator, the Prophecy's sub oscillator can be tuned to any interval up to two octaves above or below the main oscillator. The noise generator, which has its own lowpass filter, is mixed with the main and sub oscillators.

The Prophecy's analog model produces basic pulse and sawtooth waves, and a ramp wave can be mixed in. A Wave Edge parameter adjusts the high-frequency content of the pulse or sawtooth. Waveform modulation can be applied not only to pulse width but to sawtooth phase and ramp shape, modulating the ramp from a triangle to a trapezoid. Modulation can be either positive or negative.

The Comb Filter model uses a resonating filter to combine a basic waveform (sawtooth, square, or triangle) with noise, producing varying levels of distortion or clarity. Comb filtering is useful for producing unpitched sounds, but turning up the Comb Filter's resonance emphasizes the fundamental pitch.

In the VPM model, one wave (sine, sawtooth, triangle, or square) is phase-modulated by another, with the same selection of waveforms. Interestingly, a single VPM oscillator produces both waves and also includes its own Wave Shaper to emphasize the high frequencies. Applying an envelope to the modulator shapes the carrier's spectrum over time.

The Cross/Sync/Ring Modulation model lets you choose one of these three types of sound generation. The carrier wave, which is always produced

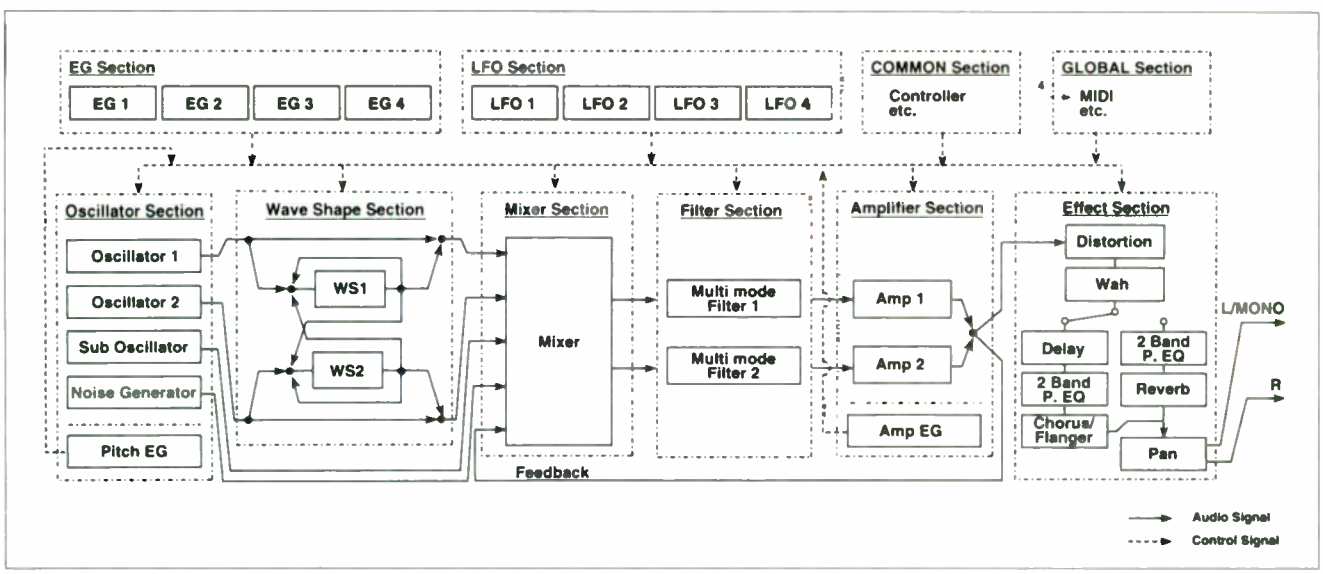

FIG. 1: The Prophecy's architecture includes two main oscillators, a sub oscillator, and a noise generator. These sources are sent through two Wave Shapers, a mixer, two multimode filters, two independent amplifiers, and an effects section. Six EGs, four LFOs, and a host of other modulation sources can be routed to nearly 300 destinations. (Courtesy Korg USA.)

by oscillator 2, can be sine, sawtooth, or square. The modulator is supplied by oscillator 1, the noise generator, or the output of the filter and amplifier sections. Again, a pitch envelope is often applied to the modulator. A Modulator Edge parameter changes the amount of high-frequency content, preventing harsh-sounding overtones from occurring when the carrier is overmodulated.

Cross Modulation varies the carrier's frequency with the modulator, producing FM sounds. It's similar to a DX-series instrument with two operators. Some of the Prophecy's FM sounds are quite lovely.

Sync Modulation resets the phase of the carrier to the zero point every time the modulator's cycle crosses zero. The spectrum is dynamic when you use an envelope generator to sweep the pitch of the modulator. In analog synthesis, this technique is known as "hard sync."

The Ring Modulation model produces metallic sounds by outputting the mathematical sum and difference between the harmonics of the carrier and the modulator. Since the pioneering days of electronic music, ring modulation has always been useful for synthesizing gongs, bells, and other clangorous sounds with nonharmonic overtones.

ACOUSTIC INSTRUMENTS

As noted earlier, three of the seven types of physical modeling simulate the physical characteristics of acoustic instruments. The Brass model simulates an instrument whose sound is produced by a vibrating lip, such as a trumpet or French horn. Three aspects of the sound can be modulated: Pressure, which corresponds to the force of breath applied to the mouthpiece; Lip, which simulates the force and tension of a musician's lips; and Bell, which adjusts the tone according to the physical shape of the simulated instrument.

Pressure is controlled by an envelope generator, which in turn is modulated by the various controllers. Breath noise is simulated by shaping noise with the lowpass filter. The Lip aspect determines how hard a note appears to be played and can be affected by various modulation sources. The Brass model's Bell parameters adjust the tone and resonance of a brass instrument's bell and determine whether it's muted or open.

The Jump Bending parameter simulates the effect of changing resonant modes on a valve instrument, whereas Smooth Bending simulates sliding on a trombone. Smooth Bending sounds much more natural than using portamento on a trombone sound.

There are four brass-instrument types: two trumpets, a trombone, and a horn. These determine the length and mouthpiece shape of the simulated instrument. I would have preferred to see a tuba model instead of the second trumpet; as it is, a large group of conical instruments are not represented.

The Reed model features fewer parameters but a much greater variety of instrument types. There are thirteen reed-instrument types in all, including baritone through soprano saxes, flute, recorder, single and double reeds, two bottles, and something called Monster. (I never realized monsters were classified as woodwinds.) Like Brass Pressure, Reed Pressure is controlled by an envelope that is modulated by other sources, such as an LFO, Aftertouch,

or Modulation. Only Smooth Bending is available, giving you control over the range, direction, and modulation source. Reed resonance can also be modulated in real time.

As its name suggests, the Pluck model simulates plucked string instruments. Almost all the factory programs that use the Pluck model are bass and guitar sounds. The parameters include whether the simulated string is played with a pick or fingers, the position of the pluck along the string's length, the distance the string is pulled away from rest position as it's played (Inharmonicity), high-frequency damping (String Loss), and various envelope settings. Velocity normally modulates the attack parameters, and keyboard tracking is routed to modulate String Loss, Inharmonicity, Decay, and Release. Some of the Prophecy's best sounds use the Pluck model.

SOUND MODIFICATION

Oscillator signals go through a number of modifications before reaching the audio output. With three assignable control wheels, 111 modulation sources, and nearly 300 modulation destinations, the possibilities seem endless.

The first modification opportunity is the Wave Shape section, which adds various degrees of distortion or resonance to oscillators 1 and 2. Next is the mixer, which controls the relative balance and stereo routing of the four audio sources (oscillators 1 and 2, sub oscillator, and noise), as well as feedback from the amplifier output.

There are two multimode filters, which can be lowpass, highpass, bandpass, or band-reject. Resonance depth can be altered by any modulation source. When using the bandpass filter, the center frequency can track the keyboard. Either mixer output can be routed through either filter or through both filters in parallel or series. Putting the filters in series doubles the filter slope.

When using both filters, there are four presets: SaxBody, Formant, Trumpet, and MuteTrumpet. SaxBody emphasizes the Reed model's tonal characteristics. Formant produces a resonance at a fixed, user-specified frequency, resulting in a more vowel-like tonal quality. Trumpet accentuates the Brass model, and MuteTrumpet simulates the tonal characteristics of—you guessed it—a muted trumpet. Any filter preset can be used with any sound; for example, you don't have to use the Brass model with the trumpet presets.

There are two separate amplifiers through which the filters are routed, although the signals are summed before the effects. Eleven amplifier-envelope presets range from Piano and Percussion to Sweep and Pressure. Modulation can be routed from any envelope generator, and any envelope can modulate any number of sources.

The Prophecy offers four assignable LFOs, a dedicated pitch EG, a dedicated amplifier EG, and four assignable, general-purpose EGs. The pitch and amplitude envelopes have four level values and four time values each, and the other four add a fifth level (see **Fig. 2**). Keyboard tracking can affect each time value to different degrees, and Velocity can affect each time value to different degrees and/or all levels simultaneously.

Keyboard tracking offers two independent split points. The tracking above a specified key can be different from the tracking below another specified key. For example, a sound could play louder as the pitch ascends in the bottom octave, play more softly as it ascends in the top octave, and play the same volume in the middle octave.

The final block in the signal path includes the effects. There are only two algorithms, each of which offers four or five effects at once, and any effect within each algorithm can be turned on or off.

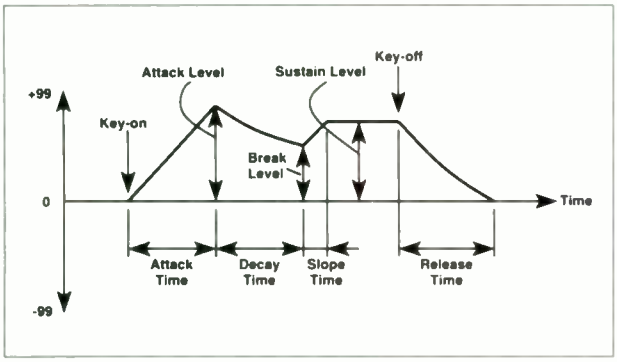

FIG. 2: The general-purpose EGs include five levels and four times. (Courtesy Korg USA.)

One algorithm features reverb, and the other features delay, chorusing, and flanging. If you want delay, chorus, or flanging, you sacrifice reverb; if you want reverb, you sacrifice delay, chorus, and flanging. It would be nice if Korg had included enough processing power for both. Distortion, wah, and 2-band parametric EQ are always available. The wah effect can be controlled by any modulation source. Any LFO can modulate the chorus/flanger, and any modulation source can affect the LFO depth either positively or negatively.

PLAYTIME IN REAL TIME

If you want to be an expressive soloist on this synth, you must focus on its controllers. In addition to all the usual choices (Velocity, Aftertouch, mod wheel, pitch-bend wheel, footswitch, continuous footpedal), you have an extra wheel, a ribbon controller, and five performance knobs to keep track of. With the optional EC5 external controller, you have five more footswitches that can control up to thirteen functions, including changing programs, jumping octaves, and turning the effects, arpeggiator, and portamento on and off.

The ribbon on Wheel 3 is sensitive not only to where you touch it but to how hard you touch it. The five performance knobs can control up to four parameters each. This means the knobs alone can vary up to twenty parameters. In addition to MIDI Control Changes 1 through 95, there are fifteen other modulation sources, all of which can be used in real time. Any control source can be routed to any modulation source, which in turn can be routed to modify nearly 300 assignable parameters. Most modulation can be applied positively or negatively. Modulation routings are stored with each program. As you can see, flexibility is the key.

The factory programs make good use of all three controller wheels. However, there is some duplication (e.g., two wheels may control the same parameter), which sometimes causes conflicts. Another problem is that some programs expect Wheel 2 to be centered initially and others expect it to be turned down. For example, in "Alto Sax," Wheels 2 and 3 control both the brightness and bite (overblown quality). If Wheel 2 is turned down when you select this program, turning it up causes an abrupt change in tone. If you then move Wheel 3 without centering Wheel 2, it causes another abrupt change.

The arpeggiator is the closest thing to an old-style analog sequencer I've seen on any digital instrument. In addition to five preset patterns, there are five user-programmable patterns that let you define each of up to 24 steps. Using a RAM card doubles the number of patterns. An octave button lets you stretch the pattern over as many as four octaves.

When it's turned on, the arpeggiator kicks in even if only one key is pressed. If Latch is enabled, you can release the keys, and the pattern continues until you play another chord, triggering another sequence of notes. If Key Sync is enabled, the first note of the pattern is synchronized to the attack of the first note you play. Otherwise, it plays in perfect sync with the flashing LED above the Speed knob. The arpeggiation rate can be slaved to MIDI Clock messages from a sequencer. This arpeggiator blows away any that came before it.

MIDI IMPLEMENTATION

The Prophecy's MIDI implementation allows you to control external modules polyphonically on any MIDI channel. It also responds to messages on any channel. The unit sends and recognizes Channel Pressure (Aftertouch) but not Poly Pressure.

In addition, the Prophecy recognizes and transmits most Control Changes. Fortunately, it sends and receives Bank Select, as well as Program Change. You can also perform SysEx bulk dumps and loads.

Product Summary

PRODUCT:
Prophecy
PRICE:
$1,599
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Korg USA
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fax (516) 333-9108
CIRCLE #437 ON READER SERVICE CARD

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AUDIO QUALITY	● ● ●
VALUE	● ● ●

IMPRESSIONS

The Prophecy offers many cool features. I especially like the keyboard's Aftertouch. Once you strike a key, you can actually feel the physical range, perhaps a quarter inch, from the lowest Aftertouch value to the highest. This tactile feedback affords unusually precise control over anything modulated by Aftertouch.

The most confusing part of programming on the Korg Prophecy could be figuring out which envelope generator you need to change. With six EGs, they can appear at practically every stage of the synthesizer's signal flow. Every synthesizer should have this problem. If you're a patch-programming type who likes to create new sounds, you could have a really good time with the Prophecy. You can set up arpeggiated patterns and twist knobs to your heart's content, just like Tangerine Dream.

Will playing a Prophecy make you a more expressive synthesist? As with any instrument, that depends on how much practice you put into it. You're dealing with more than just a keyboard, vibrato, and pitch-bend wheel here. How you use the third wheel, the ribbon, and the five performance knobs makes a huge difference. If you can use pitch bend and mod wheels expressively, the third wheel and ribbon will be natural extensions. On the other hand, if you already have your hands full dealing with Velocity, Aftertouch, and two wheels, you may find the Prophecy's expressive options overwhelming. If you aren't a great player but you're a real knob-twister at heart, you'll have fun playing the Prophecy.

The first time I played it, I thought the Prophecy's sonic personality resembled Korg synthesizers from the 1970s. I heard a certain sterile harshness in many of the factory programs that cried out for caressing the expression controllers to give them warmth. After playing it awhile, I realized that not every sound exhibits this synthetic quality.

Although acoustic-instrument modeling is implemented in nice detail, it is not the Prophecy's forte. Compared to the Yamaha VL1, this instrument doesn't come anywhere close to accurately modeling reeds and brass. Even Wendy Carlos' emulations ten years ago sounded more realistic. The Pluck model is the best of the three types, but analog-style synthesis is the hands-down winner. Some of the analog-style factory programs are very well implemented and sound very cool. Among the FM-type sounds, "Waterphonics" is one of the best sounds of its type I've heard, thanks to thoughtfully detailed programming.

Whenever a company like Korg creates an instrument like the Prophecy, it's probably someone's dream that this progeny may become a classic like the Minimoog, Prophet-5, or DX7. I think the Prophecy is a stepping stone to the next generation. It's a significant instrument, and its design will influence future instruments. It may or may not be remembered and regarded for that contribution alone. If it catches on, the Prophecy might just help shape the sound of the late 1990s.

For the first time in nearly four years, **Geary Yelton** *is taking time off from his graphic-arts gig with Ernst & Young just to play with his toys.*

TASCAM DA-30 MKII

By Brian Knave

Get behind the wheel of a new DAT deck.

That TASCAM waited five years before releasing a new version of their popular DA-30 DAT deck suggests complaints were few about the original machine. Indeed, during that time, the DA-30 developed a strong track record not only in commercial recording studios but in home studios, as well.

The DA-30 MKII should have no problem filling the shoes of its predecessor. Apart from its partially reconfigured front panel with a handy new Data/Shuttle wheel, the machine looks and functions much like the original. The great news is that, thanks to improved converter technology, the DA-30 MKII actually sounds better than the DA-30. (The DA-30 was reviewed in the March 1991 **EM**.)

PHYSICAL CHARACTERISTICS

The DA-30 MKII is a 3U rack-mount unit with removable feet, a black-satin finish, and a high-tech, no-nonsense demeanor. The sleek front panel is split between the tape transport and its controls on the left side and the display window and remaining controls on the right, with the large Data/Shuttle wheel affixed, Cyclops-like, in the center.

Except for the recessed power button, different headphone-volume knob, and metal (rather than silk-screened) TASCAM nameplate, the left half of the MKII's front panel is virtually identical to the DA-30's. The easy-to-read fluorescent display screen is also the same.

Only the lower right quadrant shows significant revision. Button controls to the right of the Data/Shuttle wheel have been ergonomically redistributed into more logical groupings (for example, all ID editing functions are laid out in a single row in the order they are most commonly used). The DA-30's three large, distinctive chrome input/output-level knobs have been replaced by two small plastic knobs, which means there is no longer an output-level control. The MKII is not as *clinical* looking as the DA-30; thanks to the gun-metal gray Data/Shuttle wheel and matching panel that flares out beneath the display window, the unit has a snazzier, more arresting appearance than its somewhat austere predecessor.

The rear panel of the MKII, though laid out differently, is functionally identical to the DA-30's, with one important difference: because there is no output-level control, the unbalanced outputs operate at a fixed level. (I'll explain the reasoning behind this change later.)

Otherwise, the rear panel has all the goods. You get simultaneously available +4 dBm, balanced, XLR and -10 dBV, unbalanced, RCA stereo analog inputs and outputs. Digital I/O is supplied in both S/PDIF (RCA) *and* AES/EBU (XLR) formats. A DB15 transport-control I/O port is provided for custom control options, and a ⅛-inch stereo mini phone jack connects to the optional RC-D30 remote control ($90).

TASCAM has another winner with the DA-30 MKII. The new DAT recorder features improved converter technology, a Data/Shuttle wheel, and a Cal switch that automatically calibrates the machine to +4 dBm balanced or -10 dBV unbalanced signals.

The unit includes a nondetachable, 3-conductor power cord. It's good to see air vents on the rear panel of the MKII, as many users are likely to rack-mount their units.

Though sprinkled with typos and bungled grammar, the MKII's owner's manual is mostly clear and concise, giving step-by-step instructions for all operating procedures. A nice addition is the "Problems and Solutions" page, which includes a table detailing Coded Error Messages. I found one operations error, though. According to the manual, the "Input Monitor mode can be entered even when no cassette is inserted to the deck." This is not the case.

OPERATION

One thing I've always appreciated about TASCAM equipment is its relative simplicity and ease of operation. Happily, the MKII continues this tradition. Anyone familiar with a tape player will understand the transport controls, and previous DA-30 users should require only a few minutes to "grok" new features.

The DA-30 MKII records digital and analog signals at three sample rates: 48 kHz, 44.1 kHz, and 32 kHz. The machine automatically switches to the sample rate of the digital source. In analog mode, the first two rates are selectable at a front-panel switch, and the slower rate is available when the Record Mode switch is moved from Standard to Long. Long mode doubles the play or record time of any DAT tape. This feature is pretty useless for studio mastering applications, but it comes in handy for people who record, say, corporate speeches, college lectures, or long-winded sermons. Sampler owners who record to DAT before sampling can also make good use of Long mode. If the highest frequency you wish to reproduce doesn't exceed 16 kHz (as with an electric guitar or bass), you can record in Long mode and save tape.

▼

The Data/Shuttle wheel is affixed Cyclops-like in the center.

Like its older sibling, the MKII automatically writes Start IDs (electronic index marks stored in subcode) and corresponding Program Numbers that allow the machine to rapidly locate selections, or Programs, on tape. Subcode data does not affect Program data; therefore, start IDs can be erased, repositioned—with 150 millisecond accuracy—and rewritten at any time. This is as much a necessity as a convenience, as the machine will sometimes mark musical silence (e.g., a slow-tempo, whole-note rest), or even a quiet passage of music, with a new Start ID. As an option, you can defeat Auto ID and write Start IDs manually. After new Start IDs are written, a simple push of the Renumber button automatically reformats the subcode with corrected Program Numbers.

The MKII also writes Skip IDs and End IDs. A Skip ID causes a Program to be skipped when the machine is in Skip Play mode (which is accessible only

from the remote control). An End ID instructs the machine to stop and forfeits access to previously recorded data beyond that point. Therefore, End IDs should be positioned only at the end of a tape, not at the end of a song.

Additional transport functions include Skip buttons that rewind or fast-forward the tape to the previous or next ID (either can be pushed repeatedly to skip any number of programs); a Standby button that, when enabled, places the MKII in Pause rather than Play after skip or search functions; and a Record Mute button that instructs the machine to record four seconds of time-subcoded digital silence. This last feature is designed for putting space between songs without interrupting Absolute time count. (Absolute time is counted from beginning to end of formatted, or recorded, data.)

BALANCING ACT

To accommodate new features within the target budget (the MKII costs only $100 more than the original DA-30), and without cluttering the front panel, TASCAM piggybacked some functions and replaced others altogether. A few of these changes are questionable, whereas others are smart improvements. For example, on the MKII, a single Input switch now does the work of two switches on the DA-30, covering analog unbalanced, balanced, and digital inputs. Putting three positions on one switch left room for a new input feature, the Uncalibrated/Calibrated select switch. Set to Cal, the MKII automatically adjusts itself to work with a +4 dBm or -10 dBV input level. As long as your gear outputs at either of these levels, you can leave the switch on Cal to achieve optimum, presumably hassle-free record levels.

The Cal setting does not, however, guarantee maximum peak levels. If, like me, you like your transient peaks to hit zeros on the peak-level meters, you may still have to adjust your board's output master faders. Of course, if you're already in the red, pushing them further could lead to distortion from the mixer. Admittedly, the habit of recording at the hottest possible level (which is zero on a DAT deck) is something of a holdover from analog mastering and is not absolutely necessary in the digital format. But there *is* a noise floor with digital audio, and it makes sense to me to stay as far away from it as possible.

The real advantage—theoretically, at least—of using the Cal setting is that it bypasses the input-level control circuitry, providing a more direct signal path to the converters. This idea is appealing, but I couldn't hear the difference. Of course, if your source unit doesn't transmit at +4 dBm or -10 dBV, you simply switch to Uncal and set your levels with the input-level knobs. The uncoupled knobs on the MKII work fine, but I miss the ease of use and precision feel of the DA-30's large, friction-clutch-coupled knobs. But no matter: the majority of users will probably choose the Cal setting most often, rendering level controls superfluous.

FEATURES LOST

It's unfortunate that TASCAM decided against having an output-level knob on the MKII. A technician explained that market research showed it wasn't being used on the DA-30. One wonders whom they polled. Without an output-level control, simple machine calibration is impossible. For example, let's say you are assembling a master DAT from DAT mixes made at various other studios using different brands of DAT machines. On one such tape, a 1 kHz tone that reads 0 VU on your DAT deck reads only -3 VU when patched into the stereo inputs on your mixer. Another tape, conversely, is so hot that it *pegs* your meters. With the DA-30, you simply boost or lower the output level until the mixer reads 0 VU. With the MKII, there's no way to calibrate the two machines.

Furthermore, DAT machines are commonly used by home recordists for bouncing analog tracks. But if the source deck lacks an output-level control, you have to boost the channel faders to increase low signal levels, which can introduce circuit noise in a less-than-quiet mixer. I also frequently use the output knob on my DA-30 when making cassette dubs from DAT. It's more convenient than adjusting separate input knobs on the cassette deck, and it allows easy, one-handed fades.

Two other DA-30 features have disappeared from the front panel of the MKII: Program Time and End Search. The former, when activated, recorded Program Time over the full length of each program, allowing you to see the elapsed time of a song even if you started it somewhere in the middle. I used this feature only once in four years;

evidently it was no more popular with other users. End Search, which fast-forwards the tape in search of an End ID (or, if there isn't an End ID, the first unrecorded section of tape), still exists but is accessible only from the RC-D30 remote control.

Another feature, Intro Check, was previously available on the DA-30's remote, but now it has been replaced by a memory Locate button—a far more useful feature in the studio. (Intro Check, primarily a consumer feature, enabled the tape to play the first ten seconds of each program. No one should miss it.)

FEATURES GAINED

The unit's main new feature, of course, is the Data/Shuttle wheel. The inner Data wheel allows you to select a Program Number for fast searches, and it lets you easily trim the position of a Start or Skip ID by incrementing or decrementing the ABS time display. The outer Shuttle wheel offers high-speed cueing at continuously variable speeds determined by the amount of wheel rotation.

These are nifty controls, but they come at a price: to offer the Data/Shuttle wheel and stay within budget, TASCAM had to relegate the remote control (which came stock with the DA-30) to optional status.

It's a questionable trade-off, though, because the remote control performs many functions the Data/Shuttle doesn't. In fact, the only thing you *can't* do with the remote that you can do with the Data/Shuttle wheel is shuttle along at variable speeds of up to sixteen times the normal Play speed. However, the Search button on the remote offers cueing at nine times the normal speed, and the Rewind and Forward buttons allow cueing at three times the normal speed. (Of course, prolonged use of cueing should be avoided so as to minimize head wear.)

I recommend you spend the extra money up front to get the RC-D30 remote control. The remote duplicates all front-panel controls except the Shuttle wheel and adds several useful features, including a numeric keypad used to designate Program Numbers for direct search (as with the Data wheel) and for programmed play (just like a CD player); a Repeat button that enables a single program, a programmed sequence, or the whole tape to play over and over; an End Search button that finds the End ID or, if there isn't one, the beginning of unformatted tape; and a Display switch that lets you vary the display screen's brightness. Of course, if your deck is located more than an arm's reach away, the remote control is especially desirable.

Other welcome new features on the MKII include Memo and Locate buttons, a Copy ID button, and a Shift key that alters the functions of three other buttons. The Copy ID button, when pushed with Shift, lets you enable or defeat SCMS copy protection and even prohibit *any* digital copies from being made. Pushing Shift with Memo displays the currently stored autolocation point, and pushing Shift with Auto ID allows you to change the sensitivity level of the Auto ID circuit.

One of the MKII's most welcome new features is neither advertised nor immediately obvious: subcode transmission via the S/PDIF digital I/O. (The AES/EBU interface does not support subcode data.) This capability allows you to make digital safety copies that include IDs and Program Numbers. Previously, when recording digitally from one DA-30 to another, subcode data was transmitted haphazardly or not at all. Start IDs had to be reinserted manually for each safety copy of a finished master, which was a royal pain, not to mention that it was all but impossible to exactly replicate the position of the original IDs. But no more: the MKII reads and writes subcode data flawlessly.

PERFORMANCE

The MKII performs perfectly the many tasks it was designed for and, like its

Product Summary

PRODUCT:
DA-30 MKII
PRICE:
$1,599
MANUFACTURER:
TASCAM
tel. (213) 726-0303
fax (213) 727-7656
CIRCLE #438 ON READER SERVICE CARD

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

predecessor, runs quietly and stays cool. Tape-access times are fast, as is specific Program location. Strangely, the sonic specifications listed in the owner's manual are slightly *less* impressive than the DA-30's, but TASCAM technicians assured me this discrepancy reflects more accurate specifications testing, *not* reduced performance.

As mentioned earlier, the MKII sounds even better than the DA-30. The difference is very slight, however, and is not easy to hear. To compare the machines, I dubbed several musical pieces from a B&K Pro Audio reference CD simultaneously to both DAT machines, using the S/PDIF inputs. In an A/B/C listening test, I compared the source CD and both DAT copies in real time, fading back and forth while monitoring alternately through Audix Studio 1A monitor speakers and Grado Prestige Series SR-325 reference headphones.

Neither DAT copy sounded *exactly* like the CD, but the MKII's sounded a bit closer. My first impression was that the DA-30 was brighter sounding. But after repeating the test several times (on different days and times of day), I realized that all of the high-end information was equally present on the MKII, but it was balanced by a fuller, more detailed low end. Specifically, bass signals between 40 and 100 Hz had greater depth and resolution. (This was most obvious on Little Feat's "Hangin' On to the Good Times," a pristine George Massenburg mix.) The low midrange also had more detail and "oomph." I would again stress, however, that the improvement in sound of the MKII over the original DA-30, though real, is nominal.

DAT'S ALL, FOLKS

The DA-30 MKII is a well-designed, great-sounding, high-performance DAT deck that, along with the optional remote control, should prove a worthy successor to the DA-30. Its new features are welcome, and the only disappointment is the absence of an output-level control.

The unit's price is competitive with high-end consumer DAT decks, and its rugged, rack-mount construction, excellent features, balanced inputs and outputs, and choice of S/PDIF or AES/EBU digital I/O make it a great investment for the pro user and serious home recordist alike. ❀

Steinberg Cubasis Audio 1.0 (Win)

By Allan Metts

Digital audio sequencing for the PC user on a budget.

Windows users have anxiously awaited a program that lets them record MIDI and digital audio together in an integrated sequencing environment. Such programs have existed for years on the Macintosh, but until recently, all of them have been aimed at the pro market. In addition, Mac users can now buy Power Mac-native (or Quadra AV-based) digital audio sequencing programs that require no external hardware.

Unfortunately, Windows programs have lagged behind. Sequencers for this platform didn't offer synchronized digital audio recording until Steinberg's high-end *Cubase Audio* (reviewed for the Mac in the January 1995 **EM**) was released for Windows. However, both the Mac and PC versions of that program require a relatively expensive Digidesign audio card or Yamaha CBX-D5/D3 audio-recording hardware, which is not attractive to budget-conscious, nonprofessional users. Soundcard users still had to run separate audio and MIDI programs.

At last, this problem is history. Several Windows-sequencer developers have released integrated digital audio sequencers for PCs with an MME-compliant sound card, and Steinberg's *Cubasis Audio* is the first of this new generation to hit the streets. The program combines the company's *Cubasis* entry-level sequencer with multitrack digital audio recording and very simple editing at an attractive price. It's a promising combination, provided you can live without some of *Cubase Audio*'s advanced features.

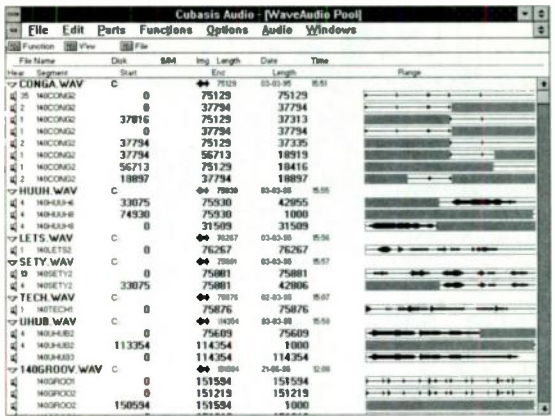

FIG. 2: The Audio Pool lets you keep a project's audio files organized in one place. You can save the Audio Pool separately for use in other projects.

FIRST TAKE

Fire up *Cubasis Audio,* and you immediately see a difference from conventional sequencers. You don't see the typical Track editor, with each track represented as a row of program parameters and musical measures. Instead, *Cubasis Audio* shows you an Arrange window that displays the output, channel, and mute settings for each track (see **Fig. 1**). Parts take the place of measures in the Arrangement window, with each Part representing an entire musical phrase or performance.

The program's transport bar offers tape deck-style transport controls, along with the tempo, time signature, song position, MIDI-activity indicators, locate points, solo controls, and metronome controls. The transport bar can't be resized and was constantly in the way on my 14-inch monitor. Unfortunately, you can't drag it up to the top of the screen to transform it into a toolbar, but you can make it disappear with one keystroke, which helps. The song position appears in bar:beat:tick format, and I counted at least nine different ways to change the current song position.

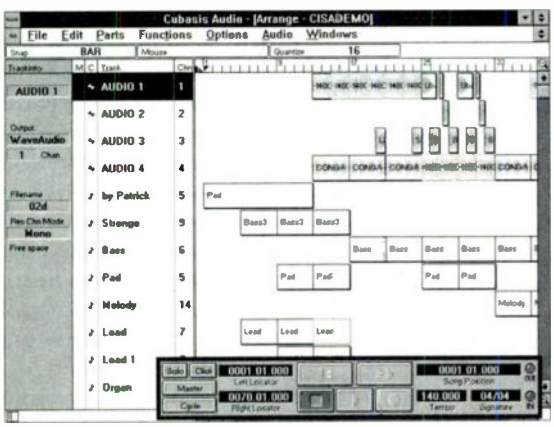

FIG. 1: Instead of a conventional Track editor, with each track represented as a row of parameters and musical measures, *Cubasis Audio* has an Arrange window that shows Parts, which represent entire musical phrases.

Recording always takes place between the left and right locate points, which can be specified in several ways. The program has no automatic punch-in feature, but the locate points provide almost the same functionality. You can automatically start recording at the left locator after a metronome count-off. However, you can punch in manually by playing the song and toggling the Record button.

In fact, you can do anything while *Cubasis* is playing a song. You can change the song pointer, open an edit window, create a new track, even load a new file, and the music never stops.

The Cycle feature is a great way to lay down drum parts. You set the left and right locators, click Cycle on the transport bar, and start recording. *Cubasis* loops through the selected section and lets you add new parts with each lap. I also turned on Cycle during many editing operations so I could hear the results of my edit as soon as I made it.

You have a choice when it comes to setting tempo and time signature. A Master Track is available from a pull-down menu, with controls for entering new tempos or time signatures at any point in the song. I prefer the ability to automatically generate accelerandos and ritardandos—you must buy *Cubase* for this feature—but the Master Track will suit most users. If you don't change tempo or time signature in your song, you can set the values on the transport bar and disable the Master Track.

Tempo is specified to three decimal places (to facilitate synchronizing MIDI to the audio tracks), and time signatures can be anything from 1/2 to 16/16. *Cubasis Audio* can sync to an external MIDI source using MIDI Clock and Song Position Pointer. SMPTE and MIDI Time Code synchronization are not supported; again, if you want these features, you need *Cubase.*

PLAYING WITH PARTS

The *Cubasis Audio* Part is a powerful construct. No longer must you remember that the synth lead solo starts on

bar 12 and runs through the third beat of bar 28; you have a block onscreen that says "Synth Lead Solo." You can move or copy the block to another track and specify its transposition, volume, and channel setting. In addition, you can change the length of the block. Making it longer adds blank time, whereas making it shorter truncates the material. However, the cut material is not lost; if you restore the length of a shortened block, the material plays again.

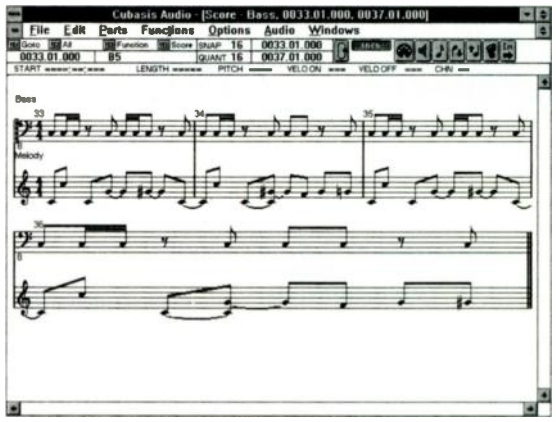

FIG. 4: *Cubasis Audio*'s Score Edit window is a simplified, but powerful, version of the score editor in Steinberg's well-respected *Cubase Score*.

Cubasis also lets you create "ghost" copies that are automatically updated whenever you change the original. For example, I used ghost parts every time I wanted to create a doubling effect using two different synth sounds.

Pressing the right mouse button in the Arrange window brings up a toolbox that allows all sorts of editing operations on Parts. The scissors break a Part into smaller pieces, and the glue tube sticks them back together again. The magnifying glass allows you to audition, or scrub, the Parts by dragging it across them.

Cubasis' Inspector lets you edit several track and Part parameters. For MIDI tracks and Parts, you can edit Volume, transposition, Velocity, Bank Select, Program Change, and the MIDI port and channel. The Inspector helps minimize the clutter in the Arrangement window, but it is a bit inconvenient at times. I like to see all my patch, volume, and pan settings at once, but with the Inspector, I had to click on each track individually. (Pan isn't even shown on the Inspector.) And although the Inspector allows you to have different settings for each Part within a track, I had a tendency to edit Part information when I wanted to edit track information. You really have to pay attention to what you've selected for editing.

REAL AUDIO

Because *Cubasis Audio*'s integrated audio recording is what makes it noteworthy, I was eager to check out this aspect of the program. I'm happy to report that I was pleasantly surprised with the audio features and their speedy execution. And when the audio processing *was* too intense for my system, *Cubasis Audio* gracefully provided a message to that effect, shut off the offending track, and kept playing whatever it could without a glitch. I greatly appreciated its stability.

You record audio tracks just like MIDI tracks by setting the left and right locate points prior to hitting the Record button. Audio tracks and Parts appear in the Arrange window, just like their MIDI counterparts, and they can be assigned to one of four audio channels. Each channel can be mono or stereo. You can assign more than one audio track to a channel as long as you don't try to play multiple audio tracks at the same time. If you try to play several tracks simultaneously on the same channel, only

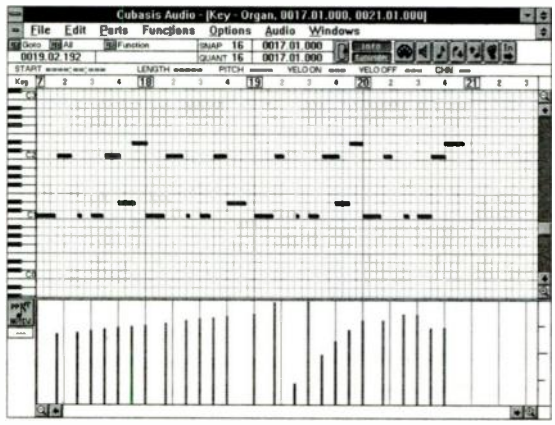

FIG. 3: The Key Edit window gives you the obligatory piano-roll screen, but it also throws in graphic controller editing.

one track will play. A Monitor window supplies volume faders, pan controls, mutes, and meters for each of the four audio channels.

You can move audio Parts around, split them, glue them together, and audition them using the tools found under the right mouse button. You can also change their length with the same results as changing the length of MIDI Parts. *Cubasis Audio* achieves this editing capability by leaving the actual audio data intact as WAV files on your hard drive. All audio edits are performed nondestructively, i.e., by manipulating pointers to the audio data rather than altering the actual data itself. I appreciated not having to wait for audio data to process every time I changed a Part in an audio track.

The program provides an Audio Pool to help you organize the audio files for a particular project (see **Fig. 2**). You can

▼

You immediately see a difference from conventional sequencers.

import WAV files from other sources and drag them into your arrangement. All files in the Audio Pool must use the same sample rate, but you can mix mono and stereo files to your heart's desire. *Cubasis Audio* automatically converts the sample rate if you try to import a file with the wrong rate. If you have a collection of favorite audio snippets, you can save the Audio Pool separately for use in other projects.

Cubasis Audio derives its MIDI timing from the clock in your sound card, so you should never have to worry about the audio drifting out of sync with the MIDI tracks. To test this out, I used a recording of a guitarist I worked with years ago. I made a WAV file of the recording, pulled it into an Arrange window, and used the tempo control to sync up to it. Then, I recorded an entire orchestra of synth and drum Parts on top and never had a problem with synchronization. Boy, was that guitarist surprised when he heard the tape! Fortunately, he had made the original recording by playing with a

fixed-tempo click track. Had the tempo been rubato, I would have been lamenting over *Cubasis Audio*'s lack of a tap-tempo feature to help me line up all the measure boundaries.

Steinberg includes a performance-checking program to help you determine how many audio tracks your system can support. (This program is also available on Steinberg's CompuServe site so you can see how your system will perform before you buy *Cubasis Audio;* see the address in the Product Summary.)

However, this program's prediction was a bit optimistic in my case. According to the performance checker, my 80486DX/33 with 8 MB of RAM, a fast SCSI controller, and a hard drive dedicated to digital audio should have supported two simultaneous stereo channels at 44.1 kHz or four stereo channels at 22.05 kHz. But in practice, I could only eke out one stereo CD-quality channel or three at the lower sampling rate. When I kept everything monophonic, I could manage three 44.1 kHz channels, which I consider pretty good for a '486 machine.

AUDIO AND MIDI EDITING

You can only perform simple edits on the WAV audio file. You can erase the portions you aren't using, normalize the file's volume (which minimizes headroom), or reverse the waveform. There is no wave editor; again, you should buy *Cubase* if you need serious audio-editing capabilities.

But *Cubasis Audio* does provide powerful tools for editing the subtle details of your MIDI data. One of the most important tools is the Key Edit window (see **Fig. 3**), which shows a piano-roll display of the notes in your Part (or Parts, if you selected more than one before opening the window). I was surprised and pleased to discover the graphic MIDI-controller display that appears below the piano roll. This display shows Velocity bars for each note or a graphic representation of Modulation, Pitch Bend, Volume, Pan, or Aftertouch. Usually, graphic-controller editing is reserved for higher-priced sequencing packages, but I consider it a necessity for my work.

A palette of tools lets you perform every MIDI manipulation imaginable in the Key Edit window. Drag-and-drop editing is supported, and you get tools for changing the duration or Velocity

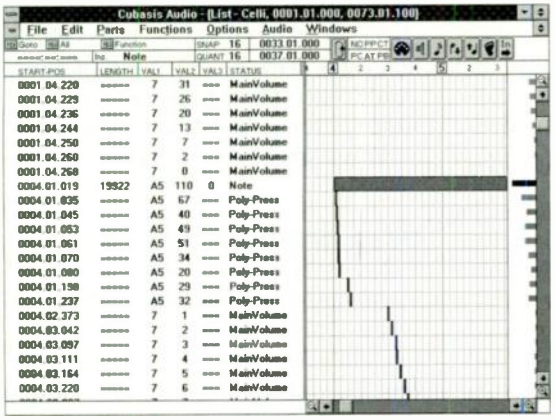

FIG. 5: The Event List editor is the most powerful I've seen in a PC sequencing program.

of each note. You can also "paint" notes in at regularly spaced intervals using the mouse. In addition, you can reshape the Velocity and continuous controller information.

Two parameters labeled Snap and Quantize appear at the top of every edit window. The Quantize label confused me at first; I assumed it would shift the MIDI data to fall on the nearest specified rhythmic position. This doesn't happen unless you request Over Quantization from a pull-down menu. When you do select Over Quantization, it is applied only during playback, which lets you undo it at any time. If you want to export a MIDI file, you can select the Freeze Play function to make the quantization permanent.

Generally, Snap determines where MIDI data will be placed when you insert it, and Quantize determines how long it will be. With a Snap value of 8 and Quantize set to 16, you'll insert sixteenth notes at the nearest eighth-note position. The real beauty of Snap and Quantize is that they are used in nearly every editing operation, which minimizes the need for dialog boxes.

A set of buttons at the top of the Key Edit window lets you use your MIDI keyboard as an editing device. Once this feature is enabled, *Cubasis Audio* cycles through each note and lets you change its pitch or Velocity using your keyboard. If you press the Footprint button (for step recording—get it?), you insert new notes. As expected, Snap controls the size of the steps, and Quantize determines the duration of the inserted notes.

WHAT'S THE SCORE?

Cubasis Audio also allows editing from standard music notation (see **Fig. 4**). Many of the features available in the Key Edit window are here, too, including step recording and drag-and-drop editing. You can place new notes and rests using the mouse and type text at any location. If you select Parts from more than one track before opening the Score Edit window, the Parts appear as separate staves.

Cubasis Audio's scoring features are intended only for simple score editing and printing. However, a host of options (such as display-only transposition and quantization) help you see the score just the way you want it. You can split a Part into a grand staff for piano scores or tell *Cubasis Audio* to clean up the display when long and

short notes appear together at the same rhythmic position.

You also get an Event List editor that is probably the most comprehensive event editor I've seen in a sequencing package (see **Fig. 5**). Events appear with their position in time, their length (if appropriate), up to three data bytes, an event description, and their MIDI channel. Each event is plotted in time on a grid, letting you drag the event to a new point in time or change its length.

There's even a bar graph for each event, which lets you change the Velocity of a note event or the value of a continuous controller. You can also filter the display to show only certain kinds of events. System Exclusive events are displayed here, as well, and short SysEx messages can be edited in a pop-up window. MIDI-based editing and step-recording tools (the same ones found in the Key and Score Edit windows) are also found here.

In the bells-and-whistles category, *Cubasis Audio* supports orchestral transposition as well as alto and tenor clefs, features you typically expect to find in dedicated scoring software. The program also offers a General MIDI window (see **Fig. 6**), where you get volume faders, pan knobs, and the ability to change program (by name), chorus, and reverb settings. This window supports all three flavors of General MIDI (GM, GS, and XG).

I didn't have much use for the GM window. To begin with, the fader and knob movements can't be recorded. In addition, there's no link between the information in the GM window and the rest of the program; if you change a patch name or volume setting in the GM window, you must also make the change in your MIDI file. The GM window is for playback-only convenience. I would have liked to see patch-name support for popular non-GM synths and the ability to create my own patch-name lists.

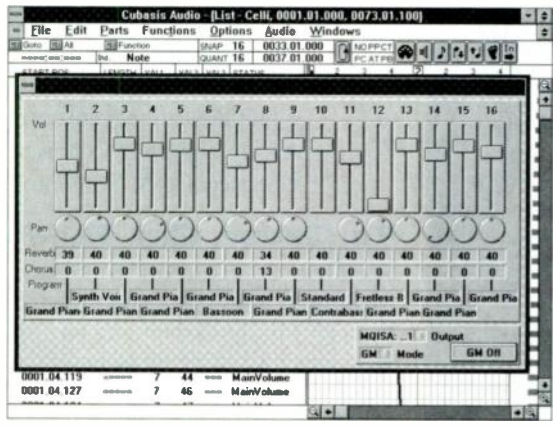

FIG. 6: The General MIDI window is handy for changing settings during playback, but the faders can't be recorded in the main program.

USER INTERFACE

Cubasis Audio falls a bit short in the ease-of-use department. Essentially, you access tools with the right mouse button and perform tasks with the left button. However, you must be willing to learn some rather arcane mouse movements. For example, you can create repeating ghost Parts that follow the original. But to do it, you must press the right mouse button, select the pencil, then drag (with the left mouse button) the right edge of the original part while holding down the Control key. In this instance, a menu pick with a dialog box would have been more appropriate.

There are keyboard shortcuts for most commands in the program, but you need a cheat sheet in front of you to use them. Sometimes, you just press a key, but other shortcuts require the Alt, Control, or Shift key, as well, and I never knew which one to use. Some operations (such as clearing the last lap of a Cycle recording) can only be done with a keystroke and have no corresponding menu or button on the screen.

There are instances where *Cubasis Audio* deviates from standard Windows conventions. For example, you usually press Alt-F to pull down the file menu. But to pull down the file menu in *Cubasis Audio,* you press *and release* the Alt key and then press F; if you hold the Alt key while pressing F, the program does something else.

In addition, most Windows programs let you copy something by holding the Control key and dragging. In *Cubasis Audio,* however, you use the Alt key, which is a Macintosh convention. Given that one of the main purposes of Windows is to provide a standard user interface, I get cranky when a program departs from the standard. (You can also make copies by selecting the Part, holding down the

left and right mouse buttons, and dragging to the desired location. It's not a Windows convention, but it is fast.)

Some of the user-interface quirks would be forgivable if online help were available. However, there is none, not even a status bar that tells you what a button does. Fortunately, the manuals are good, with plenty of illustrations and a logical organization. One manual covers the MIDI and score functions and a separate book explains installation and the audio functions. The main manual has no index, but the table of contents has enough detail to find information in a hurry.

Plan on reading both manuals from cover to cover, and keep them near your computer when you start working with the program. Technical support is available via CompuServe and telephone.

THE BOTTOM LINE

Is *Cubasis Audio* for you? If you have a simple home studio, it will probably meet your needs. But if you need more advanced features, such as SMPTE synchronization, advanced scoring, audio-waveform editing, and esoteric MIDI processing (such as Groove Quantize), save up your money for *Cubase Audio* (which should support MME sound

Product Summary

PRODUCT:
Cubasis Audio 1.0
PRICE:
$299
SYSTEM REQUIREMENTS:
80386DX PC with 8 MB of RAM, Windows 3.1 or Windows 95, fast hard disk, Windows-compatible sound card, VGA monitor
MANUFACTURER:
Steinberg
tel. (818) 993-4091
fax (818) 701-7452
e-mail 71333.2447@compuserve.com
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CIRCLE #439 ON READER SERVICE CARD

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

cards by the time you read this) or Cakewalk Software's *Cakewalk Pro Audio,* which costs just $100 more than *Cubasis Audio.*

If I were *Cubasis Audio*'s developer, I would make the user interface more Windows standard, improve support for synthesizer patch names, and get rid of the copy-protection dongle that sticks out of the parallel port. But I wouldn't change the powerful MIDI-editing capabilities or the great audio performance. I would also maintain the rock-solid stability of the program; I never experienced a crash when using *Cubasis Audio.*

Steinberg has delivered a lot of MIDI muscle along with modest audio features in this program. If you are a home recordist who is ready for an integrated digital audio sequencer but doesn't need a long list of pro features, there's plenty of reason to get excited about *Cubasis Audio.*

Allan Metts *is an Atlanta-based systems designer, musician, and MIDI consultant.*

Marion Systems ProSynth

By Peter Freeman

The latest Tom Oberheim analog synth offers digital precision.

With all the recently renewed interest in analog synths, several manufacturers have wasted no time jumping on the bandwagon. On the other hand, there are a few manufacturers that never got off the bandwagon. Among them is Tom Oberheim, who became famous for designing some of the best-sounding analog synths ever made.

The first product of his current company, Marion Systems, was a 16-bit upgrade board for the Akai S900 sampler. More recently, he has turned his attention back to analog synths. The company's latest offering is the ProSynth. This digitally controlled, analog sound module is basically a stripped-down (and thus less-expensive) version of the Marion MSR-2 without the latter's separate outputs, external audio inputs, and ability to add synthesis expander cards. However, the sound engine of the ProSynth is identical to that of the MSR-2.

FIRST GLANCE

The ProSynth is an 8-voice instrument with two oscillators per voice and 16-channel multitimbral capabilities. The front panel of the 1U rack-mount device includes a 2-line × 40-character backlit LCD; Preset, Edit, and System buttons; and Data Entry/Page knobs. The back panel sports MIDI In, Out, and Thru ports and a pair of ¼-inch audio outputs.

There are 200 Presets in ROM and 200 user Program locations. There are also 100 memory locations that store Layers, which combine up to four Programs that can be split across the keyboard, Velocity switched, or both. There are no memory locations for multitimbral setups *per se.* Instead, you simply assign any Program to each MIDI channel, which is similar to the E-mu Proteus.

ARCHITECTURE

Two features distinguish the ProSynth from its competition: high-resolution oscillators and the ability to smoothly crossfade between different analog waveforms (sawtooth to triangle to clipped triangle). According to Tom Oberheim, the high-resolution oscillators exhibit much greater pitch resolution and stability than conventional analog oscillators. In practice, I found that this translates into a perceptibly high degree of tuning stability.

The ProSynth includes the expected complement of analog-synthesis components. You get two oscillators, one multimode (2-pole or 4-pole) VCF, one VCA, two LFOs, a noise generator, two ramp generators, and three envelope generators (one for the VCF, one for the VCA, and a general-purpose EG). An additional LFO is dedicated to global vibrato, with a wide variety of analog waveforms.

In addition, modulation routing is quite flexible, with up to ten simultaneous paths between sources and destinations (see table, "ProSynth Modulation Paths"). Positive and negative modulation depths from 0 to 99 are available.

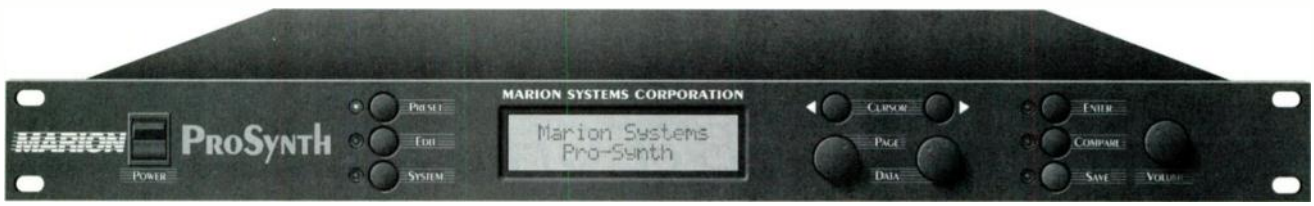
▼

The oscillators have a high degree of tuning stability.

There are also four preset Velocity curves and one user-specified Velocity curve, which remap incoming Velocities to different values.

The ProSynth offers users eight voice-allocation modes, which provide a lot of flexibility in how the instrument assigns polyphonic voices. Some of these modes "steal" held notes, and others layer two or four voices for each note played. There is also a monophonic mode that plays only one voice at a time.

Four user tuning-table locations let you create and store custom tunings with 0.2-cent precision. The synth's high-resolution oscillators offer stability and precision superior to any conventional analog synth, and you can tune each MIDI note independently. These two features make the ProSynth a better choice for alternate tunings than any other analog synthesizer.



Marion Systems' ProSynth offers extremely stable, precise oscillators and can crossfade between waveforms. It sounds like a digitally controlled analog synth, rather than a pure analog instrument.

You also have access to some handy editing features. For example, you can assign a Control Change (CC) to edit any parameter by selecting the parameter, holding the Edit button, and sending the desired Control Change.

The manufacturer has put much thought into making a user interface with a small display easier to navigate. For example, if you press the Edit button to go into Edit mode and then press it again, you'll see the Quick Edit Catalog. The two-page Catalog shows sixteen general parameter groups (e.g., the audio oscillators), with eight groups on each page. You just cursor or scroll to the parameter group you want and release the Edit button, and you'll go right to the selected group.

What if you need to manipulate two parameters in tandem, moving back and forth between the two, but the parameters are found on unrelated pages? The ProSynth lets you set a marker for each parameter. Once you've marked the parameters, you can jump between them simply by holding the Enter button and turning the Page knob.

MIDI AND MANUAL

The ProSynth recognizes MIDI Note On/Off, Program Change, Volume, and Tune Request, in addition to the eight Control Changes assigned as modulation sources. Five of the modulation sources can be any Control Change from 1 to 31, and the other three can be any Control Change from 64 through 79. I would prefer the ability to assign *any* CC from 0 to 127 to any source. In addition, you can remap Program Changes (using 0 to 99 or 0 to 127) and send and receive System Exclusive

Product Summary

PRODUCT:
Marion Systems ProSynth
PRICE:
$1,149
DISTRIBUTOR:
RiCharde & Co.
tel. (408) 688-8593
fax (408) 688-8595
e-mail richarde@got.net
CIRCLE #440 ON READER SERVICE CARD

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

bulk dumps from the front panel.

The MIDI implementation is more thorough than I suspected, as certain details are omitted from the current version of the manual. I refer primarily to the ProSynth's SysEx capabilities, which include messages for every parameter. In fact, Marion Systems is developing a Macintosh editor/librarian for the ProSynth, which is expected to be ready by the time you read this. However, this program was unavailable for evaluation in time for this review.

The manual adequately covers the ProSynth's various features and functions, without going into deep detail. In general, the manual is oriented toward the nontechnical musician rather than those with in-depth knowledge of MIDI and synthesis. No MIDI implementation chart was included in the manual; I had to request one separately.

THE SOUND

I programmed the ProSynth to generate the types of sounds for which I would normally use an analog machine: bass, sustaining texture, unpitched effects, and monophonic melody sounds. The ProSynth seemed to fare best with sustaining textures, which were well served by the synthesizer's modulation capabilities.

I was able to construct a few nice Programs for playing melody lines, but the instrument's relative lack of "weight" seemed to prevent these sounds from exhibiting the authority and conviction to make them hold up in a musical context with other instruments. This is also true for bass sounds, which can be quickly eaten alive by a dense or big-sounding drum track unless they are really robust and powerful.

Given the design and layout of the ProSynth, I expected classic analog textures in the tradition of Tom Oberheim's earlier instruments. However, the new instrument lacks punch. In general, attempting to create big, analog sounds with impact left me unsatisfied.

Although a few interesting modulation paths are possible, there is no cross-modulation between the oscillators, which is unfortunate; many interesting analog textures use this feature. The unit I received for review had been updated with a faster envelope response time than earlier versions, but I still wasn't able to get really tight, pointed attacks.

WISH LIST

In addition to cross-modulation, it would be helpful to have additional

ProSynth Modulation Paths

The ProSynth offers up to ten simultaneous paths between 24 sources and 33 destinations. For the sake of brevity, destinations of the same type have sometimes been combined into one entry; for example, the frequencies of oscillators 1 and 2 can actually be modulated separately.

Modulation Sources	Modulation Destinations
Velocity	oscillator frequency
Release Velocity	pulse width
Channel Pressure	wave shape
Polyphonic Pressure	wave mix
Pitch Bend	filter cutoff
8 user-selected Control Changes	filter resonance
MIDI note number	pan
VCA EG	overall amplitude
VCF EG	LFO rate
General-purpose EG	LFO amplitude
LFO 1, LFO 2	FM amount
Vibrato LFO	EG/ramp delay
Ramp 1, Ramp 2	EG/ramp attack
	EG/ramp decay
	EG/ramp release
	noise amount
	portamento rate

oscillators, ramp generators, envelopes, and LFOs to work with, as well as more waveforms, filter modes, and modulation paths to create really sophisticated timbres.

Two hardware upgrades are currently in the works for the ProSynth. An external output panel will provide sixteen discrete outputs (left and right for each of eight voices) to increase the usefulness of the unit's multitimbral capabilities. In addition, a hardware programmer is on the drawing board, which will provide knobs and sliders for the ProSynth's most frequently used parameters.

▼

The ProSynth seemed to fare best with sustaining textures.

CONCLUSION

When I'm presented with an analog synthesizer that Tom Oberheim designed and built, I expect a big, analog sound. Although you can program some good almost-analog sounds with this unit, the ProSynth always sounds like a hybrid instrument, such as an Oberheim Matrix-1000. I was hoping for a gutsier, pure analog sound, reminiscent of earlier-era Oberheim synthesizers.

On the other hand, the ProSynth has several advantages over older, classic analog synths. For example, it is more reliable than the old-timers and offers improved tuning stability and resolution, smaller size, a modern MIDI implementation, and more Program memory. If these issues are your primary concern and you need an instrument that fulfills some of the functions of an analog synthesizer, the ProSynth is a reasonable choice. But if you need pure, classic analog sound and programming, you will have to look elsewhere.

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

Hohner MIDIA Drumatix 1.0 (Win)

By Zack Price

Put a better groove in your MIDI rhythm tracks.

For many electronic musicians, one of the most difficult aspects of sequencing is creating drum parts. After all, few of us are competent drummers, and many nondrummers don't have access to, or studio space for, a real drummer with an electronic kit.

You could play the parts yourself using a set of electronic pads or a keyboard, but many nondrummers find it difficult to establish a realistic groove that way. The rest of us must buy preprogrammed patterns or create the drum parts in software. If you prefer the latter approach, a good rhythm editor is an invaluable tool.

FIRST GLANCE

Drumatix is a Windows-based rhythm editor that includes 64 pattern locations for recording and playback. Each pattern can accommodate up to 64 separate instrumental sounds (e.g., snare, kick drum, etc.), which are assigned to different lines in the pattern (see **Fig. 1**). Each line also includes the instrument's MIDI note assignment, MIDI channel, Velocity values, and duration. (I'll discuss this in more detail shortly.) Although pattern and instrument settings default to GM/GS mapping, you can create and save your own unique drum and instrument maps (see "Instrument Maps" section).

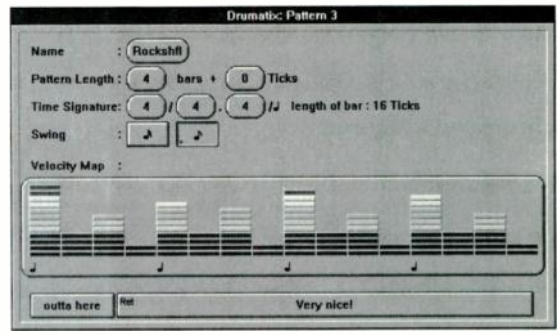


FIG. 2: Each pattern's parameters can be individually set using the Pattern map.

Like most rhythm editors, *Drumatix* lets you copy patterns to other pattern locations. However, you can't append one pattern to another, copy a portion of one pattern to another, or copy individual instrument data to other lines within the same pattern. Those who are used to manipulating patterns in this way might consider this a serious deficiency. Fortunately, *Drumatix*'s Repeat function speeds up pattern creation by automatically duplicating your pattern data in the *following* bars. (Conversely, clicking on an existing note erases it and all notes on that beat in the following measures.)

For example, entering a kick-drum hit in bar 1, beat 1 generates kick-drum notes on beat 1 in the following measures of the pattern. Placing snare-drum hits on beats 2 and 4 in a pattern's second measure automatically generates snare hits on the second and fourth beats in the following measures. However, no snare hits are entered in the preceding measure. This doesn't make up for the program's inability to copy between patterns, but at least you don't have to keep manually reentering the same data within a line.

To arrange patterns for song playback, you switch to Song Mode and select one of *Drumatix*'s eight song locations. Each song is divided into 64 steps. Each step has an inner and outer loop for extending song playback. Each inner and outer loop can be repeated 99 times, providing almost endless playback. In practice, however, you don't need to create or nest many loops to construct most songs.

When it's time to save your work, you can save all pattern, song, and instrument-map data as one large file or as separate file types. Individual patterns or songs can also be saved as Type 0 Standard MIDI Files. Unfortunately, *Drumatix* doesn't import Standard MIDI Files, which makes it impossible to modify patterns from other sources.

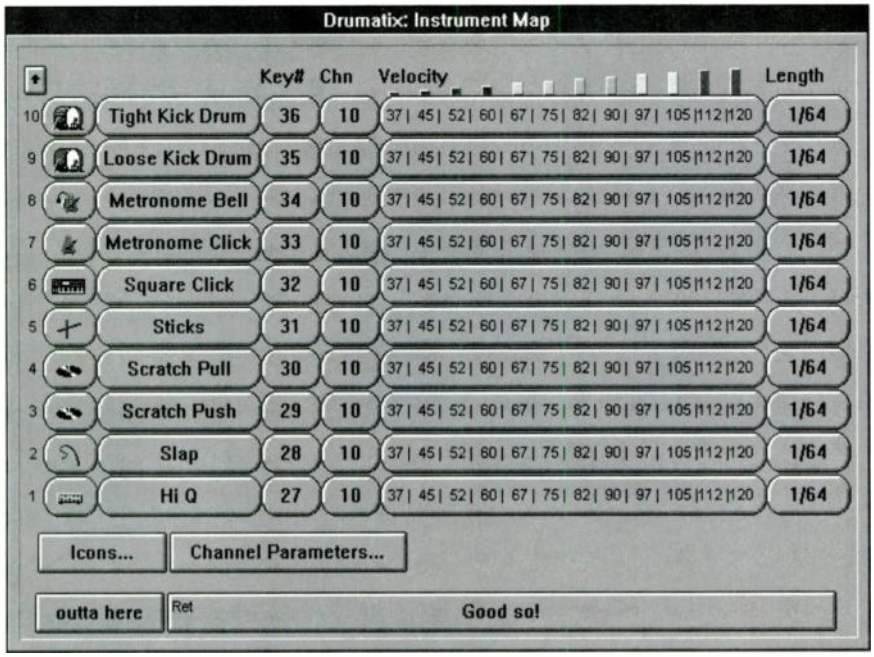


FIG. 1: The Instrument Map is used to assign MIDI notes and channels to drum and instrument sounds. Each line's Velocity Scale and note length is set here, too.

INSTRUMENT MAPS

You can use *Drumatix*'s multitimbral capabilities to produce rhythm patterns that include bass lines, arpeggios, melodies, and/or chords. To do this, however, you must set up specialized instrument maps more often than when creating drum parts.

Fortunately, creating new instrument maps is easy. You just select Instrument from the Edit menu to call up the Instrument Map screen (see **Fig. 1**), assign a MIDI note number and channel to each line, and then name its sound with GM/GS or custom names. For easier visual identification, you can also

associate an instrument or note icon with a line's instrument name from one of the 128 icons in the Icon submenu.

The Channel Parameters submenu lets you input the Bank, Program Change, Volume, and Pan settings for each MIDI channel in use. From there, you can set reverb and chorus levels for Roland GS instruments and other devices that respond to Control Change 91 and 93.

Next, you establish each line's Velocity Scale by setting the MIDI Velocity value for each of its twelve steps (see **Fig. 1**). These steps correspond to the levels you specify for each rhythmic subdivision of the bar in the pattern's Velocity Map, which determines the Velocity with which the instrument is played when placed at different rhythmic locations in the bar. The Velocity Map is also crucial to utilizing *Drumatix*'s real-time, intelligent fill function. (I'll discuss both features in a moment.)

▼

Although I like playing with *Drumatix*, it isn't always a picnic.

The values of each step in the Velocity Scale can be set independently for each instrument. This makes it easier to customize an individual sound's Velocity response. For example, you might want bass and snare drums that don't produce extreme changes in Velocity but that still sound realistic. In this case, you might scale their Velocity values to a narrower, higher range relative to the other sounds in the instrument map.

Finally, each line's note duration can be individually adjusted. Unfortunately, *Drumatix* doesn't let you set note duration on the fly, as is possible in some other rhythm editors, such as Mediatech Innovations' *Rhythm Brainz* and Howling Dog's *Power Chords Pro*. This makes it more difficult to create melody or bass lines with notes of identical pitch but different durations. The only workable solution is rather clumsy: create a separate line for each note's pitch *and* duration.

PATTERN SETUP

To create a pattern, you click on, or type in, the desired pattern-location number. Then, go to the Edit menu, select Pattern, and the Pattern setup screen appears (see **Fig. 2**). You can name the pattern and set its length in bars and ticks.

Interestingly, *Drumatix* lets you create patterns that contain partial bars. This is useful for creating pickup measures or rhythms that don't correspond to a particular meter. This is a pretty cool feature, but it can cause some sequence-editing headaches later because the pattern data might not line up with another sequencer's meter and measure references.

Next, you set the time signature, quantization, and swing resolution. *Drumatix* offers a wide range of time signatures, from two to sixteen beats per measure with basic beats of half, quarter, and eighth notes. Next to the Time Signature boxes is the Quantization Resolution (i.e., beat subdivision) box. *Drumatix* is capable of subdividing a measure from 4 to 48 ticks per beat, which encompasses a range of sixteenth notes to 128th-note triplets in 4/4 time. The Swing Resolution box offers a choice of eighth- or sixteenth-note swing resolution. However, each pattern's actual swing percentage is set globally.

Finally, you create the pattern's Velocity Map by setting the Velocity step for each tick in the bar. These steps determine which step in each instrument's Velocity Scale is used when that instrument is placed on the corresponding tick. For example, if you place a snare-drum hit on beat 2 and the Velocity Map level for beat 2 is set to 6, the snare drum will play with the Velocity value entered into step 6 of its Velocity Scale.

The Velocity Map helps you create patterns more quickly by automatically setting the Velocity level of any beat entered into a pattern. Moreover, the Velocity Map acts as a groove template for making a pattern "style." If necessary, you can manually override the Velocity Map at any time.

HIDDEN CONTROLS

If you grab the left side of the pattern grid and slide it to the right, you see an array of hidden controls (see **Fig. 3**). Some of them are common to most rhythm editors, such as the Mute and Solo switches (next to the instrument names), Velocity Offset controls, and Delay and Humanize Velocity settings.

However, a large, rounded box in the middle of the screen contains the controls for a powerful feature not found in most Windows rhythm editors: the Intelligent Real-Time Fill function. As its name suggests, this function is used to create variations of basic rhythms in

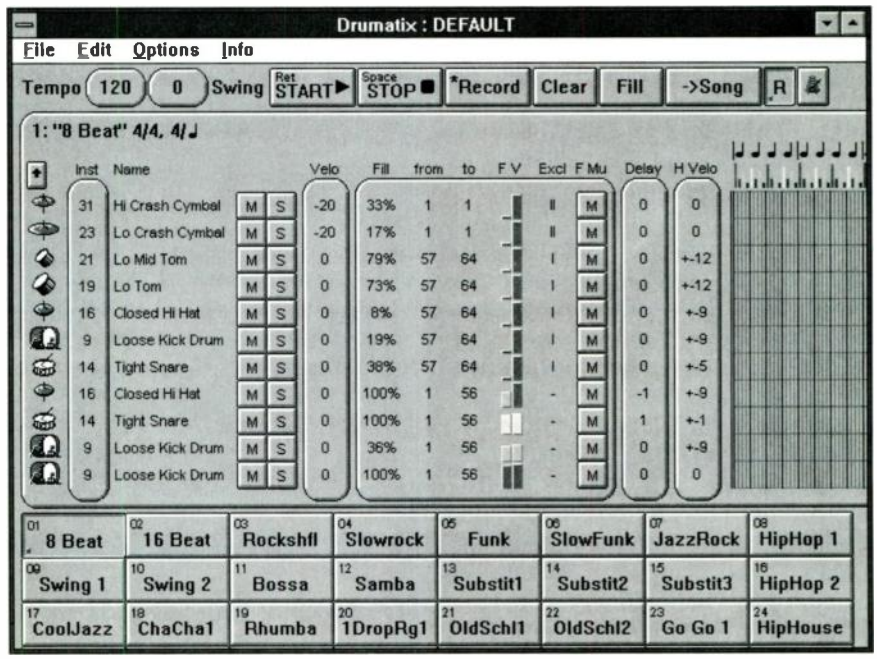


FIG. 3: Additional pattern controls can be found under the pattern grid. This is also where the settings for the Intelligent Real-Time Fill function are located.

real time during individual pattern playback and when the patterns are chained in Song Mode.

The operation of the Fill function depends on the interaction between the pattern's various settings, the individual Velocity Scales, and the overall Velocity Map. The Fill setting determines the likelihood, expressed as a percentage, of a note being generated on a particular line. The Fill Start and End settings determine the points within the pattern where a fill starts and ends. These values are expressed in absolute ticks or total pattern beats.

Next are the Fill Velocity parameters, which set the minimum and maximum Velocity steps that cause a note to be triggered. These are set according to the color-coded bar graphs of the pattern's Velocity Map. The actual Velocities are, in turn, determined by the Velocity Scales of the instrument map.

In most cases, you don't want *Drumatix* to generate fills that sound like they're being played by a drummer with six arms and legs. To avoid this pitfall, you can assign each pattern line to one of ten exclusive groups. Thereafter, when a group member plays a given note, the program prevents other members of the same group from playing on the same beat. This applies whether the note was generated randomly by the program or written into the grid by the user.

Product Summary

PRODUCT:
Drumatix 1.0

PRICE:
$69

SYSTEM REQUIREMENTS:
80386 or better PC with 4 MB RAM, Windows 3.1, VGA monitor, hard drive, and sound card or MIDI interface and synth

MANUFACTURER:
Hohner MIDIA
tel. (707) 578-2023
fax (707) 578-2025
e-mail 100772.1052@compuserve.com

CIRCLE #441 ON READER SERVICE CARD

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

Drumatix further determines the frequency of note generation by line position, with the pattern's lower lines having priority over the upper ones. However, you can also set each instrument's ranking by rearranging the pattern lines in one of two ways: you can drag a line's instrument icon to the new line location, and *Drumatix* will switch the positions of each affected line; or you can click on the Instrument column to change a line's instrument.

This second method lets you put the same instrument on more than one line and individually adjust the fill parameters for those lines. In effect, this lets you create patterns and variations without having to place any notes in the pattern grid, which is pretty nifty.

Normally, the Intelligent Fill function constantly creates new pattern variations in real time. As it cooks along, it overwrites previous variations until you stop it. This is true even if you save the pattern as a Standard MIDI File and reopen it in *Drumatix*.

Although the pattern variations are generally usable, *Drumatix* does lay an occasional egg. Fortunately, you can filter out the rejects and create permanent pattern variations (that is, variations that are not automatically overwritten) by using the global Fill button. The Fill button writes permanent notes into a specified line or pattern using the Intelligent Fill settings.

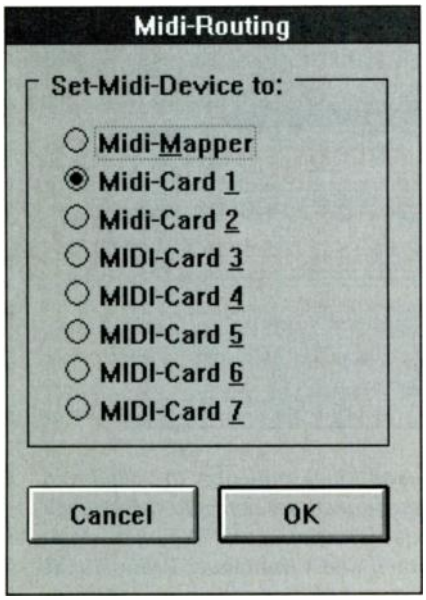


FIG. 4: The MIDI Routing utility control screen is one of *Drumatix*'s weakest features, especially if you have multiple MIDI interfaces and sound cards.

Once the notes are created, *Drumatix* automatically activates Fill Mute switches to prevent further random note-generation in that pattern.

OFF BEATS

Although I like playing with *Drumatix*, it isn't always a picnic. First, *Drumatix* differs from most similar software in that you can't call up or change MIDI devices within the program. You must assign the MIDI device before entering *Drumatix* and exit the program to change devices.

To make matters worse, the MIDI Routing utility included with *Drumatix* (see **Fig. 4**) isn't very helpful. If you use only one MIDI interface or the MIDI Mapper, the MIDI Routing utility works fine. However, MIDI-device routing is a real problem for those with multiple MIDI interfaces and sound cards. The only way to match devices to settings is to pick one, enter *Drumatix*, and hope things work. That's not what I call user friendly.

In addition, the documentation is weak. The manual is a skimpy 34 pages long, including the front cover and table of contents. The materials concerning each feature and function are presented as separate pieces of information, with no attempt to provide a cohesive overview of program operation. Compounding the problem further is the intermittent confusion caused by the manual's translation from the original German into English.

SUCH A DEAL

Overall, *Drumatix* is an interesting program. A lot of thought seems to have gone into making the Intelligent Real-Time Fill feature work well. Unfortunately, less thought was apparently devoted to the MIDI Routing utility. Still, the latter feature's design is more a major nuisance than an insurmountable barrier. And even though the documentation is weak, the example maps, patterns, and songs included with the software make the program's overall functions easier to understand.

Finally, the list price is easy on the wallet. If you're looking for a decent, reasonably priced rhythm editor with intelligent fill features, *Drumatix* is worth your consideration.

Occasionally, **Zack Price** *has to remind his wife that there's no law that compels him to like musicals just because he's a musician.*

Oberheim OB-3

By Julian Colbeck

An aging drawbar-organ expander gets a fresh coat of paint.

Apparently, plenty of musicians don't want to use the organ sounds in their main synths. Perhaps they don't want to use up their polyphony for organ parts, or maybe the factory organ sounds aren't convincing enough. At any rate, the demand for other sound sources is evidenced by the increasing popularity of organ modules such as Peavey's Spectrum Organ, Voce's Micro B and new V3, and Oberheim's OB-3.

▼

What you need are strong, earthy tones that remind you of back-breaking Hammonds.

The OB-3 is a suspiciously familiar-looking tabletop module that features 8-voice polyphonic, digitally controlled analog organ tones under authentic drawbar control. Sturdy, compact, and completely foolproof, the OB-3 is a neat solution for the frustrations of trying to elicit organ-type sounds and control features from your average synthesizer.

Does this sound familiar? Have you seen this gadget before? Well, you might have, because the Oberheim OB-3 was originally introduced in Europe in 1991 as the Viscount D9E. (Viscount also markets the D9 keyboard in Europe, but that unit never came to the United States.) If you're even more observant, you may notice that the Fujiha D9E looks pretty darn similar, too. Indeed, they're all one and the same,

made by veteran Italian manufacturer Viscount. The OB-3, then, is getting a bit long in the tooth. In fact, Oberheim will soon augment its product line with a new, improved version. But the OB-3 will still be around, and it's still well worth checking out.

PHYSICAL ATTRIBUTES

The OB-3's physical design is interesting. The unit is roughly a 1-foot-square box that can sit safely on top of a piano, a synth, or even a stand, thanks to its reasonable weight (6.6 lbs.) and four heavy-duty rubber feet.

Aside from the obvious fingers-on-keys part, playing organ is all about hand and arm movements, grasping a fistful of drawbars, controlling Leslie speeds, switching sounds, and so on. All of this is lost on rack-mount organ expanders (such as Peavey's Spectrum Organ, reviewed in the December 1995 **EM**). In the process, much of the pleasure—if not the actual style—of playing organ goes along with it. The tabletop module is an ideal compromise between having to buy, store, and carry another wretched keyboard and substituting a seemingly disembodied rack module.

The OB-3's nine drawbars conform to the standard sizes (16', 5⅓', 8', 4', 2⅔', 2', 1⅗', 1⅓', and 1'). They feel firm and positive, and they're click-stopped and calibrated, as on a real Hammond organ. Beneath the drawbars are two rows of buttons for accessing the presets, along with controls for vibrato, rotary-speaker emulation, percussion effects, and key click. These are all high-quality buttons (like those on a Prophet-5) with built-in status LEDs. There are only two control knobs: Master Volume and Overdrive.

At the back are the mono audio out, headphone out, and fine-tuning pitch control (±1 semitone). There's a volume-pedal jack and two footswitch jacks; one switch selects between a preset and the drawbars, and the other switches between the slow and fast rotary-speaker effects. The OB-3 has MIDI In and Thru jacks, but it can't send MIDI data out, which is a real shame. The module's age shows when it comes to controllers, too. Its MIDI specification is dated and limited.

ORGANIC SOUNDS

Fortunately, organ tones are anything but fashion items. What you need are strong, earthy tones that remind you of back-breaking Hammonds: full of snarl, grit, and spit. And to a reasonable extent this is what you get with the OB-3. The OB-3 excels when it comes down to sound and real-time, hands-on control.

There are six presets, which are labeled with Roman numerals. (This is an Italian instrument, after all.) Preset I has a gentle, muted undertone with a glistening top, perfect for incidental music during a church service. Preset II is warmer and more subdued in the high registers. Preset III is dark and fluted, with a moderate tone. Preset IV is a no-nonsense, standard rock organ. Preset V is bristling, fat, and full. And Preset VI is all stops out—rich and jangly.

Switching between presets is quick and easy, and you can even cue a preset for use by pressing its button while you continue to play the current sound. The current sound's LED will blink until you lift your fingers off the keys, and the OB-3 will then automatically switch over to the new preset. This is an old trick, to be sure, but it's still a good one to try.

Oberheim's OB-3 drawbar-organ module has a weak MIDI implementation but delivers very good sounds. An improved version will be released soon.

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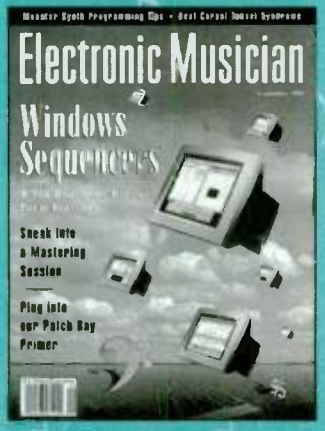

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In Drawbar mode (entered by pressing the Drawbars button); you can mix and match nine organ harmonics to create an almost limitless range of custom sounds. Each drawbar corresponds to a specific pitch. Pull a drawbar out, and its specific pitch gets progressively louder. With nine drawbars at hand, the process becomes pure additive synthesis. (Several books have been written on drawbar selection, theory, and what have you. I recommend Steven Irwin's *Dictionary of Hammond Organ Stops*, originally published in 1939 by G. Schirmer.)

ORGANIC EFFECTS

On the world's most famous drawbar organs, the Hammond C3 and B3 (which are sonically identical), other factors also come into play, some deliberate, some accidental. The OB-3 makes a decent stab at offering these sound-enhancing controls, too.

The first emulates the Percussion feature found on a real Hammond organ. This adds a harmonic to the attack of the note in order to give the note more cut or bite. Traditionally, these harmonics are labeled "second" and "third" harmonics, but on the OB-3, Oberheim calls them 4' and 2⅔', respectively. You can use either with a choice of two decay lengths and two volume settings. This is a single-triggered effect, much as it would be on a real Hammond organ. In other words, the harmonic only sounds on the first played note. If subsequent notes are played while the first continues to be held down, no percussion effect is heard. Percussion should be sharp and, well, percussive, but I found the OB-3's rendition of the feature a little under strength. It's sharp, but by no means is it razor sharp.

You can get a bit more "spit" using the Key Click feature. Key Click is the commonly accepted term for one of the Hammond organ's inherent foibles, namely dry key contacts that have the effect of adding a sort of spark to the note's front end. Keith Emerson claims that his explanation of this characteristic fault to Korg back in the early 1980s resulted in the feature's first appearance as a tone enhancer on the Korg CX3 and BX3 portable organs. The OB-3's version of Key Click is a little less dramatic, but it is a welcome and valued feature. In a mix, this feature can allow a sound to poke out without obliterating others around it. It's very handy, and you generally won't find it on a synth.

The other Hammond fault-turned-feature is distortion. Although pure organ tones are best left pure, a full-blown, flat-out organ simply doesn't cut the mustard if it isn't riddled with grit and grunge. The OB-3's built-in distortion is called Overdrive, and it is sensibly offered under progressive, rotary control. As it happens, you can have too much of a good thing. If you nudge it much past halfway, Overdrive just sounds like you've blown your speakers. There's distortion, and then there's *distortion*.

▼

Aside from the fingers-on-keys part, playing organ is about hand and arm movements.

Vibrato is available in three speeds. This is quite generous for an effect most people find a limp alternative when compared to a good Leslie simulator. That said, and although the OB-3's colors are nailed firmly to the Hammond mast, I quite admired the instrument's ability to sound like '60s combo organs, an effect obtained by turning on the rotary speaker; finding a thinnish, hollow drawbar setting; and selecting Vibrato 3, which is fast and strong.

LESLIE EMULATION

For some unfathomable reason, Viscount called our old friend the rotary-speaker effect "Intersound" on earlier European versions of this instrument. But whatever you call it, the OB-3 has a pretty decent Leslie emulator.

There are two modes of operation: slow or fast. The instrument makes a commendable effort to re-create the famous speed-up and slow-down factor—on the real McCoy, the revolving drums take time to get up to full speed or wind back down again—but there is a rather unpleasant level of noise added when you play without the effect and then kick it in. I liked the slow speed a lot. If you hold down a low bass note on an all-stops-out setting, the sound is very close to the real thing. Excellent. The fast setting, however, is less convincing. It's a bit shrill and one-dimensional.

The speed-up factor, although essential for anything approaching a realistic Hammond-plus-Leslie tone, takes forever to get up to speed in the OB-3 version. Without the benefit of a direct comparison—my Hammond organ was stolen by one of my delightful former management companies—I can't put an actual time discrepancy on it, but it just feels tardy.

On the module's control panel, the rotary speaker can be switched on and off and switched from slow to fast, but you can free up a finger by putting the speed change under momentary-footswitch control. Certainly, if your most common need is Hammond-type sounds, I'd leave the rotary effect on permanently, so footswitch toggling between slow and fast makes a lot of sense. However, should something go awry with the footswitch (for example, if it slides beyond the reach of your flailing foot), be warned that the front panel switches become inoperable once the footswitch is connected.

Two other pedals can be connected: a continuous controller for volume and another momentary switch for toggling between a preset tone and the current drawbar settings. Current settings are remembered, so this is a particularly thoughtful feature, allowing you to dart back and forth between two totally individual tones without having to stab at control buttons.

Product Summary

PRODUCT:
Oberheim OB-3
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MANUFACTURER:
Oberheim
tel. (510) 635-9633
fax (510) 635-6848
Web http://www.gibson.com
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VALUE	● ● ●

MINIMAL MIDI

The manufacturer's thoughtfulness is good as far as it goes, but the problem with the OB-3 is that all the thought took place in or around 1990. And in 1990, the world was a very different place in terms of what was expected, or indeed wanted, from MIDI control.

When I checked out the keyboard version of this instrument back then, it was not a big deal that the only MIDI messages it kicked out and recognized were note, MIDI channel, and a handful of Program Changes. Critics moaned about the absence of Control Change 7 (Volume) support, but that was about it. Today, I would look for changes in drawbar position to be recordable (even if only over SysEx), and I would simply presume that slow/fast rotary settings and preset/drawbar choices would be MIDI-controllable.

But it's a big "nope" all around, I'm afraid. Volume messages are neither transmitted nor received; in fact, there is no MIDI control information of any sort. To my mind, this disqualifies the instrument for serious MIDI-studio work that relies on sequencing.

A SOLID PERFORMER

Fundamentally, this is an instrument of quality. But if only Oberheim had waited until it brought the MIDI control aspects of the instrument up to 1995 specifications, it would have made a more tempting morsel. Hopefully the promised new version will address these concerns and more.

The lack of MIDI power might cripple the OB-3 for sequencing, but the module could work just fine in the studio if you're going directly to tape or disk. Of course, if you're just after organ sounds and to heck with MIDI control, you could use a real organ, assuming you have enough physical space for it.

I wouldn't hesitate to use the OB-3 for live performance. To begin with, it seems sturdily built. I toured Romania with a Viscount piano that held up fine, and believe me, that's a strong recommendation. And the OB-3's combination of footswitch controls, hands-on access to drawbars, and strong sounds would be hard to beat onstage.

Julian Colbeck *is author of the* Keyfax *series of synthesizer buyers guides, whose* Omnibus Edition *should be available from Mix Publications by the time you read this.*

Lyrrus G-VOX (Win)

By Bob O'Donnell

Learn to play and sequence your guitar.

I admit it: my keyboard chops suck. I'm another frustrated guitarist who has never been able to take full advantage of MIDI synths and sequencers because I can't get my musical ideas down quickly. Sure, I've played with MIDI guitars (I even bought one), but they're just not the same as jamming on my axe. I want to sequence from a regular guitar with no fuss or muss. And I don't want to spend a fortune.

Several companies have struggled to meet this need over the last few years, but none have completely succeeded. One contender brings unique credentials to the ring: it uses a belt pack and a floppy disk. Offered by Lyrrus, Inc., the $129 *Bridge* software (currently available for Windows, with a Mac version under construction) works in conjunction with the company's $349 G-VOX Musician guitar-teaching system to offer wannabe MIDI guitarists a potent package of music education and MIDI sequencing.

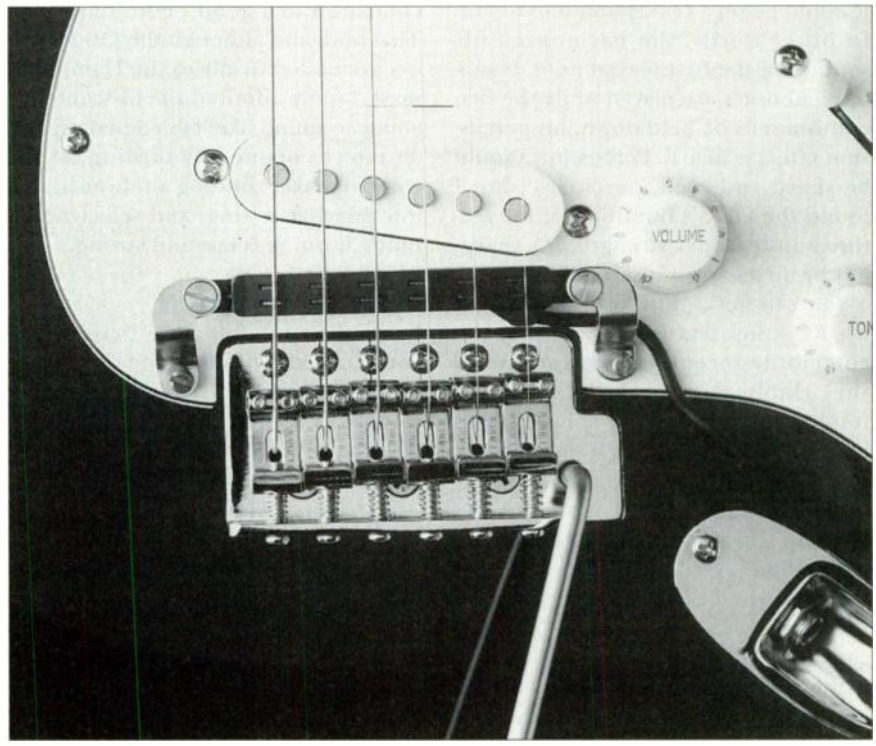
GET WIRED

The most critical aspect of the G-VOX system is setting it up properly. In previous versions, this was also the most frustrating aspect. The process still isn't foolproof, but Lyrrus has taken several steps to ease the pain.

For one thing, they redesigned the bulky, over-the-strings hex pickup and replaced it with a tiny model that is curved to fit under the strings of virtually any acoustic or electric guitar. The new pickup attaches to the guitar with tiny suction cups and connects directly to your computer's serial port from a belt pack, which remains unchanged from its original design. The

▼

***Bridge* turns your guitar into a simple MIDI controller.**



This Fender guitar includes the G-VOX hex pickup and special mounting hardware.

company has also signed a deal with Fender to produce G-VOX-ready Fender Squiers and Stratocasters (see photo) that include special mounting hardware to simplify installation. In fact, the G-VOX system is now distributed through Fender dealers.

Once the hardware is set up, you run the supplied *G-VOX Riffs* program and go straight into its Settings dialog (see **Fig. 1**). This section of the program lets you adjust the tracking threshold of each string, select one of four available tracking methods, and watch what you play on an onscreen fretboard. To ensure proper tracking, the belt pack includes set screws to adjust the output level of each string. You can even save and load different settings for different applications or different guitars.

Getting these settings just right can take a while. I'd like to see the software do some of the work by automatically recognizing and compensating for the levels coming from the belt pack. (According to Lyrrus, this will be available sometime in 1996.) However, once you're finished with the settings, you shouldn't have to worry about them again. Once everything is set to your liking, you can switch to the application's built-in tuner to quickly tune up.

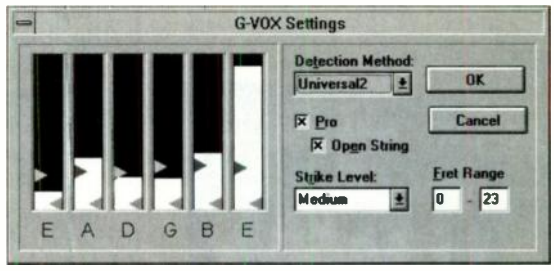


FIG. 1: The *G-VOX Riffs* Settings dialog lets you select a tracking method and fine tune the threshold settings for each string.

RIFFING AROUND

Riffs teaches new playing skills by displaying what you play on your guitar in addition to examples from preprogrammed riff libraries. As its name suggests, *Riffs* displays a short sequence of notes in standard and tab notation (see **Fig. 2**). You can also purchase additional libraries that have been created by a variety of professional guitarists, including guitar virtuoso Steve Morse.

Riffs lets you choose one of the riffs in a library and hear it played as an 8-bit digital recording of the pro who created the riff. Alternatively, the riff can be played by the computer's sound card. The library on the bundled, cross-platform CD-ROM includes a video of each riff being played. Using the computer's sound generation is great for learning because *Riffs* lets you adjust the tempo of the lick between 30 and 240 bpm.

The onscreen display follows the speed you set: as you lower the tempo, the "fingers" on the fretboard and the bouncing ball above the notation and tablature slow down. To help you learn the riff, the program offers an interactive mode that doesn't advance to the next note until you've played the previous note correctly.

Lyrrus includes *Venue One of Tour*, a Windows or Mac game in which you must dodge an onslaught of flying tomatoes and oranges by playing the proper notes on the fretboard. I ran

into difficulties running the *Tour* game on an Austin Direct '486 notebook—I kept getting General Protection Faults—but Lyrrus assures me that it works fine on the many systems they've tested.

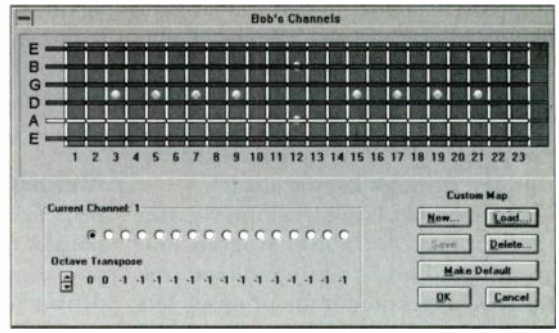


FIG. 3: *Bridge* lets you set each string or each section of a string to send MIDI data on its own MIDI channel.

MIDI CONNECTION

Tapping into the world of MIDI requires the addition of *Bridge*, which is a MIDI input driver for G-VOX. (As mentioned earlier, this software is currently available for Windows, with a Mac version on the way.) As an added value, *Bridge* comes bundled with Cakewalk Music Software's *Cakewalk Express* 3.01, Howling Dog's *Power Chords* 2.0, and Midisoft's *Recording Session* 1.12.

Bridge turns your guitar into a simple MIDI controller you can use to play MIDI sound modules or record straight into the included sequencers (or any other Windows MIDI program). You're limited to sending Note On messages—Program Change, Pitch Bend, and Control Changes are not supported—but you can assign each string or user-defined portion of the fretboard to its own MIDI channel (see **Fig. 3**).

The default tracking method (Universal) does not send Velocity information, but if you select Universal2 in the Settings dialog, the *Bridge* driver will send Velocity. (This is not mentioned in the slim *Bridge* documentation.) Tracking works reasonably well, but expect to make some adjustments to your playing technique. Most guitarists aren't used to the precision demanded by MIDI sequencers, and unless you're a very precise player, your sequences will need cleaning up.

MIDI OUT

Guitarists looking for the answer to their MIDI prayers won't be completely satisfied with the G-VOX/*Bridge* combination, but they will find that it works well enough and the price is definitely right. The system's controller functions are limited—the lack of Pitch Bend support is particularly frustrating—but it still offers the freedom of composing MIDI sequences from a regular guitar.

In fact, the generous MIDI software bundle that is included with *Bridge* gives

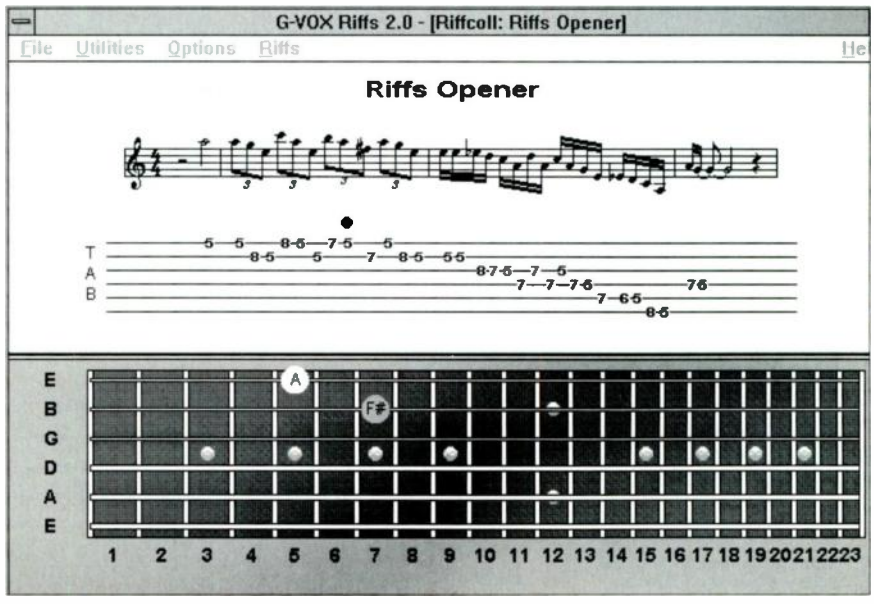


FIG. 2: *Riffs* shows a short musical sequence as notation and tablature and provides an animated display as it plays.

guitarists a lot of things to play with. *Cakewalk Express* is a powerful, entry-level sequencer with notation editing; *Power Chords* (reviewed in the June 1994 issue of **EM**) is a combination auto-accompaniment/composition package that permits direct G-VOX input of chords and other musical ideas; and *Recording Session* is a simple sequencer that supports notation editing and printing.

Even better, the G-VOX educational software is great stuff. By interacting with your playing, *Riffs* can do wonders for your guitar skills, and you will have fun. Even if you have no interest in guitar-controlled MIDI playing and sequencing, the G-VOX Musician package is a solid value. If you are interested in both MIDI sequencing and interactive learning, the G-VOX/*Bridge* combo is a great way to go.

Bob O'Donnell, *the former editor of* **EM**, *used to be knee deep in MIDI gear, but now as* PC/Computing*'s features editor, he's hip deep in PCs.*

Product Summary

PRODUCT:
G-VOX
PRICE:
G-VOX Musician: $349
Bridge: $129
Libraries: $19.95 to $24.95 ea.
SYSTEM REQUIREMENTS:
Windows: 80386 or better PC, 5 MB RAM, Windows-compatible sound card, Windows 3.1 or later, VGA display, CD-ROM drive (optional).
Macintosh: 68030 or better Mac, 5 MB RAM, System 7.0, 256-color display, CD-ROM drive (optional).
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EM METERS	RATING PRODUCTS FROM 1 TO 5
FEATURES	● ● ●
EASE OF USE	● ● ● ●
DOCUMENTATION	● ● ●
VALUE	● ● ● ●

Big Fish West Coast Funk Stew

By Al Eaton

Hip hop loops are the main course on this sampling CD.

What happens when you take L.A.'s top funk session players and a top rap engineer, toss in a pinch of Soul Brother Number One, try to give it a Compton attitude, and mix it at 100 bpm? The result is a double-CD set entitled *West Coast Funk Stew.* Those ingredients sounded tasty to me, but as we'll see, when the meal was brought to the table, it didn't have the fine flavor the menu promised.

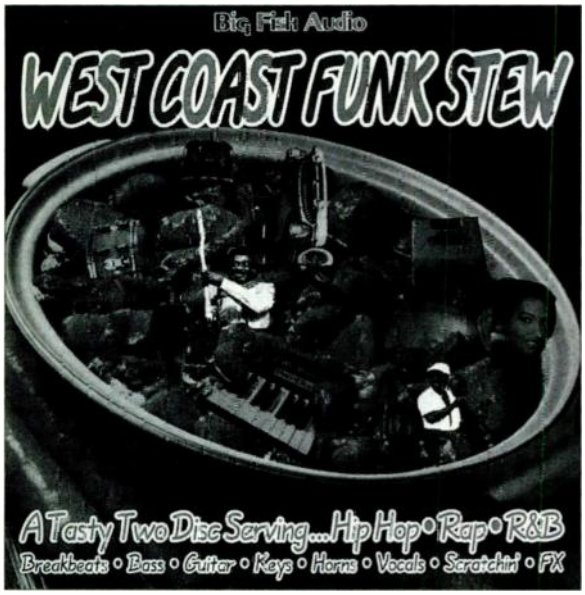
Disc 1 contains more than 73 minutes of sounds and disc 2 more than 72 minutes. Those 145 minutes are filled with more than 1,000 drum, guitar, horn, keyboard, and vocal loops. A lot of the sounds (drum sounds in particular) are used in several different places; unfortunately, there is no cross-reference to their other locations. Sometimes the same sounds appear with or without the EQ, reverb, or other effects.

I wish the manufacturer had identified the different variations of the same sound and documented where each variation is located so the user could readily compare them. It would also be nice to have dry versions; after all, most home studios have a small arsenal of effects.

SPICE WITH CARE

The biggest problem with this sonic stew is the considerable amount of unwanted residual noise on the tracks. Each track is marred by hum and hiss from the mixing board, as well as the noise of whatever effects were used on groups of samples. Noise, noise everywhere.

On many sample CDs, each sample is preceded and followed by digital black (silence). This isolates each sample and makes it easier to find the exact sample start and end points so you can truncate the sound without cutting off too much or leaving too much (which would eat up sample RAM). With *West Coast Funk Stew,* though, digital black is



Big Fish Audio's *West Coast Funk Stew* sample-CD set offers plenty of East Coast-style loops. Unfortunately, aside from their wrong-coast style, the CDs are plagued by sonic problems.

used only between tracks, not between each sample.

Unfortunately, almost all of the sample loops contain sonic garbage that makes it impossible to get a good clean loop. For example, the full instrumentation loop is given, followed immediately by the broken-down drum loops. This is usually not a problem. However, in this set, the drum parts include the reverb or echo effects that were used on the other instruments. This can be infuriating, especially when you are trying to use the affected loop in another song and/or another key. The only workaround I found was to use just the second half of the loop. So if the loop is a 2-bar loop, you can only use the second bar. Arghhhh! There's not enough paprika in the stew!

Furthermore, in most of the individual samples that make up the loops, I could hear a quarter-note hi-hat ticking away in the background. Although this is not a big issue, I think each sample that is meant to be soloed should be isolated. Fortunately, the individual guitar, vocal, organ, bass, horn, and other samples at the end of each CD sounded better and included digital black between samples. But why weren't all the samples in the set done this way?

Another problem is that the volumes of some individual samples appear to differ from their volumes in the full instrumental loop. According to Big Fish's representative, the samples' volumes actually are the same; they just sound different when taken out of the loop. But for practical purposes, if you want to use a full loop for, say, the chorus of your new song but you want to break it down to just one of the percussion loops and an organ, you may have to work a little to get the same balance between the instruments.

SLOW COOKING

All of the scratch samples are uneven and greatly out of time with the tempos of the loops to which they are connected, as well as with themselves. It seems the scratches have no real tempo, so the only way I could use them to my liking was to cut the number of scratches used in each sample and edit the samples in a digital audio workstation. Otherwise, I could not use

FROM COAST TO COAST

Any smart producer recognizes that popular tastes keep changing. If you listen to snippets of the top rap, R&B, and hip hop songs from the radio, videos, or cars riding around on the street (where you can really find out what is happening), you will find a more simple, almost transparent feel than was popular just a few years ago. The current styles often use a simple, funky, memorable loop over a strong but simple drumbeat. The rappers' personality and delivery carry a lot of the weight now.

For an example of the current West Coast sound, pick up a copy of any of the E-40, Dr. Dre, Snoop Doggie Dog, or Notorious Big CDs. Dr. Dre and Snoop are considered the originators of the current lower West Coast, or Compton, sound. Notorious Big is an East Coast native, but he has capitalized on the Compton rap sound.

The definitive formula for this Compton sound is to first make the track as funky—and usually as danceable—as possible without turning it into a disco dance track. The track almost always falls below 100 bpm, with most songs falling between 80 and 90 bpm. (Disco is generally at least 110 bpm and usually higher.) The tracks have a more live feel, even if they include samples, as in the case of a lot of the Notorious or Snoop tracks, where they sample records of live musicians from the old and not-so-old schools of R&B and jazz.

There are usually lots of analog-sounding synths, including what some folks call the Funky Worm sound (single-note legato lines in the upper register, played with short portamento). The Funky Worm phrase is from an Ohio Players song by the same name, released in the early 1970s. This is where, for the most part, the grit for the funk comes in.

Probably the most identifiable parts (other than the Funky Worm synth) that determine the "coast" origin of a track are the drum patterns and drum sounds. The drum sounds and much of the other instrumental sounds in East Coast productions often are captured at low sampling rates, which results in very low fidelity and an absence of top end. The bass guitar or bass synth usually has an overabundance of lows and very little high end, and the individual instruments do not necessarily go together musically.

The resulting East Coast sound is like that of very old records recorded on not-so-state-of-the-art equipment. (I still find it funny that record companies and major acts record in world-class studios but spend a lot of time and money to make the album sound like it was recorded in a low-budget home studio. But that's hip hop). In contrast, the West Coast sound is usually more polished and produced and has a more obviously studio-recorded quality.

them at all and had to do new scratches myself, taking care not to infringe on anyone's copyright.

Tempos are given for each group of loops. In the company's effort to get a live feel, however, they ended up with tempos such as 95.3 or 88.9. Normally, I would have expected these to be rounded off to the nearest whole number to make it easier to use them with sequencers that support bpm in whole numbers only. But at least the unusual tempos were intentional and are accurately documented.

Product Summary

PRODUCT:
West Coast Funk Stew
PRICE:
$99.95 (2-CD set)
MANUFACTURER:
Big Fish Audio
tel. (800) 717-FISH
or (818) 768-6115
fax (818) 768-4117
CIRCLE #444 ON READER SERVICE CARD

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

WEST IS WEST

Modern West Coast funk has a sparser sound than the East Coast variety (see sidebar "From Coast to Coast"), and accordingly, few of these loops have a West Coast sound. Trying to use these samples in their entirety gave my songs too much of an East Coast, drum-track-on-top-of-drum-track sound. This style was popular in the late 1980s and early 1990s (e.g., listen to Public Enemy) but is less common in today's popular rap and hip hop songs from either coast.

I could get a West Coast feel only when I stripped away the layers of samples and started from the bottom up, using the samples sparsely, then adding my original West Coast ideas on top. I was hard pressed to achieve the Compton sound by just cutting a loop (in its full form) from the CD and relooping the sample.

FINGER BOWL

According to Big Fish Audio's Tom Meadows, "We mixed [the set] at slow tempos, used a ton of funky live stuff and gave these discs a Compton attitude." Although I did find a lot of the live stuff very hip and usable—I really fell in love with the Hammond organ licks, as well as the bass and guitar samples—I found the disc as a whole annoying to use in most applications and impossible to use in others.

Except for a few samples on both of the discs, the *West Coast Funk Stew* CD set sounds more like an East Coast funk set than a Compton set. By itself, that's not so bad, but it's just not what I expected. If East Coast sounds are what you are looking for, this set can supply plenty of them. But the set's more serious sonic problems left me disappointed. Although I used *West Coast Funk Stew* on numerous tracks with some success, I found it a tougher job than working with most other sample CDs.

Al Eaton *is a producer, engineer, and musician who mostly works on rap and hip hop. He owns and operates One Little Indian Music Productions, located near Oakland, California.*

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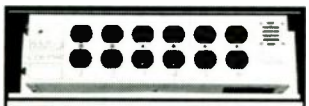

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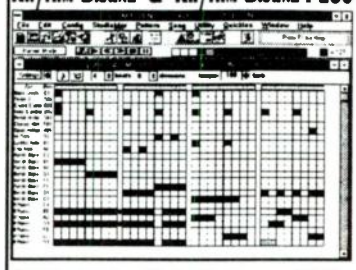
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TECH PAGE

Holographic Data Storage

Data crystals are coming to a computer near you.

By Scott Wilkinson

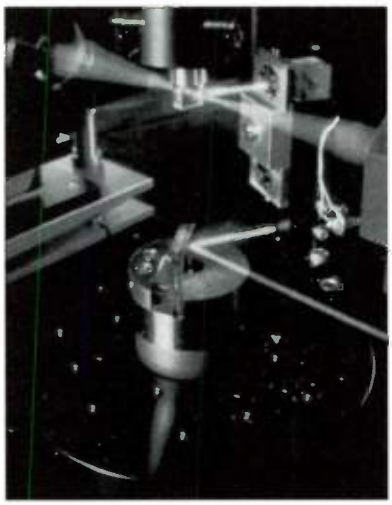
Fans of the TV series *Babylon 5* know that denizens of the space station use small "data crystals" to store large amounts of information. This show is set more than 260 years in the future, but the concept of data crystals may become a reality much sooner than that.

Among those who are working on holographic storage is a consortium of companies and universities, including IBM, Stanford, GTE, Kodak, Rockwell, Carnegie-Mellon, and others. In conjunction with the Department of Defense's Advanced Research Project Agency (ARPA), each participant in the Holographic Data Storage System (HDSS) project is developing components or applications that are relevant to its particular business.

A related project, called the Photorefractive Information Storage Materials (PRISM) program, has engaged many of the same organizations in a search for substances suitable for storing data holographically. These substances include various organic and inorganic crystalline materials that are *photorefractive:* their refractive properties change when exposed to light.

To store data as a hologram within one of these materials, a laser beam is split in two. One beam, called the *signal beam,* passes through a *spatial light modulator* (SLM), which consists of an LCD screen measuring 1,024 × 1,024 pixels. The data to be stored is represented by a pattern of transparent and opaque pixels; the signal beam is blocked by the opaque pixels and passes through the transparent ones. This pattern is called a *page* and represents one megabit of data. The other beam, called the *reference beam,* intersects the signal beam within the storage material, creating an interference pattern that represents the page of data.

Many pages can be stored within one crystal by changing the angle of the reference beam with respect to the signal beam for each page. This is called *angle multiplexing.* The difference between the angles used for consecutive pages is typically 0.001°, but the minimum angular difference depends on the thickness of the material. The HDSS project uses crystals that are 5 mm to 1 cm thick, which allows 1,000 to 10,000 pages to be multiplexed within a single volume of crystal. At one megabit per page, this yields a total storage capacity of one to ten gigabits per volume.



The crystal at the top center contains holographically encoded data. (Courtesy IBM Almaden Research Center.)

Once each page is stored, it can be retrieved by directing the reference beam into the material at the same angle used to record it. This reconstructs the signal beam, which is read by an array of photodetectors. Unlike conventional magnetic storage, an entire page is read all at once; a single-megabit page can be read in 1 ms, which corresponds to a data-transfer rate of one gigabit/second. Access time is also greatly improved: any page can be accessed in 100 ms or less.

In addition to higher data-transfer rates and lower access times, holographic storage offers better data reliability than magnetic designs do. The information within any hologram is stored everywhere in the material simultaneously. For example, if you cut a visual hologram into small pieces, each piece includes the entire image. Similarly, the data within a storage crystal exists everywhere at once. As a result, localized defects in the material don't necessarily affect the data.

Holographic storage is finally practical thanks to the computer and consumer-electronics industries. CD players spawned small semiconductor lasers, laptop computers brought us high-resolution LCD screens, and camcorders fostered the development of high-resolution photodetector arrays. Along with improved storage materials, these developments make small holographic storage devices possible. As a result, you may soon store your music and multimedia projects in data crystals instead of on magnetic disks.

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