It's Here! First Look at Alesis ADAT

Electronic Musician

U. S. $3.95/Canada $4.95
October 1992

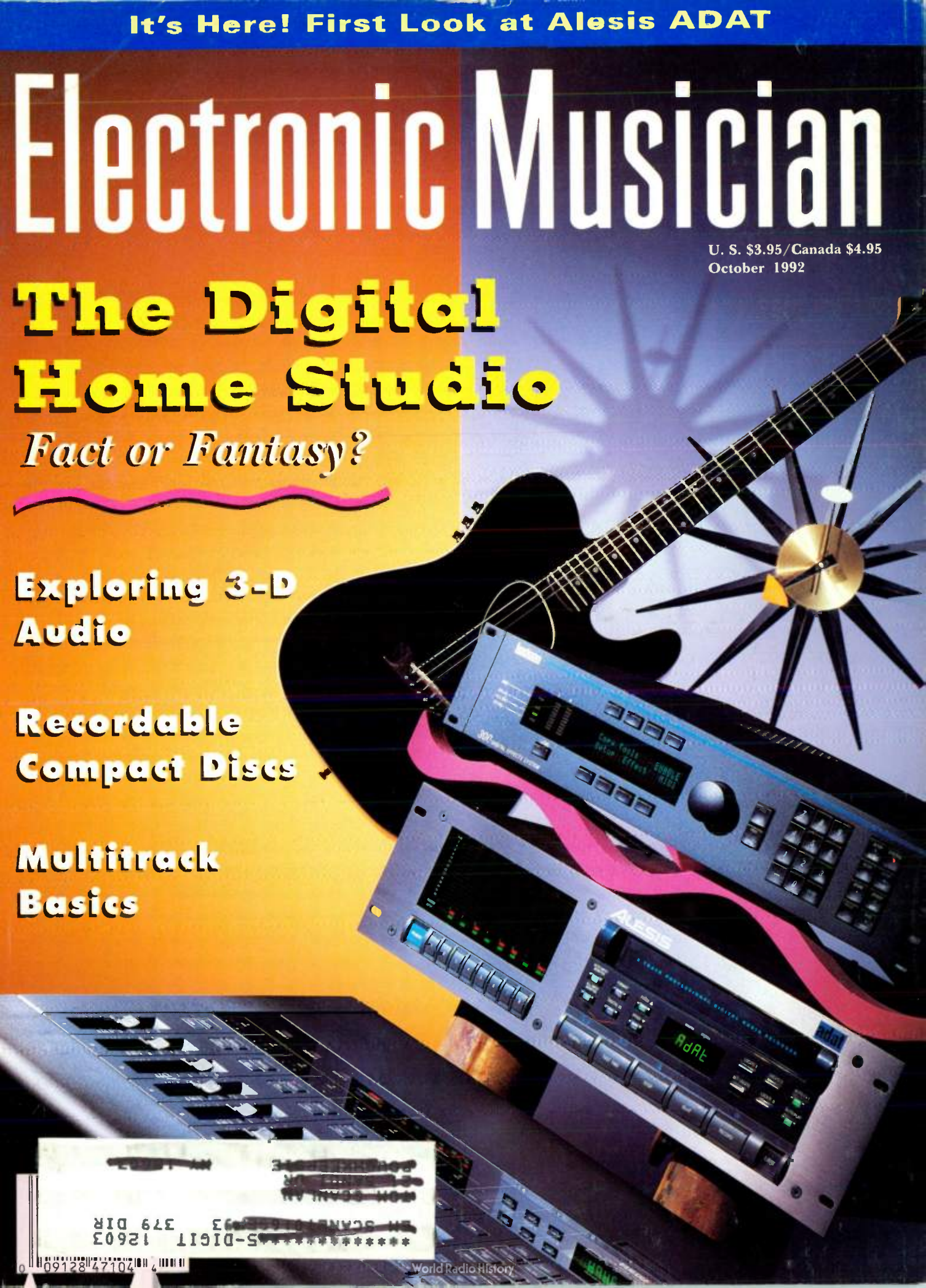
The Digital Home Studio

Fact or Fantasy?

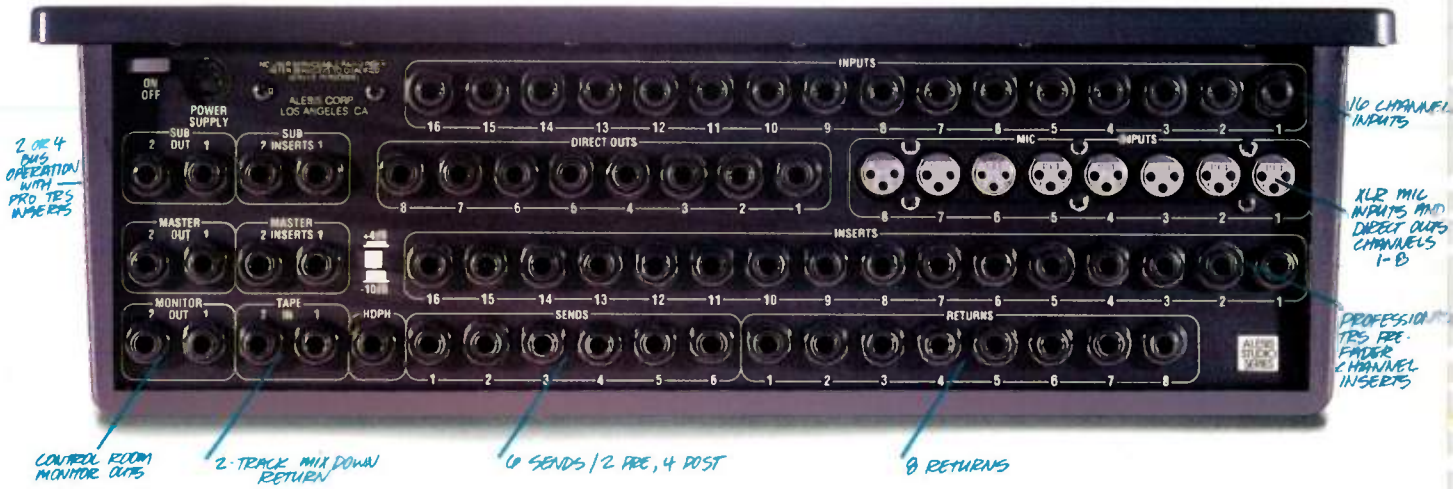
Exploring 3-D Audio

Recordable Compact Discs

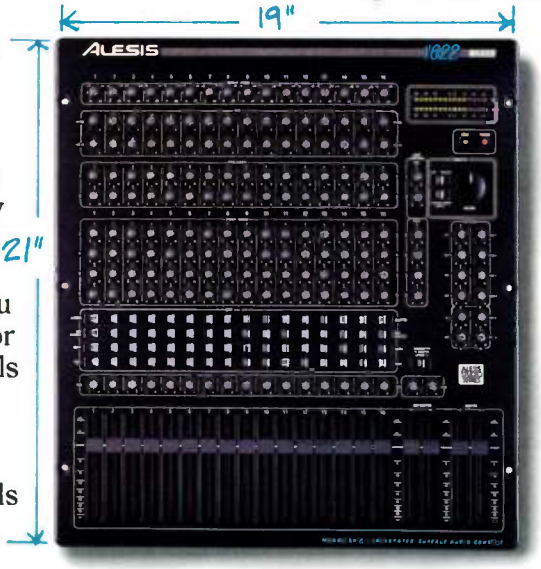
Multitrack Basics



16 Channels, 4 Busses, 6 Sends, 8 Returns, 20 True Inserts. $899



Flexibility is the horsepower behind any professional recording mixer. You need all the channels, sends, returns and inserts you can get your hands on in the heat of a mix. Check out these front and rear panel shots of the Alesis 1622 and you'll see professional features that make other mixers pale by comparison.



To suit your tracking needs you can set up for 2 bus/2 master or 4 bus operation. All 16 channels have 6 sends: 2 pre-fader for your choice of dual mono or stereo monitoring and 4 post-fader for effects. Use all 6 sends for effects-heavy mixdowns or set up three separate monitor mixes plus 4 effects for a live recording. And the 8 returns handle any combination of stereo or mono sources.

Every channel and all 4 busses feature professional TRS inserts for individual processors.

And they're true pre-fader inserts so you can change levels without disturbing critical effects settings. Master outputs are switchable +4 or -10 to drive pro or semi-pro mixdown decks, and channels 1 through 8 feature XLR mic inputs and direct outs. There's even a headphone output for convenience.

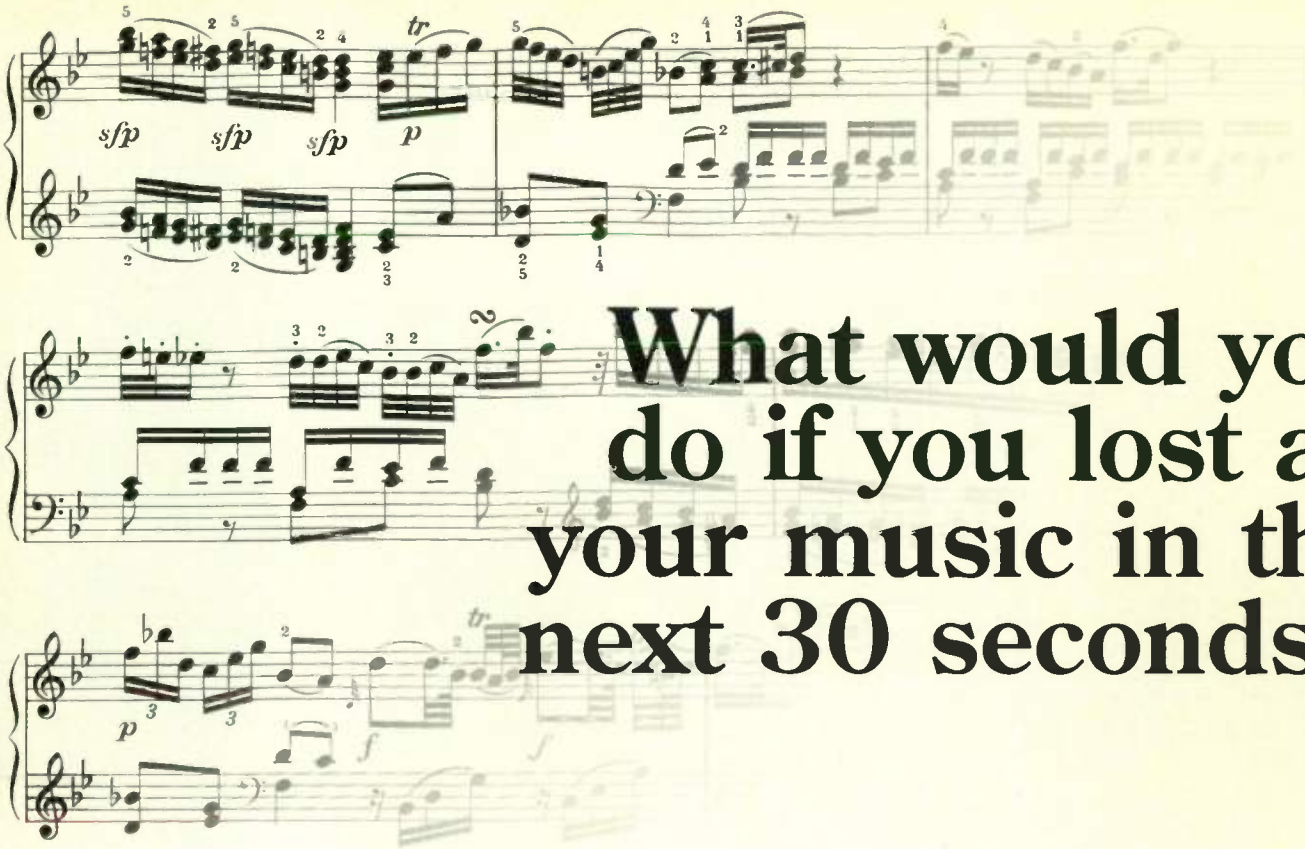
All this flexibility wouldn't mean anything if the 1622 didn't sound great. Specs like "distortion plus noise: too low to measure"*, and the cleanest, quietest signal path we could possibly devise, truly put the 1622 in a class by itself. In fact, it's the absolute best mixer under $2000 for recording with our ADAT Digital Audio Recorder. Your ears will prove this.

Flexibility, superb audio, unbeatable price. Ultimate value. See your Alesis dealer for a demo and start mixing today.

Keyboard Magazine July '90

Alesis Corporation 3630 Holdrege Avenue Los Angeles CA 90016

ALESIS



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The SY35.

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OCTOBER 1992 VOL. 8, NO. 10 · AN ACT III PUBLICATION

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DEPARTMENTS

Cover: Photo by Mark Johann.

New Products

The **EM** *Digital Piano Buyer's Guide* appears at a newsstand near you.

As a product-oriented magazine, **EM** covers other companies' new products every month. Rarely do we have the opportunity to discuss creations of our own. This month, however, we've produced a new publication that I'd like to tell you about: *Electronic Musician's Digital Piano Buyer's Guide.*

The *Digital Piano Buyer's Guide* (*DPBG*) is specifically dedicated to explaining digital pianos, portable keyboards, acoustic pianos with MIDI, and related accessory products to a mass-market audience. It is intended for families, schools, churches, and individuals interested in lower-cost, high-tech alternatives to the revered acoustic piano. The articles are written in a non-intimidating, non-technical style that newcomers to electronic musical instruments should find quite approachable.

The guide is divided into three sections: "Buying," "Using," and "Advanced Applications." It takes the reader from the pre-purchase research phase, through learning how to play, all the way to applications that include connecting a digital piano to an appropriately equipped personal computer. Don't look for elaborate technical details here, though. The *DPBG* has a different feel and audience than **EM**. The intended *DPBG* reader has less technical knowledge and needs more basic information than the average **EM** reader.

The first section of the guide provides information for those planning a purchase. It includes an introductory article that explains how to determine your needs, buyer's guides for digital pianos and portable keyboards (complete with comparative charts), and an overview of MIDI-equipped acoustic pianos. The second section covers basic applications and care for your instrument, and it features an article with suggestions for educational books, videos, and software. The final section concentrates on concepts and products that the general consumer marketplace considers advanced: MIDI, sequencing, sound modules, and computers. It includes introductions to MIDI and sequencing, an article on the use of computers with digital keyboards, and buyer's guides for inexpensive sound modules and hardware and software sequencers.

The *DPBG* is available on newsstands and through traditional piano and organ dealers. If you're in the market for a digital piano and would like to brush up on a few fundamentals, I strongly recommend that you to pick up a copy. Even more important, recommend the *DPBG* to a family member or friend who will find the guide helpful.

• • • • • • • • • •

On the subject of new products, we've redesigned **EM**'s "What's New" section and added a department called "ProFile," which replaces "The Back Page" on the last page of the magazine. Each month, "ProFile" presents a specific, real-world recording or live-performance application and includes a brief interview with an artist currently putting that technique to use. In our debut column, we explain how to create a compressed vocal sound similar to the one used on INXS' new record *Welcome To Wherever You Are.* In upcoming issues, we'll cover topics such as kick drum sounds, synth layering, and guitar processing. We want to make the column as topical and relevant to your needs as possible, so let us know what you think.

Art director Andrew Faulkner also wants to point out that the illustration on p. 39 accompanying "3-D Audio" is not out of register; like the article, it's 3-D. You'll need a pair of 3-D glasses to fully appreciate the effect. Enjoy the issue.

Bob O'Donnell

Electronic Musician

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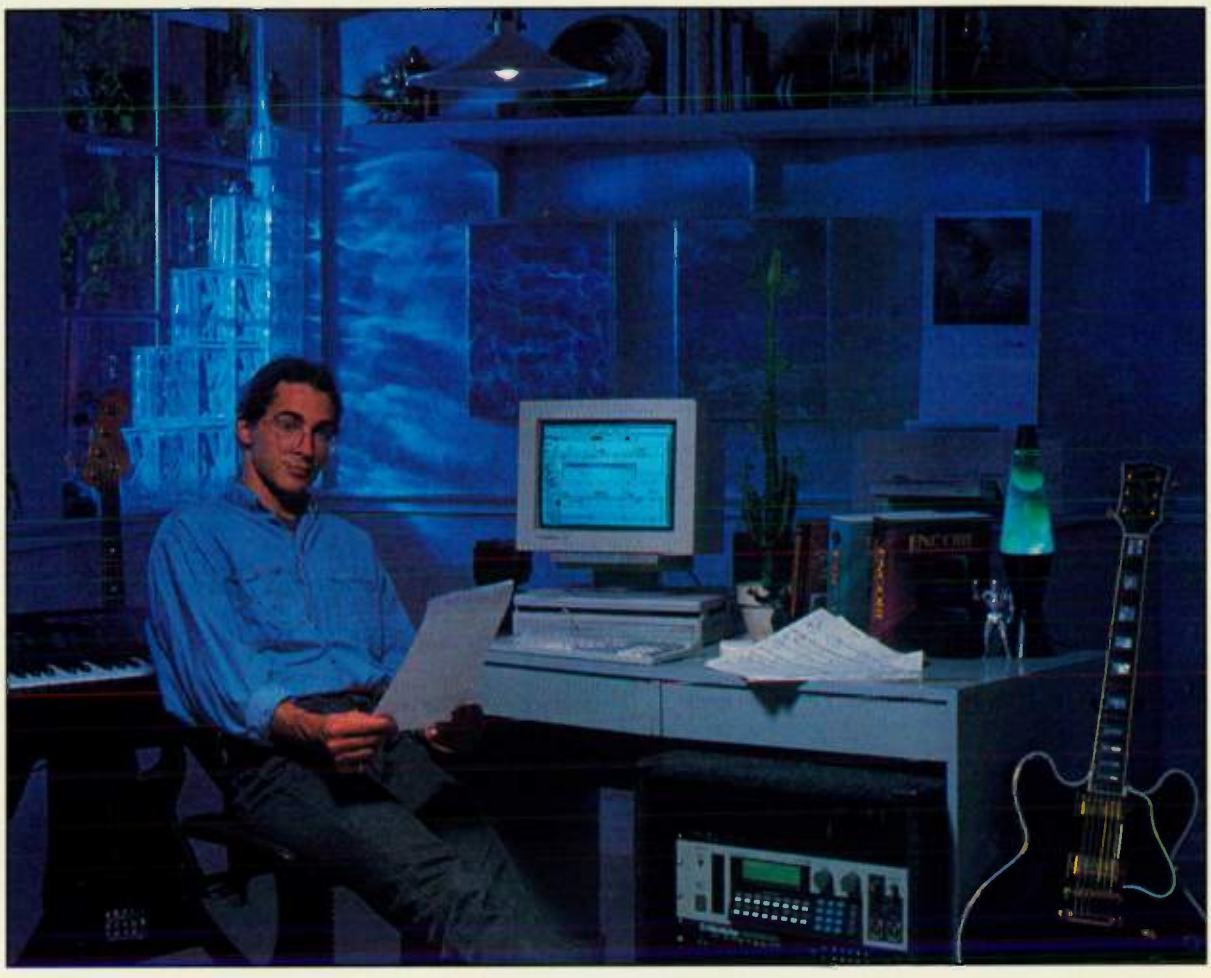

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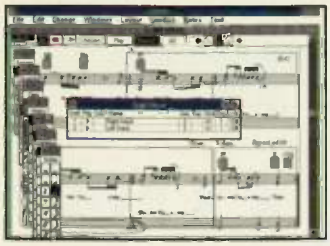

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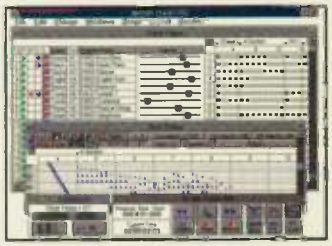

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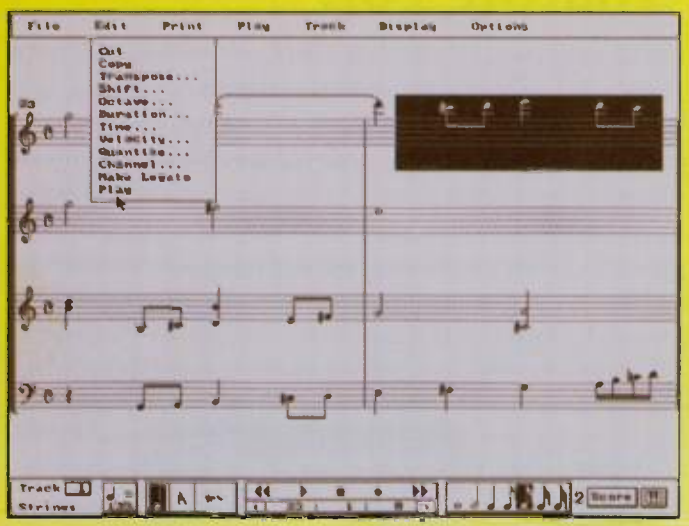

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NOTATION NOTES

First of all, I love the magazine. The articles talk about things I want to hear about, and I like the half-amateur, half-professional style of the magazine, which allows newcomers and old-timers in the business to find a happy medium.

Here's why I wrote. The article about notation software ("Computing the Score," August 1992) spoke clearly about the subject. But when people transcribe music into notation, they're usually most concerned with the melody of the song. How can you inexpensively do that with an acoustic piano?

I know you had an article on the Synchrovoice MidiVox in the July 1992 issue, but $1,595 is a lot of money. What are the other alternatives to this kind of pitch-to-MIDI conversion?

Alexander Zwick
Encino, CA

Alexander—If you're purely interested in playing melodies on an acoustic piano into notation software (these programs use MIDI as their means of real-time input), the best solution would be an acoustic piano MIDI retrofit like the Gulbransen KS20 reviewed in the August 1992 EM. *Unfortunately, at $1,990 it's even more expensive than the MIDIVox (it's $1,190 for the less sophisticated KS5), but it turns your piano into a sophisticated MIDI controller. A less-expensive pitch-to-MIDI converter is available from Roland (the CP-40, $295), but it's not well-suited for use with acoustic pianos. The most inexpensive solution would be to buy a small, low-cost, MIDI Out-equipped keyboard from K-Mart or any consumer electronics outlet (available for $250 or less) and use it to play in the melodies.—Bob O'D*

HOLY MIDI, BATMAN

I've been looking for an article like yours on MIDI in churches for a long time ("MIDI on High," July 1992). There must be a lot of keyboard players like myself who play in schools and churches for whom electronic keyboards and computers have completely changed their way of playing. I am interested in hearing what other church musicians do with MIDI equipment. I am also interested in finding user's groups with similar interests.

Jim VerLee
1205 Vinsetta
Royal Oak, MI 48067

GOOD TIMING

Congratulations to Chris Meyer for a very readable and well-researched article ("A Matter of Time," June 1992), and kudos to you and your staff for coverage of one of the most fundamental—and might I add, little-known and less-understood—aspects of music. Perhaps you can convince Mr. Meyer to next do an article on the effects of the listener's placement in space on the perception of time.

Also, a tip to your readers: I often tell my students who have trouble playing along with a metronome not to "follow" the clicks, but to synchronize their internal time to the clicks. This often clears up timing errors caused by reacting to the clicks instead of actively anticipating and preparing for their arrival.

Mark Merchant
Alexandria, OH

A CASIO CLASSIC

I am pleased your magazine featured an article on the classic CZ-series synthesizers ("Programming the Casio CZ-101," April 1992). I used a Casio CZ-1000 for over five years and have found much joy in the CZ's versatility and flexibility. Your excellent article, however, did have the following errors:

1) At one point the article claims waveforms 1 through 4 are non-resonant and that waveforms 5 through 8 are resonant. Actually, waveforms 1 through 5 are non-resonant, and waveforms 6 through 8 are the resonant waveforms. I assume this is a typo because the article elsewhere states that waveforms 1 through 5 are the non-resonant waveforms.

2) The article implies that you can combine two resonant waveforms in a single line. This is impossible to do from the front panel, although it might be possible using MIDI System Exclusive information.

3) The article says, "The DCO level values don't bear any relationship to musical intervals such as half steps or cents." Although the DCO level values do not directly correspond to musical intervals, the following table shows you the DCO level values that do correspond to musical intervals:

DCO EG Value	Musical Interval	# Semitones
8	minor second	1
16	major second	2
24	minor third	3
32	major third	4
40	perfect fourth	5
48	augmented fourth	6
56	perfect fifth	7
64	minor sixth	8
85	minor seventh	10
66	octave	12
67	octave + major second	14
68 and higher	add 2 semitones per DCO EG value	--

There is another trick you can do with the DCO envelopes: A DCO EG value of one has a corresponding fine detune value (on the detune page) of 7 1/2. This allows you to double the resolution of the fine tuning. If, for example, you want one oscillator to be detuned half of a fine interval from the other oscillator, do the following: 1) Use the 1 + 2 line select option; 2) Disable DCO 1's EG by making stage one an end stage; 3) Set DCO 2's EG to the following values: Stage 1: Rate 99, Level 01, Sustain; Stage 2: Rate 00, Level 00, End. Now set detune to: Down (-), 0 octaves, 0 notes, fine 07.

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GLASS HOUSES

I am writing to comment on a suggestion that appeared in two **EM** articles over the last year and a half: the use of fiberglass insulation as an acoustic damping material in home studios ("Production Tips for Your Home Studio" in May 1991, and "The Taming of the Room" in August 1991).

This type of fiberglass has been identified as a possible carcinogen. While it may present an acceptably low risk when used in attics or other closed areas, having this material present in a living environment where people are breathing, whether wrapped in fabric or not, seems to present an unnecessary danger. There are many safer alternatives that are specifically made for the purpose of deadening acoustic environments, including sculpted foam products such as Sonex, as well as acoustic tiles and blankets. Retailers of these products frequently advertise in audio magazines. These alternatives also can be reasonably economical, particularly when considering the potential health benefit.

Daniel Feldt
Streamwood, IL

Author Bruce Bartlett responds: *My books and articles recommend that fiberglass insulation be covered in muslin fabric to contain the fibers. Although fiberglass insulation is an efficient and inexpensive sound absorber, there are alternative materials, including rock wool, acoustic foam such as Sonex or Cutting Wedge, and thick blankets or comforters.*

Dave Brown, a health-hazards spokesperson for Dow Corning, claims that over the past 50 years, several research groups have concluded there is no evidence that inhaling glass fibers causes cancer in humans.

In 1987, the International Agency for Research on Cancer (IARC) rated fiberglass insulation as a possible human carcinogen. This is because in experiments in the late 1960s and early 1970s, fiberglass surgically implanted or injected in the tissues and trachea of lab animals produced tumors.

These studies showed no significant results of cancer. However, IARC believes it is prudent to treat a substance that produced positive results in animal tests—regardless of the route of administration or the level of risk—as a possible human carcinogen.

When inhaled, fiberglass particles are too big to reach the lungs. But the particles can mechanically irritate the skin, eyes, nasal passages, and throat. This irritation stops in a day or two. To prevent irritation, Dow Corning recommends that the installer wear goggles and a face shield, a dust mask, gloves, and a loose long-sleeved shirt. It also recommends that exposed insulation be covered in fabric to prevent skin irritation from rubbing against the insulation.

For a detailed overview on the latest medical/scientific research on fiberglass, you can order the brochure "Health and Safety Research on Fiberglass" from TIMA Inc., 29 Bank St., Stamford, CT 06901; tel. (800) 237-TIMA.

Address correspondence to "Letters," Electronic Musician, 6400 Hollis St. #12, Emeryville, CA 94608. Published letters may be edited for space and clarity.

Corrections to articles are listed at the end of "Letters." We compile these published corrections annually; to receive a copy, send an SASE to "Error Log Listing" at the above address.

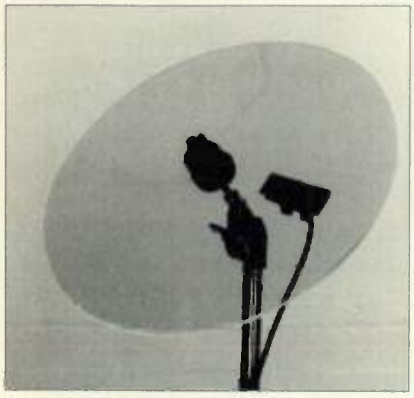
WHAT'S NEW

AKG C 547 BL ▶

AKG Acoustics is shipping the C 547 BL ($489), a hypercardioid boundary microphone designed for theater, studio, and sound-reinforcement applications. The mic's switchable bass-cut filter, shock-mounted capsule, and rubber feet reduce low-frequency noise, and a low-impedance, RF-suppressed output reduces radio-frequency interference. The C 547 BL is designed to be visually unobtrusive, with a non-reflective finish and a low profile. A snap-on windscreen is included. AKG Acoustics; tel. (510) 351-3500; fax (510) 351-0500.

AUDIO-TECHNICA ATM63HE ▶

Audio-Technica has added the ATM63HE hypercardioid dynamic mic ($190) to its Hi-Energy Microphone series. The new mic is said to provide bright, highly articulated sound with high output, low handling noise, and extended high-frequency response. It is recommended for miking snare drums, toms, acoustic instruments, and vocals. Audio-Technica; tel. (216) 686-2600; fax (216) 686-0719.



▲ EPS VISU-LITE CYMBALS

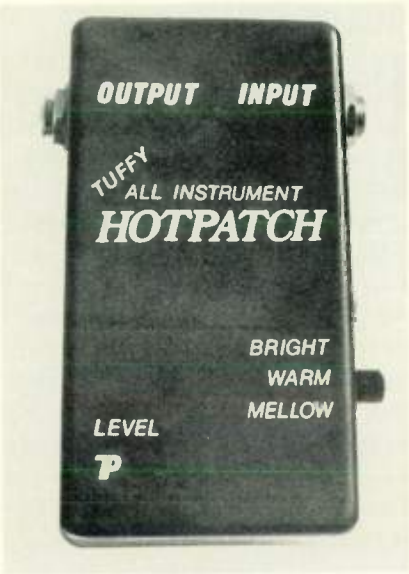
Electronic Percussion Systems is offering the Visu-Lite line of electronic cymbals. Made of 1/4-inch plastic, they are shaped like regular cymbals, are said to feel and play like brass cymbals, and mount on common cymbal stands without extra hardware.

Standard single-trigger crash/ride models are available in five sizes, from 10 to 18 inches ($116 to $175). Dampening cymbals, which use two trigger inputs, stop the sound when touched. They are available in 14-, 16-, and 18-inch sizes ($192 to $225). Visu-Lite hi-hat cymbals ($199), which also use two trigger inputs, work like regular hi-hats.

The cymbals are available in sixteen opaque and translucent colors and come with a 10-foot cable and two cord locks. Electronic Percussion Systems; tel. (612) 259-1840; fax (612) 259-8719.

▲ E-MU EMULATOR IIIXP

E-mu Systems unveiled the Emulator IIIxp ($3,995; Turbo model, $5,995), a MIDI-based, digital sample playback system. The EIIIxp incorporates the E-mu G-chip technology first used in the company's Proteus synths and the company's proprietary resonant filters. The 3U rack-mount, 32-voice (in mono; 16-voice stereo) instrument is compatible with the Emulator III library and loads EIII samples over SCSI. The unit accepts digital audio input from a professional DAT or other digital source via AES/EBU. It plays back in the digital domain via AES/EBU and in the analog domain (using 18-bit DACs at 44.1 kHz) through four pairs of -10 dBV unbalanced 1/4-inch and one pair of +4 dBm, balanced XLR outputs. E-mu claims flawless pitch transposition over a 10-octave range. The standard model includes 8 MB of ZIP RAM (expandable to 32 MB) and a 3.5-inch floppy drive. The Turbo model comes with 32 MB of RAM and adds an internal 105 MB hard drive loaded with EIII sounds. The EIIIxp is compatible with Passport *Alchemy* and Digidesign *Sound Designer II*. E-mu is preparing an *EIIIxp Remote Controller/Librarian* program. E-mu Systems; tel. (408) 438-1921; fax (408) 438-8612.



▲ SDM TUFFY HOTPATCH

The SDM Productions Tuffy Hotpatch ($119) converts a high-impedance signal from any electronic instrument (including piezo transducers) and converts it to a high-level, low-impedance output. The battery-powered Hotpatch has a 3-way equalization switch (bright, warm, and mellow) and boosts the signal by up to 20 dB. According to the manufacturer, the device adds considerable clarity and definition to the sound. Battery life is rated at thousands of hours thanks to the Hotpatch's microamp power requirements. SDM Productions; tel. (702) 883-4751; fax (702) 883-2161.

▲ YAMAHA MC-SERIES MIXERS

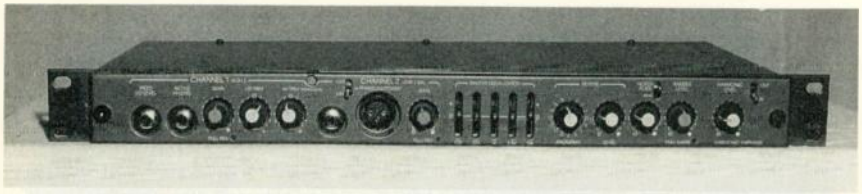
Yamaha unveiled four MC-series sound-reinforcement mixers: The 12-channel MC1204II ($3,100), the 16-channel MC1604II ($3,600), the 24-channel MC2404II ($4,300), and the 32-channel MC3204II ($5,800). All models feature four subgroups; four aux sends; 4-band EQ with sweepable midrange and switchable, 80 Hz highpass filter; two stereo aux returns; two stereo tape inputs; and +48V phantom power. The MC series also includes a Mix Matrix feature, which allows two separate mixes that blend the subgroups and stereo bus. Yamaha Corp.; tel. (714) 522-9011; fax (714) 739-2680.

▲ PS SYSTEMS POWER TOOL

PS Systems released the Power Tool ($699), a multiple-use guitar processor and amplifier. The device accepts and mixes a line-level input and the speaker-output signal from a guitar amp. It processes the signal with a 4-band active graphic EQ (±18 dB) and has an effects send and return for an external effects processor. The Power Tool's line-level output can emulate the sounds of either an open-backed guitar cabinet or a 4x12 cabinet. An internal 50W power amp feeds a switchable 4x12 cabinet simulator, and the unit offers both balanced and unbalanced, line-level, 1/4-inch outputs. A headphone output is included. PS Systems; tel. (800) 446-8404 or (619) 578-1118; fax (619) 578-8851.

BEYERDYNAMIC DT HEADPHONES ▶

Beyerdynamic introduced a new line of headphones. The DT 911 (open; $349.95) and DT 901 (closed; $299.95) feature triple neodymium magnets designed for high efficiency and extra transient response. Both lightweight, circumaural headphones feature velvet cushioning. The DT 811 (open; $249.95) and DT 801 (closed; $199.95) use a similar magnet structure and offer a full, saturated sound. The mid-priced DT 511, DT 411, DT 311, and DT 211 ($159.95, $119.95, $79.95, and $49.95, respectively) are supraural open phones with cloth-covered ear cushions. Beyerdynamic, Inc.; tel. (516) 293-3200; fax (516) 293-3288.



▲ TRACE ELLIOT TA-RP1R PREAMP

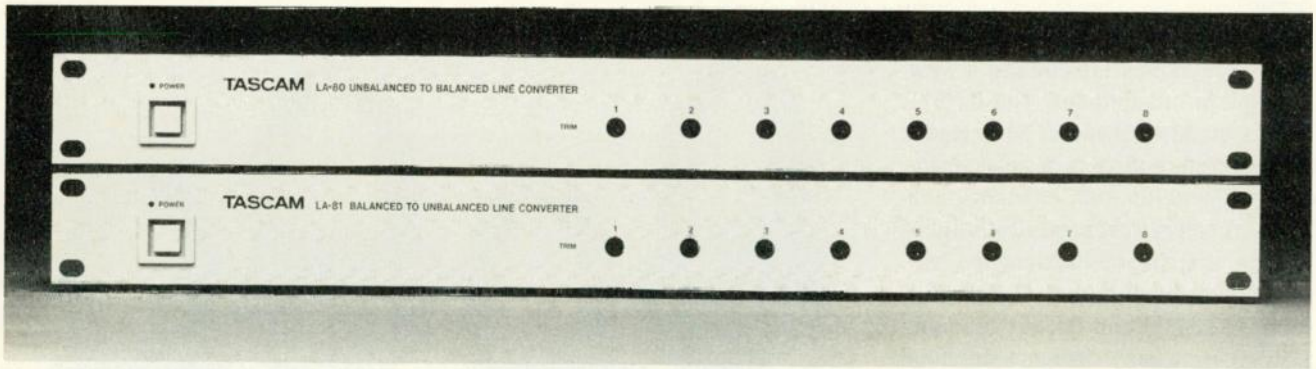
Trace Elliot introduced the TA-RP1R ($795), a 1U rack-mount preamp with a 5-band graphic master EQ; a notch filter (for tuning out feedback); Harmonic Emphasis spectral enhancement; and an assignable, 16-preset, Alesis digital reverb. Channel 1 is high-impedance and includes discrete high-level piezo and low-level active inputs for instruments. Channel 2 offers a low-impedance, balanced XLR input with phantom power. A version without reverb, the RA-RP1 ($595), also is available. The manufacturer considers the units suitable for both live and studio applications. Trace Elliot, U.S. distributor Kaman Music; tel. (203) 243-7941; fax (203) 243-7102.

▲ FURMAN PS-8 POWER SEQUENCER

Furman Sound is offering the PS-8 Power Sequencer ($329), a 9-outlet rack-mount power conditioner that powers up and shuts down attached equipment in a 3-step sequence. The PS-8 also offers varistor spike and surge protection and RFI filtering. Sequenced power-up and shut-down is useful in an audio system, where it's best to turn on power amps last and turn them off first, avoiding annoying and potentially speaker-damaging audible pops. The unit includes an onboard circuit analyzer with three green and red neon indicators that indicate wiring faults. Furman also offers the PS-8R ($359), which adds a terminal strip on the rear panel for connecting a remote power switch and LED. Furman Sound; tel. (415) 927-1225; fax (415) 927-4548.

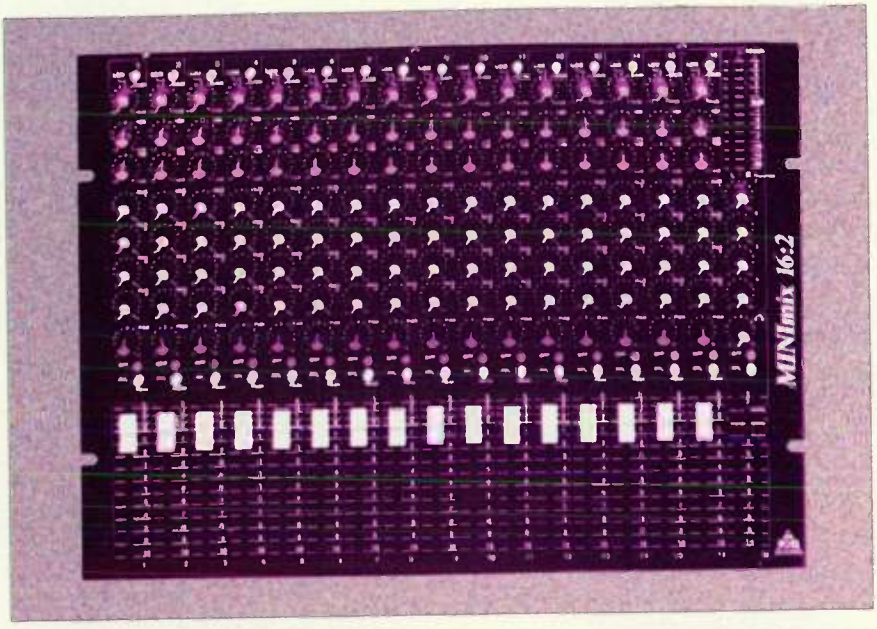
CIRCA INDUSTRIES ORPHEUS 2.0

Circa Industries has announced *Orpheus 2.0* ($50 shareware; add $5 s/h direct from Circa), a 64-track sequencer for IBM PC-compatibles. System requirements are minimal: The program runs on a PC with 256 KB RAM, CGA graphics, and an MPU-401-compatible interface (including the Music Quest MQX-32 for 32-channel operation). The program offers both event-list and graphical piano-roll editing, real-time entry, and scrolling sequence playback. It imports and exports type 0 and 1 Standard MIDI Files. Chains of SysEx and other MIDI messages can be recorded into the sequence, or triggered via one keystroke using user-programmed MIDI macros. Editing functions include sophisticated quantizing, randomizing, controller thinning, scaling, track merge/unmerge, and time compression/expansion. You can select and deselect events using Boolean criteria, e.g., by pitch, time, track, and MIDI channel. The user interface features a windowing environment and has pop-up menus and defeatable online help with a search function. *Orpheus* can be configured with Setup files that autoload track/instrument names, MIDI channel assignments, macros, sync parameters, song files, and more. The program supports tape sync, MTC, or Song Position Pointer. Circa Industries; tel. (703) 435-5628.



▲ TASCAM LA-80 AND LA-81

Tascam's LA-80 ($525) is an 8-channel, unbalanced-to-balanced line converter. Eight RCA inputs are routed to eight male XLR outputs. The LA-81 Line Converter ($525) converts eight balanced, XLR female input connectors to eight RCA unbalanced outputs. Both single-rackspace units include individual channel trims and ground-lift switches and a master ground lift switch. The LA-80's input link function allows the unit to act as a distribution amplifier. The manufacturer claims .005% THD and a signal-to-noise ratio better than 90 dB. Tascam; tel. (213) 726-0303; fax (213) 727-7656.



▲ ROSS SYSTEMS MINIMIX MIXER

Ross Systems' Minimix ($995) is a 8U rack-mount 16-channel mixer that offers 100 mm faders and selectable 1/4-inch line-level and XLR mic-level inputs on all channels. The four aux sends are pre-wired as two pre-fader and two post-fader but are internally pre/post selectable via jumper wire. Other channel features include 2-band shelving EQ (±12 dB at 100 Hz and 10 kHz), channel mute switches, +10 dB peak indicators, and +48V phantom power. The master section includes four aux send pots, separate left and right master faders, stereo PFL headphone monitoring, and a 12-segment bar graph meter. Ross Systems; tel. (817) 336-5114; fax (817) 870-1271.

WAVEBOY AUDIO-IN EFFECTS DISK

WAVeBOY Industries announced the Audio-In Effects Disk ($39.95), a collection of loadable effects for the Ensoniq EPS-16 Plus sampler. The software allows you to route any audio signal that appears at the audio input to the sampler's onboard effects processor. In addition, the disk provides several new effects algorithms, including Plate Reverb, Non-Linear Reverb, and a 3-voice pitch shifter. An input-level control lets you adjust for guitar, mic, and line-level signals. WAVeBOY Industries; tel. (215) 251-9562.

▲ ROLLS RA62HA HEADPHONE AMPLIFIER

Rolls announced the RA62HA Headphone Amplifier ($199.99), a 1U rack-mount, 6-output headphone amp with individual volume controls and a master pan control. The device has a stereo 1/4-inch input; 1/4-inch, left and right main inputs; six stereo channel inputs (which defeat the main input signal); and six stereo, 1/4-inch headphone outputs. Mono/Stereo and power switches are included. The RA62HA uses a military-grade, double-sided circuit board and steel chassis. Rolls Corp.; tel. (801) 562-5628; fax (801) 562-5655.

REV UP ▲ ▲ ▲ ▲ ▲

Dynaware (tel. [415] 349-5700) announced the latest version of ***Ballade*** ($195) for PC-compatibles (2.51) and the Macintosh (1.04). Unlike previous versions, this one is not so intimately tied to the Roland MT-32 and its offspring. It still includes patch editors for these instruments, and it's still GS-compatible, but it also offers 10-track sequencing (sixteen tracks on the Mac) with standard notation editing and printing as well as an automated 10-channel mixer with level meters and volume/pan controls.

Dynaware *Ballade* 1.04 for Macintosh

Waldorf Electronics is offering a free software update for the **MicroWave** wavetable synth (distributed by Russ Jones Marketing Group; tel. [818] 993-4091). The operating system update includes a just intonation feature that retunes each note in real time, depending on the harmonic context.

Spectral Synthesis is offering version 1.4 of ***StudioTracks*** (free to registered users; tel. [206] 487-2931), the software interface for their Digital Studio hard-disk recording system for the PC. New features include non-destructive crossfades within a track, ten levels of Undo, and more stereo editing conveniences. The company also has written a *Windows* application that allows Spectral System owners to control and integrate Mark of the Unicorn's Video Time Piece. Contact Spectral for details.

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DO IT

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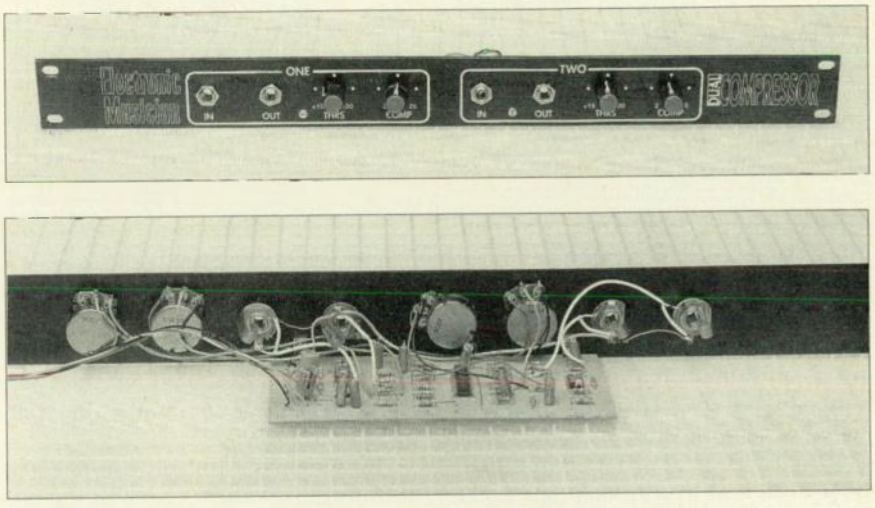
YOURSELF

Build the EM Dual Compressor

By Jules Ryckebusch

If your acoustic sounds range from barely audible to a meter-pinning roar, this dual compressor can help.



PETER DIGGS

The finished product (sans case), viewed from the front panel (top) and inside rear.

One of the most important, but often overlooked, tools in any studio is a compressor. This device is essential when recording real-world acoustic instruments, particularly the human voice. When an audio signal fed into a compressor reaches a user-defined level, or *threshold*, the device reduces the gain of its internal circuitry to regulate the output signal's rate of increase.

For example, suppose you are recording a mellow lead on your favorite guitar, and the level meter on your tape deck is resting comfortably at the -3 dB mark. Suddenly, you hit the ultimate power chord from hell. In other words, the guitar signal is now about 20 dB louder. Congratulations! You just overloaded your tape deck.

However, all would not be lost in a sea of distortion if you had a compressor connected between the guitar and the tape deck. With a 5:1 compression ratio, an increase of 20 dB above the threshold in the input signal would result in only a 4 dB increase in the output signal going to the tape deck. In the example above, this would take the level meter to the +1 dB mark. (For more details about the operation of compressors, see "Pumping Gain: Understanding Dynamics Processors" in the March 1991 **EM**.)

So now you're thinking, "Wow! Where do I get one?" Obviously, you can buy a compressor, but you also can build your own. Before we get into the actual construction, let's see how the device works.

HOW IT WORKS

The **EM** Dual Compressor provides two independent channels of compression. The heart of the circuit is the SSM-2120 Dual Dynamic Range Processor. While the rest of the world is going digital, the folks at Precision Monolithics

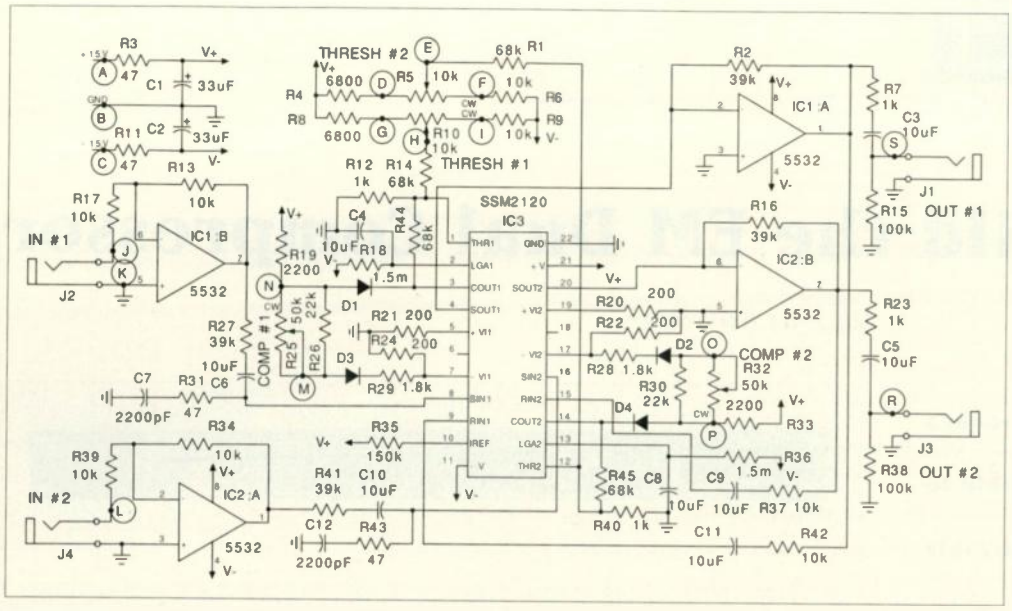


FIG. 1: The schematic of the EM Dual Compressor. Circled letters correspond to circuit-board points.

have been designing better analog building blocks, and the SSM-2120 is no exception. It features a dynamic range of 100 dB—16-bit digital audio only has a 96 dB dynamic range—and 0.01% distortion at +10 dB input. (The SSM-2120 also would make an excellent single-ended noise-reduction unit or expander. If there is enough interest, I will design them. I can be contacted at 928 Fairway Dr., Winter Park, FL 32792. Please include a self-addressed, stamped envelope.)

The chip includes two independent VCAs, two sets of precision rectifiers, and two logarithmic converters. The only other required elements are some external components to buffer the input and output signals, set the operating threshold, and adjust the compression ratio.

The schematic isn't as complicated as it looks (see **Fig. 1**). Each of the two additional ICs include two operational amplifiers, labeled A and B. Op amps IC1:B and IC2:A buffer the incoming signals. R35 provides a reference current to the VCA stages of the SSM-2120. R27 and R41, combined with R31/C7 and R43/C12, provide the correct inputs to the VCAs. IC1:A and IC2:B are current-to-voltage converters that retrieve the signals from the VCAs. R2 and R16 set the gain of the outputs and have the same value as R27 and R41. This completes the audio section.

In the control section, the audio output signals are sent back into the SSM-2120 at the Rectifier Input pins via R42 and R37. C11 and C9 are necessary due to a DC level present at the Rectifier Input pins. R18 and R36 establish a reference current in the Log Converter circuit. C4 and C8 are averaging capacitors that determine the attack and decay characteristics of the compressor.

Potentiometers R5 and R10 form a voltage divider that is used to set the compression threshold from -30 dB to +15 dB for each channel. R44 and R45 establish the internal gain of the Control Output pins. This control signal is sent to voltage-divider networks consisting of R25/R26 and R32/R30 and then to the -VIN pins of the VCA sections. This causes the gain of the VCAs to decrease as the control voltage increases. Potentiometers R25 and R32 set the compression ratio from 2:1 all the way to about 25:1. Diodes D1 through D4 provide a unipolar control voltage. R3/C1 and R11/C2 decouple the power supply. All in all,

PARTS LIST

Resistors (1/4W)

R1, R14, R44, R45	68 KΩ
R2, R16, R27, R41	39 KΩ
R3, R11, R31, R43	47Ω
R4, R8	6.8 KΩ
R6, R9, R13, R17	10 KΩ
R34, R37, R39, R42	10 KΩ
R7, R12, R23, R40	1 KΩ
R15, R38	100 KΩ
R18, R36	1.5 MΩ
R19, R33	2.2 KΩ
R20, R21, R22, R24	200Ω
R26, R30	22 KΩ
R28, R29	1.8 KΩ
R35	150 KΩ

Potentiometers

R5, R10	10 KΩ
R25, R32	50 KΩ

Semiconductors

IC1, IC2	5532 dual low-noise op-amps
IC3	SSM-2120
D1-4	1N4148 silicon diode

Capacitors

C1, C2	33 µF, 16V electrolytic
C3, C4, C5, C6	10 µF, 16V non-polarized
C8, C9, C10, C11	10 µF, 16V non-polarized
C7, C12	2,200 pF ceramic disk

Connectors

J1-4	Open-circuit, 1/4-inch phone jacks

Other Components

Circuit board
Case
Knobs
Panel
Wire

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it's pretty straightforward; all the hard-to-build stuff is contained within the SSM-2120.

CONSTRUCTION

Construction is relatively easy. PAiA Electronics (3200 Teakwood Lane, Edmond, OK 73013; tel. [405] 340-6300) has developed a kit of all parts and a circuit board (see **Figs. 2a** and **2b**). The complete model 9205K kit, including PC board and all electronic components, except panel and power supply, costs $56.50. For you "real" men and women, PAiA carries the SSM-2120 and other parts separately; call for more information.

Use a low-wattage soldering iron and rosin core solder. Take your time; the results will be worth it. Good grounding techniques also are important. Be sure to use shielded wire for the inputs and outputs.

A clean power supply is important; the compressor is designed for ±15V operation. Unfortunately, this is not a standard configuration for external "wall-wart" power supplies, so you'll have to install one in the compressor case. There are plenty of good power-supply designs available from various sources, including *Electronic Projects for Musicians*, by Craig Anderton (available from Mix Bookshelf; tel. [800] 233-9604 or [510] 653-3307). The finished compressor should look something like the opening photos.

TESTING

Before applying power to the compressor, check over your wiring thoroughly. Check for solder bridges, then check your wiring again. I can vouch for the "haste makes waste" axiom.

▼

In addition to vocal applications, compressors are perfect for recording instruments with wide dynamic ranges.

To test the compressor, try hooking it up between a CD player and stereo amplifier. Set the compression ratio to 2:1, with a threshold of +15 dB. This should have no effect on the input signal; you should hear the CD in full fidelity, with no distortion. The dual compressor is a studio-quality device, so there is something wrong if you hear noise or distortion.

Once you get past the first test, turn up the compression ratio about halfway. You should hear no difference, as the output of the CD player is roughly 0 dB, which is below the threshold setting. Start turning the threshold controls toward -30 dB. The volume should go down as the compressor starts compressing. You should still hear no distortion. Listen to the mix of the CD at the maximum compression ratio. Everything should seem to be mixed at the same level.

IN USE

There are many good uses for compressors, both in the studio and onstage. In addition to vocal applications, they are perfect for recording instruments with wide dynamic ranges. For recording purposes, set the compression ratio and threshold to maximum values (25:1 and +15 dB). Now start reducing the threshold until you hear a reduction in the signal. Increase the threshold just a bit and reduce the compression ratio to the minimum value required to get the job done. This will preserve as much dynamic range as possible.

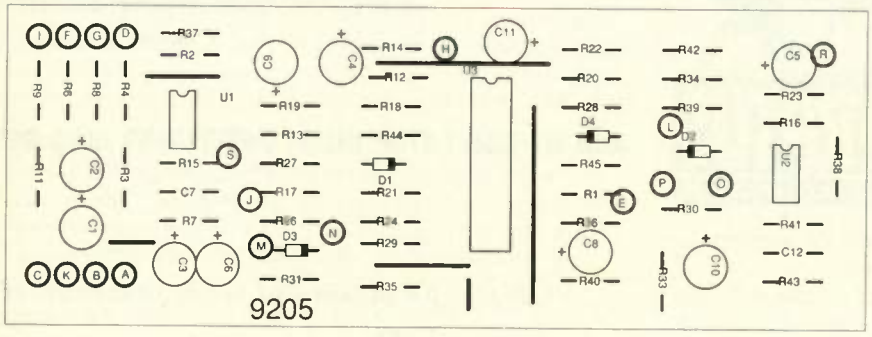
Compressors can be used to create extended sustain by using minimum threshold settings and large compression ratios. The output will maintain a relatively constant level until the input signal finally decays below the threshold level. This is useful for lead guitar and really long piano chords like the final chord on the Beatles' "A Day in the Life."

Used at the input to a DAT machine, the compressor will ensure that you don't overload the D/A converters. The unit is quiet enough to be used for this purpose. Remember, digital audio is only as good as the analog front end.

Have fun, and DIY!

(Special thanks to Joe Buxton of Precision Monolithics and John Simonton of PAiA Electronics.)

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



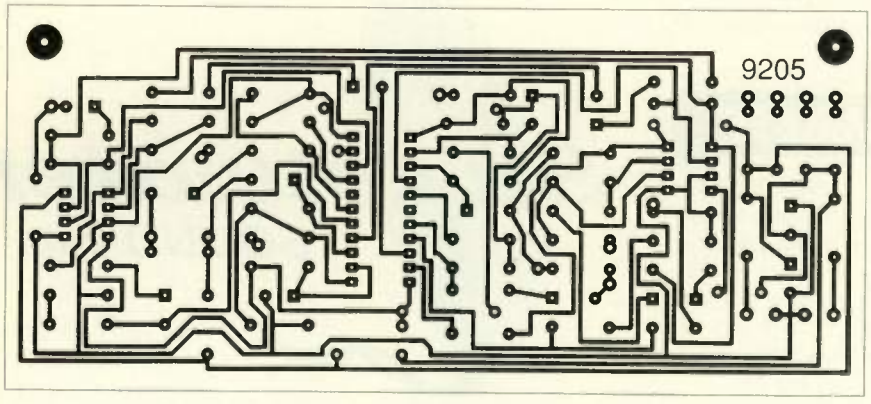


FIG. 2: The printed circuit board of the EM Dual Compressor. The top view (a) shows the location of the circuit elements. The bottom view (b) reveals the conductive traces.

Admit it. You get off on the notion of having the world at your fingertips. You, my friend, are what is known as a power freak.

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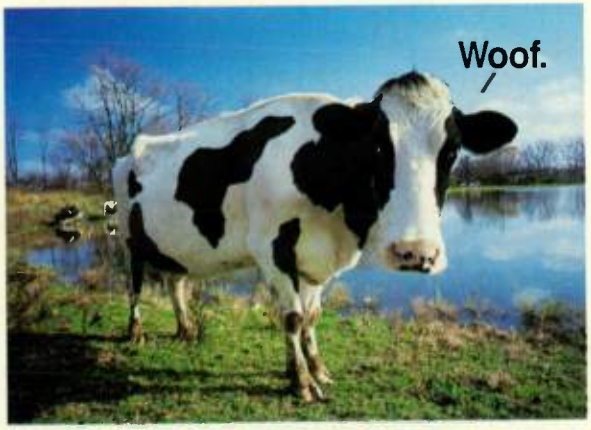

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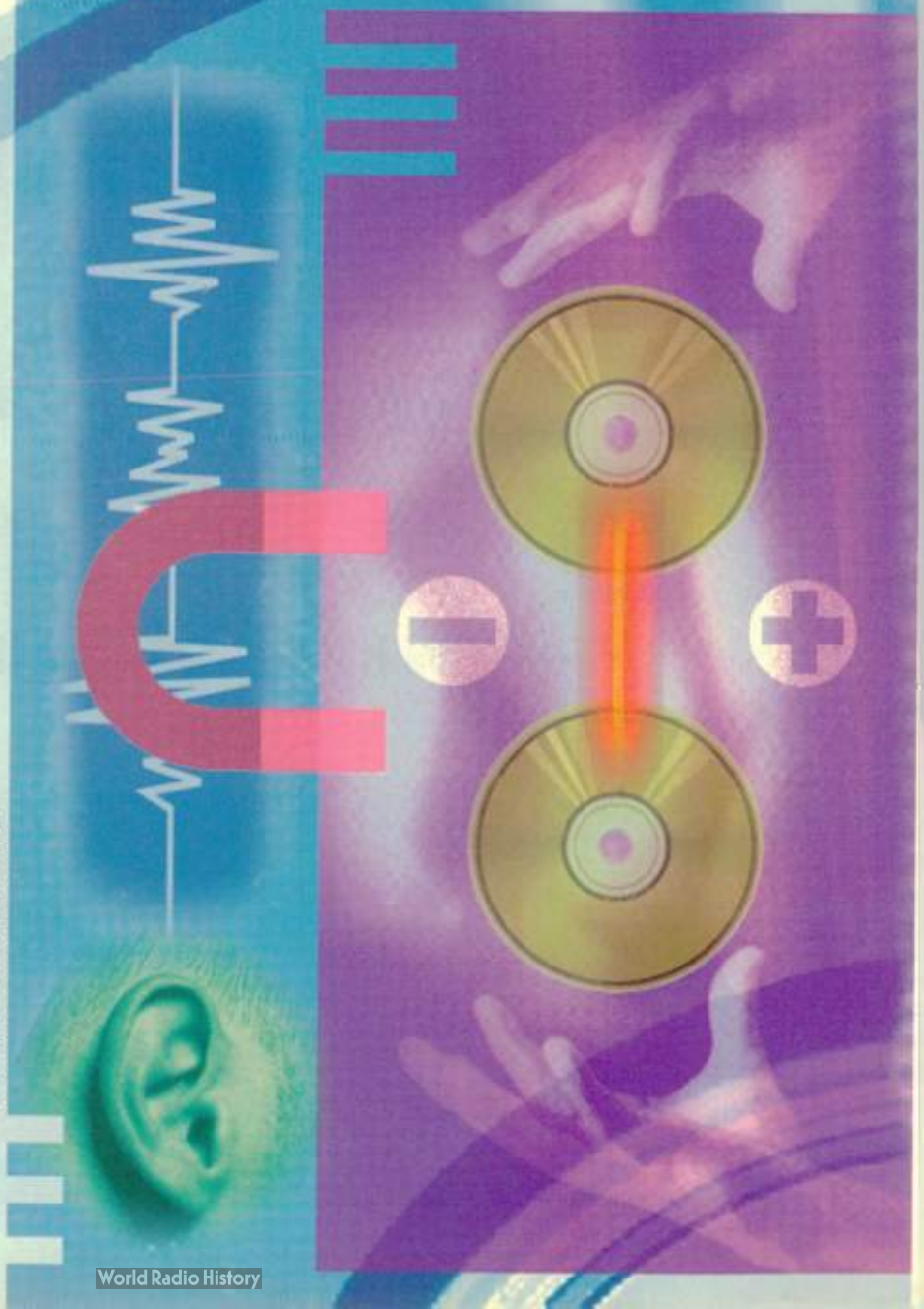

ILLUSTRATION BY GORDON STUDER

Ever since the introduction of the compact disc over a decade ago, musicians and consumers alike have hailed the pristine sonic quality and apparent longevity of this convenient medium. During playback it endures no physical contact whatsoever, allowing the millionth play to sound just as good as the first. The capability of random access eliminates the fast forward and rewind functions, providing accurate and instantaneous cueing as well as the ability to customize the order in which selections are played. And the nearly universal availability of CD players makes it easy to use CDs almost anywhere.

CDs have one significant drawback, however: They are non-erasable and non-recordable. Once they've been replicated, the recorded material is indelible. Also, producing a CD has

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In the beginning there was the 01/W. Now this award-winning keyboard has evolved into a full line of extraordinary music workstations.

01/W The 0 that started it all. 32 voices, 200 programs, 200 combinations. And you can access up to 800 of the best sounds on the planet using Korg's SRC-512 RAM

card! Wave Shaping (Korg's exclusive process for modifying waveforms) yields super-realistic acoustic instrument sounds and original sounds nothing else can. A 7,000 note, 16-track sequencer adds more versatility.

01/WFD The "pumped up" 01/W. All of the incredible sounds and power of the 01/W. Plus a built-in

disk drive that lets you store programs, combinations, sequences and sysex data. Flex your creativity with an expanded 48,000 note, 16-track sequencer. Like the 01/W, it includes two Stereo Dynamic Digital Multi-Effect Processors with 47 effects and real-time control.

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And, like the 01/WFD, it can even be used as a MIDI data filer.

01/W ProX The most evolved 01/W. Features an 88-note weighted action keyboard that makes the ProX an ideal Master MIDI Controller. And you get the full complement of the 01/W Pro's sounds, sequencing power and storage capability.

01R/W A perfect MIDI module. All the sounds and features that have made the 01/W the leader in music workstations. Plus a 7,000 note, 16-track sequencer with sophisticated editing control. Receives on 16 independent MIDI channels. MIDI overflow. Four polyphonic outputs. The ultimate open-ended system in a compact two rack space.

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3. ***PLAY!***

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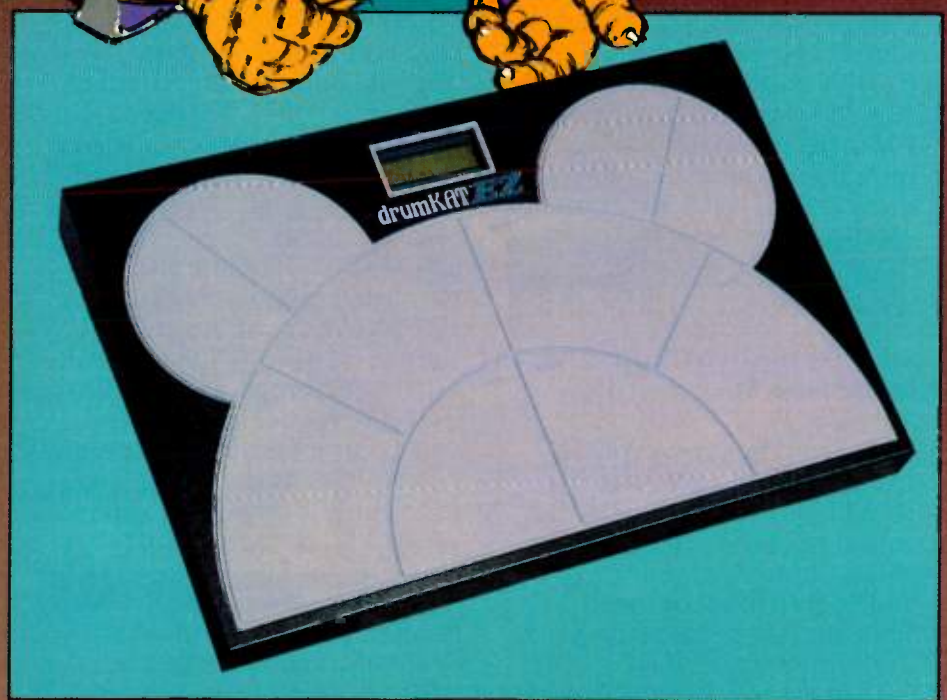
The **drumKAT EZ** is perfect for any live, recording, or MIDI studio situation. If you're tired of pushing buttons, then pick up your sticks and play — it's **EZ** with KAT.



- **Compact 10 pad gum rubber playing surface**
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- **3 note dynamic layering**
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- **Expressive foot and breath control**
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been prohibitively expensive. The required equipment is cost-effective only if large numbers are duplicated for the mass market.

Wouldn't it be wonderful if home studios could run off a few CDs at a time for reference listening, demos, mastering, and archiving? Thanks to recent technological advances, this dream is a giant leap closer to reality. CD recorders have dropped to near or below the $10,000 price point, bringing them within the reach of many studios that would otherwise rely on cassettes or DATs for these applications.

BACKGROUND

The technology behind all types of CDs is outlined in a set of specifications developed by Philips and Sony, which are available only to licensed developers. These specs, known as "Books," are identified by the color of their cover. They include complete descriptions of data format, encoding, error correction, physical dimensions, and all other aspects of the technology.

The Red Book, which describes the original CD-Audio spec, has been updated to include CD+Graphics and CD+MIDI. The Yellow Book encompasses CD-ROM and CD-ROM XA (Extended Architecture), while the Green Book is dedicated to CD-Interactive. Recordable CD technology is outlined in the Orange Book, which is entitled *The Compact Disc Recordable System* (also known as CD-R). This Book is divided into two parts. Part I covers rewritable magneto-optical discs, and Part II is devoted to optical WORM (Write Once Read Many) discs such as recordable audio CDs.

The obvious advantage of magneto-optical (MO) discs, which are now common computer accessories, is their erasability. Currently available MO drives employ heat-assisted magnetic recording. In these systems, a laser heats a small spot in a layer of magnetic material within the disc to a temperature at which it is no longer magnetic. The laser is then turned off and the material cools in the presence of an external magnetic field. As it cools below the threshold temperature known as its "Curie point," the material retains the magnetic orientation of the external field. This process can be repeated any number of times, allowing almost infinite erasability.

MO readers require a sophisticated playback mechanism that bears little resemblance to a standard CD player. MO units detect changes in the polarity of laser light reflected from different areas on the surface of the disc, while CD players read changes in the reflected light's intensity. Although the data structure for audio information can be similar to standard CDs, the mechanisms and techniques are fundamentally different. Thus, MO discs cannot be played in standard CD players.

WORM CD-Rs use optical techniques for recording and playback (described shortly). Although they are not erasable, they are fully compatible with existing CD players, giving them an advantage over MO discs when it comes to audio storage and distribution.

ANATOMY OF A CD

All CDs are oriented from the inside out (see Fig. 1a). At the center is the hole that fits on the spindle of the player. Surrounding the hole is the clamping area used to physically secure and spin the disc. On commercial CDs, the next area is called the lead-in. This area contains the table of contents (TOC) for the disc, which includes the track number and timing for each selection as well as the total time of the program material.

The digital audio is encoded in the program area, which occupies most of the disc. Like a phonograph record (remember those?), the material on a CD is stored in a single spiral track, which should not be confused with the tracks that identify different selections in the program material. Unlike records, however, the information encoded in the spiral runs from the inside out. At the outer edge of a CD, the lead-out defines the end of the program area.

CD-Rs include two extra areas between the clamping area and the lead-in (see Fig. 1b). The program calibration area (PCA) is used to adjust the power output of the laser before recording begins. This power level is critical and varies slightly from one disc to the next, so the laser is reflected from the PCA to determine the correct power setting for each disc. The program memory area (PMA) is used to store a temporary TOC during the recording process. This allows portions of the program material to be recorded at different times.

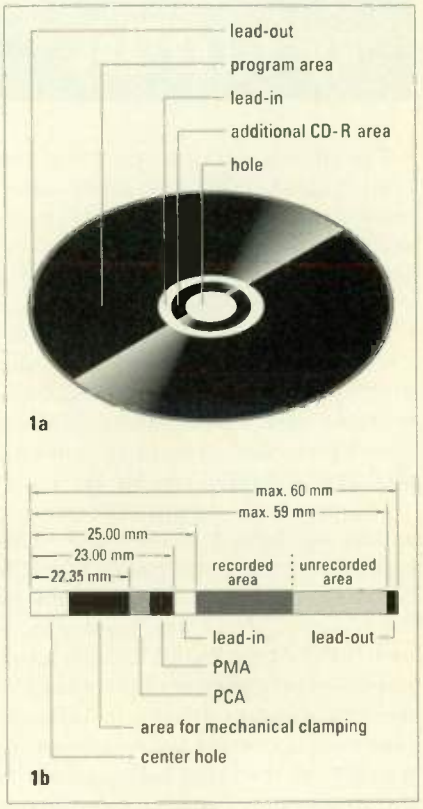


FIG. 1a: Concentric map of a compact disc. Commercial CDs and CD-Rs are identical except for the additional CD-R area before the lead-in.

FIG. 1b: Radial cross-section of a CD-R. All dimensions are specified in the Orange Book and are compatible with the Red Book.

In addition to these concentric areas, all CDs consist of several layers of material (see Fig. 2a). The topmost layer is protective plastic and the printed label, beneath which is a reflective layer of gold. The lowest layer is a clear polycarbonate substrate.

CD-Rs contain an extra layer between the reflective layer and substrate called the recording layer, which consists of a colored dye. The dye fills a preformed spiral groove, which will ultimately hold the digitally encoded program material, in the substrate of a blank CD-R. The groove is 0.6 micrometers (µm) wide, with 1.6 µm between adjacent grooves, resulting in about 15,000 grooves per inch. Blank CD-Rs are manufactured by Mitsui Toatsu, Taiyo Yuden, and TDK, and they cost between $25 and $40 each when purchased in large quantities.

The digital data representing the audio signal, TOC, and other information on a commercial CD is represented as a series of "pits" that are stamped into the spiral track in the substrate layer. These pits are then filled in with material from the reflective layer. As the disc spins above the playback laser, the intensity of light reflected from a pit is significantly less than light reflected from an unpitted section of the track (see **Fig. 2b**).

The process is slightly different for a fully assembled blank CD-R. The recording laser beam passes through the clear substrate and heats a spot in the recording layer dye, causing it to melt away. This emulates the basic physics experiment in which a laser is fired at a colored balloon inflated inside a larger clear balloon. Because it's colored, the inner balloon absorbs the laser's energy and bursts while the clear balloon remains intact.

Although the laser doesn't affect the clear CD substrate directly, the heat from the melting dye causes the polycarbonate material to expand and fill the hole left by the dye as it melts (see **Fig. 2b**). This process forms bumps along the spiral track in the substrate, which have reflective characteristics similar to the pits in commercial CDs.

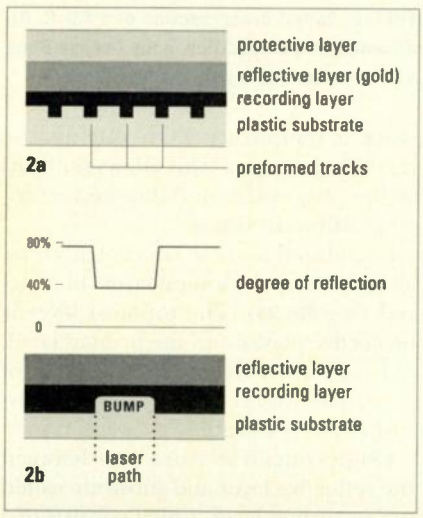


FIG. 2a: The layers of a CD-R include the recording layer, which is absent in a commercial CD. A preformed spiral track in the substrate is filled with the recording dye.
FIG. 2b: After a pit is burned in the recording layer and the plastic substrate expands to fill it, creating a bump, only about 40 percent of the reading laser beam is reflected. In an area without a bump, almost 80 percent of the light is reflected. These reflectivity values are similar to those on a commercial CD with pits in the substrate instead of bumps.

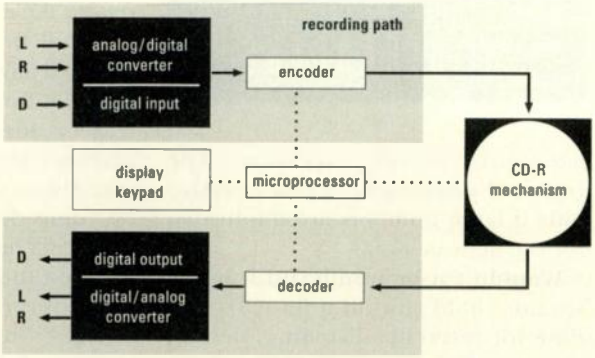


FIG. 3: A self-contained CD-R system includes analog and digital audio I/O, encoder, decoder, display, keypad, and read/write mechanism, all controlled by a microprocessor.

Interestingly, the digital information is not stored sequentially along the spiral track. Instead, it undergoes a complicated encoding, scrambling, and error correction process that spreads the samples all over the disk. During playback, the samples are retrieved and stored in RAM, after which they are sent to the D/A converter in the correct sequence.

RECORDING PROCESS

The recording process is quite straightforward. Self-contained CD-R units include analog and digital audio I/O (see **Fig. 3**), while computer-based systems use SCSI to receive data from a hard disk (see sidebar "CD-R Systems").

As mentioned earlier, the exact laser power required to record on a particular disc must be determined before recording. A CD-R recorder uses the PCA on each disc to adjust the laser's power to a level between 4 and 8 mW. After that, program material is recorded on the spiral track in the program area. A temporary TOC is created in the PMA, which is updated every time new material is recorded. A partially recorded disc cannot be read by the current generation of CD players.

Once all material has been recorded, the disc is "fixed" by writing the final TOC in the lead-in. This renders the disc unable to record any additional material and allows it to be played in any CD player. Up to 99 program tracks with up to 99 index marks each can be recorded and identified in the final TOC. However, not all CD-R recorders can write index marks.

The Yamaha YPDR601 (see **Fig. 4**) can operate in the manner described, but it also offers a unique alternative. Before recording any audio, the user can write a TOC in the lead-in consisting of fixed-length tracks of 10 or 30 seconds each. Program selections can extend across these tracks seamlessly, although the remainder of a partially-recorded track is wasted; each program selection must start on a new track.

This scheme allows partially recorded CD-Rs to be played in standard CD players, after which new material can be recorded at any time. However, the track numbers in the player's display will not correspond to the number of each program selection. Nevertheless, there are some distinct advantages to using this procedure, such as the ability to slowly accumulate daily reference mixes or radio broadcast material to use in standard CD players between recordings.

Because the medium is "write-once," it's generally a good idea to master to DAT or a hard-disk recorder before recording onto a CD-R. Use a direct digital transfer if possible. Start IDs on a DAT master often are recorded as track numbers on the CD-R. With some systems, the process of making perfect digital clones are automated. The digital clock signal and start IDs or track numbers from a DAT or CD can be used to synchronize the transfer of all digital information to a CD-R.

The quality of CD-R recordings is exceptionally high. In fact, CD-Rs exhibit far fewer interpolation and other errors than commercially manufactured CDs. In addition, many experts believe that a direct digital CD-R copy of a commercial CD sounds better than the original.

APPLICATIONS

The applications of CD-R technology are numerous and varied. In the recording studio, CD-R demos retain the high audio quality of a DAT master, while offering the ability to be played

virtually anywhere. A&R reps may not have DAT machines in their offices, but they are almost certain to have CD players, and hopeful artists may impress them by submitting a demo on CD.

Commercial studios sometimes use CD-Rs for reference mixes, which allow artists and producers to hear what the final CD product sounds like. Another wide area of application is the creation of custom sound libraries. Those who use samplers can build their own custom libraries of samples. Video post-production houses can use CD-R to build custom libraries of sound effects, themes, and production music cues.

Radio stations and broadcasting networks are perfect arenas for CD-R technology. According to CD-R manufacturer Studer Revox, 60 percent of all radio broadcast programming originates from CD. Custom libraries of station identifications, themes, jingles, commercials, sound effects, and music can be easily assembled. Denon offers CD "cart" players for radio stations that can play incomplete CD-Rs without a final TOC.

DUPLICATION

You might imagine that CD-Rs could be sent directly to a CD manufacturing house for mass duplication, avoiding tape altogether. However, it is usually not that simple. All CDs include timing information called "PQ subcode" that is embedded within the audio data. The PQ subcode includes the absolute time code used by a CD player to indicate elapsed and remaining time at any point as the disc plays.

FIG. 4: The Yamaha YPDR601 CD Recorder lets you record multiple times on Red Book-standard audio CDs.

In order to cut the glass master disc that will be duplicated on a large scale, the PQ subcode must be sent to the mastering machine separately before the audio data. This code is known as the "PQ burst." Normally, the manufacturing house makes a copy of your DAT or analog master tape onto U-matic video tape in Sony PCM 1630

digital audio format. This tape includes the PQ burst at the beginning of the tape on one of the audio tracks, SMPTE time code on the other audio track, and the primary digital program material on the video track.

Unfortunately, most standard CD-R systems do not record the PQ burst on a disc, requiring an intermediate 1630 tape anyway. But at least two CD-R systems do record the PQ burst directly on the CD-R. This is known as the "pre-master CD" format.

The Philips CDD 521 provides SCSI connection to a host computer and records digital information directly from a hard disk at double speed; of course, the computer and hard disk must be able to send data at this rate. This unit is primarily designed to record CD-ROM and CD-I, which lets the user include liner notes, lyrics, still images, or musical scores with the audio. This additional graphic information can be accessed by CD-ROM or CD-I players.

The CDD 521 records audio CDs with the addition of Optical Media International's *TOPiX* CD-recording software for Macintosh, PC compatibles, or Unix systems. The system creates pre-master CDs at a cost of around $10,000 for the CDD 521 and software, excluding the computer and hard drive.

Sonic Solutions offers a variety of Macintosh-based modular digital audio workstation (DAW) systems with dedicated SCSI ports, various analog and digital audio I/O boxes, A/D and D/A converters, and extensive DSP. With the addition of their CD-200 CD Printer and *TrackMaker* PQ-preparation software, pre-master CDs can be created for as little as $15,700, excluding the computer and hard drive.

Sonic Solutions also offers the MasterMaker system for CD pressing plants, which reads pre-master CDs in preparation for cutting glass masters. However, it also can scan an entire CD and extract the PQ subcode. This information is then sent as a PQ burst to the mastering machine and is followed by the audio data. Although this process saves less time than direct cutting from a pre-master CD, it allows any CD-R or commercial CD to become the program source without the intermediate step to 1630 tape.

Currently, there are few CD pressing plants that can accommodate pre-master CDs; Sony Digital Audio Disc Corp. (DADC) in Terra Haute, Indiana, is among those that can. However, the industry is rapidly moving in this direction, and most pressing plants should have pre-master CD capabilities by sometime next year.

SPINNING DOWN

Clearly, the potential of recordable CDs is vast, but how soon will they become commonplace? Even though prices are falling fast, the cost of CD-R systems and blank discs is still relatively high. It will probably be a few years before small home and project studios can afford to purchase them. However, they may be available from rental companies in the near future, making it possible for just about anyone to record their own CDs. This capability will further blur the distinction between commercial and home studios, and enable those of somewhat lesser means to play in the big leagues.

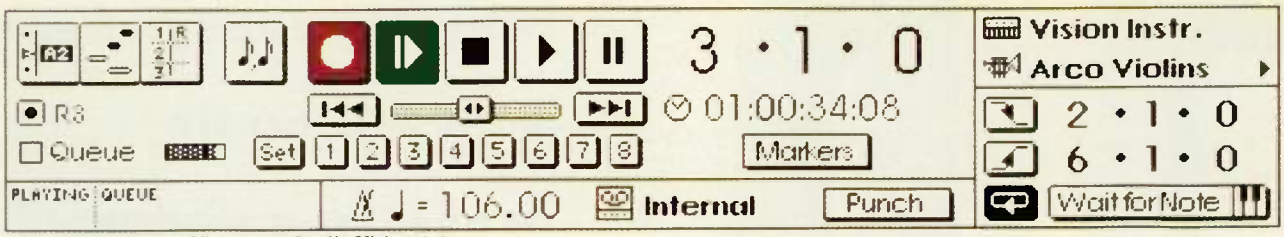
(Thanks to David Schwartz, Marantz Professional Products; Phil Van Allen, Philips Interactive Media; Robert Mueller, Studer Revox America; John Geiger, Yamaha Professional Digital Products; Gary Hall, Sonic Solutions; Ken Pomper, Optical Media International; Walt Klappert, Warner New Media; Mark Waldrep. Diagrams reprinted from *CD-Recordable: Basic Principles*, courtesy Marantz Professional Products.)

EM *technical editor* **Scott Wilkinson** *does not subscribe to the notion that digital sound is somehow less "warm" than analog. He thinks CDs sound just fine, thank you, and loves the convenience they offer.*

CD-R SYSTEMS

MANUFACTURER	PRODUCT	LIST PRICE
Self-Contained Systems		
Marantz Professional Products Dist. by Dynascan Corp. tel. (708) 820-4800 fax (708) 820-8103	CDR600	$7,500
Studer Revox America, Inc. tel. (615) 254-5651 fax (615) 256-7619	D740	$11,500
Yamaha Corp. of America Professional Digital Products tel. (714) 522-9011 fax (714) 739-2680	YPDR601	$13,980
Denon America, Inc. tel. (201) 575-7810 fax (201) 575-2532	DN-7700R	$16,000
Computer-Based Systems		
Philips Consumer Electronics tel. (615) 521-4395 fax (615) 521-3210	CDD 521	$5,995
Optical Media International tel. (800) 347-2664 or (408) 376-3511 fax (408) 395-6544	*TOPiX* software for the CDD 521	$4,000
Sonic Solutions tel. (415) 485-4800 fax (415) 485-4877	Sonic System DAW SonicStation DAW CD-200 CD Printer *TrackMaker* software	$20,000-$100,000 $5,000 $9,750 $895

Whaddaya Waiting For?



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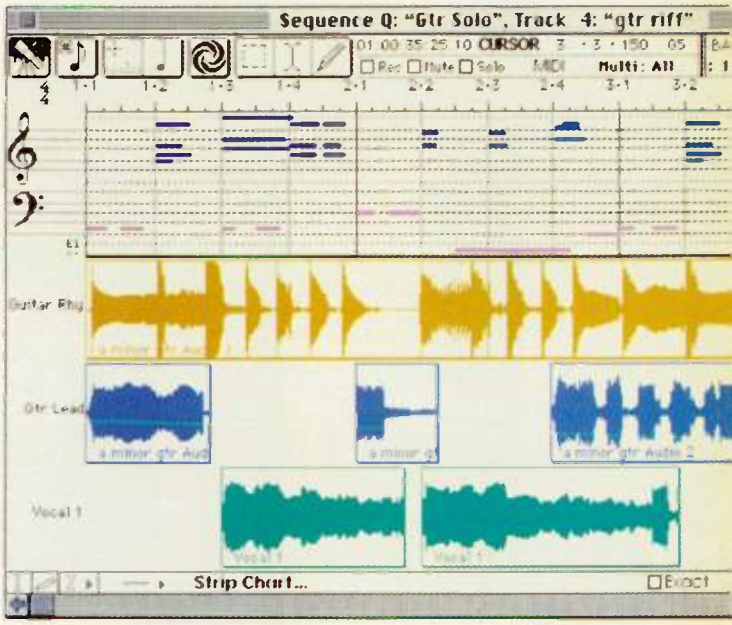

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3-D Audio

Sweet music is literally everywhere with 3-D audio processing systems.

In this era of rapid technological change, the way we listen to recorded music is based on a technology that is over 30 years old. Stereo was the breakthrough of its day and has survived pretty much unchanged since then. Some people would like to keep it that way, but industry innovators are working on the latest spin in audio recording: spatial enhancement. These companies realize that a convincing sonic image is as much a matter of perception as circuitry, and perception can be manipulated as easily as a patch change.

Three-dimensional audio is a heady brew of digital signal processing and psychoacoustics; your brain is manipulated as much as the signal. The goal is the reproduction of a broadened soundstage, with precise localization of instruments. When it works, the effect can be startling. The sound moves horizontally and, in some cases, vertically beyond the speaker positions. When it doesn't work, the results are not only disappointing, but arguably detrimental to the source material. Still, the idea of a spherical soundstage that can be controlled with a panpot, a fader, or MIDI is an enticing prospect. Maybe space really *is* the final frontier.

OPPOSING CAMPS

As in the breakup of a long-established political union, there's a lot of factional debate over what to do with stereo now that we're able to move beyond it. Since stereo is a universal delivery system, some parties argue that spatial enhancement should be single-ended (i.e., encoded during recording, without requiring decoding during playback), and the results should be playable on any 2-channel setup without additional hardware. This philosophy has the most devotees, with various 3-D recipes coming from companies such as Archer Communications (QSound), Gamma Electronics (B.A.S.E.), and Roland (RSS).

Other companies argue that the stereo format is

By Ron Goldberg

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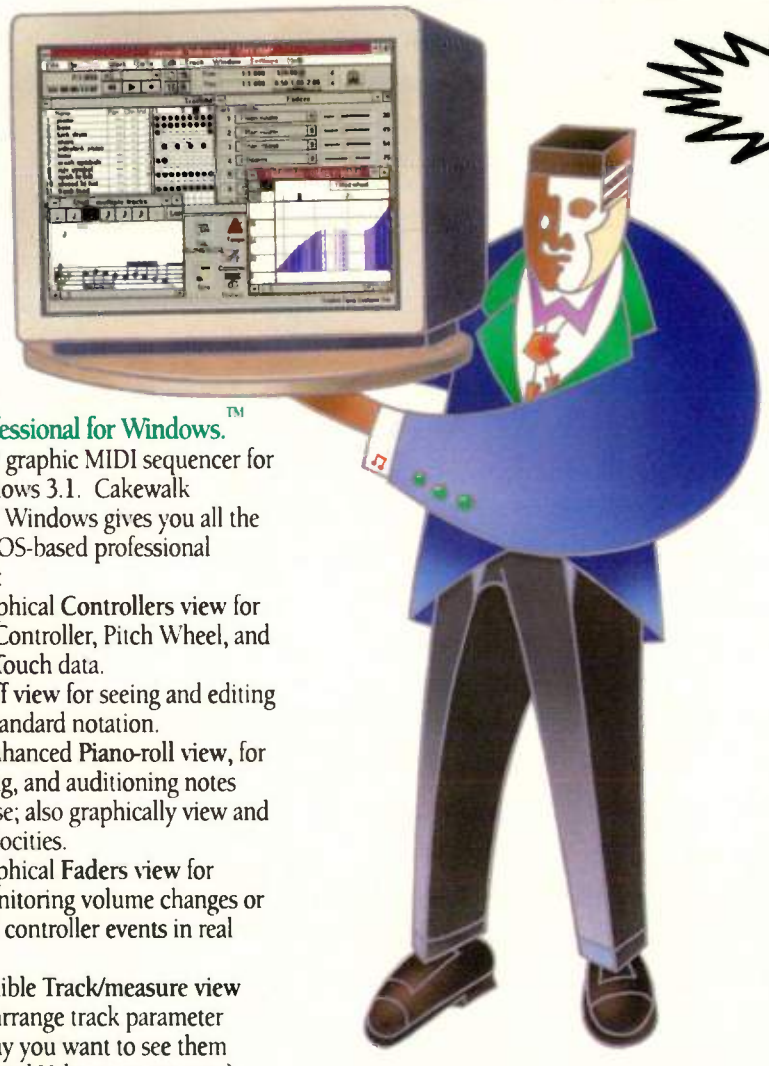

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Cakewalk PROFESSIONAL for Windows

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

Twelve Tone SYSTEMS

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on its last legs, and trying to coax more spatial information from such a compromised medium is technically interesting but a waste of time. Dolby Labs, the force behind this second philosophy, feels that multi-channel audio is the inevitable future. While Dolby Surround has some difficulties of its own when it comes to straight music playback, even pessimists admit that the multi-channel approach opens new possibilities.

A third faction argues for the enhancement of non-encoded source material at the playback stage. This is accomplished by a "black box" that treats incoming signals with various helpings of time delay, reverb, EQ, phase manipulation, or more secret formulas.

One of the best-known names in this last group is Hughes, whose Sound Retrieval System (SRS) has been praised as an effective after-the-fact solution. SRS isn't really a 3-D audio box; it expands the soundstage, but not in all directions. Although it originally was marketed as a home playback device (hence the unbalanced RCA phono input and output jacks), some engineers have discovered that SRS is an effective track-encoding device. Thus, the Hughes system has crossed over into the majority camp.

HOW DOES IT WORK?

That's a good question, and it's one that's still being answered. The perception of directionality and distance is a combination of three factors: amplitude, timing, and timbre. Amplitude cues are the easiest to recognize: If something sounds louder in your left ear, your brain normally says the sound is coming from your left. In addition, closer sounds are louder than those from farther away.

Timing also is obvious: Sounds from your left arrive at your left ear before diffracting around your head and ending up at your right ear. Sounds from directly in front of you arrive at both ears simultaneously. The brain's ability to detect a delay as short as 10 to 30 milliseconds or even less is known as the Haas Effect.

Timing and amplitude interact in an interesting and unexpected way. If a sound arrives at your left ear 10 to 30 milliseconds before arriving at your right ear, your brain perceives the sounds as simultaneous if the delayed sound is about 10 dB louder than the early sound. Under these conditions, the sound source appears to be directly in front of you, even though the time delay would otherwise indicate that the sound source is to your left. This effect can be used to shift the apparent position of a sound source without recalculating the time delay and phase compensation used to establish the sound's initial direction.

The effect of distance on timbre is well-known. Low frequencies travel farther than high frequencies, so sounds from far away are "rolled off" in the high end. The relationship between timbre and direction is more complicated. Timbre is modified by your skull and pinnae (ear flaps) by the time the sound travels from one ear to the other. A computer's approximation of this effect is called a *head-related transfer function*. This transfer function is the "subjective" model on which developers try to base their spatial algorithms. If you combine the transfer function with the inevitable reflections and resonances found in any listening environment, you can see that, despite precise digital control, this is an inexact science.

Equalization is another ingredient in this sonic stew. According to Oliver Masciarotte, Sonic Solutions product specialist, "The apparent vertical position of certain sounds boosted in the 7 kHz band seems to elevate subtly. When you intensify the effect in this band, it can add a new dimension to the sound."

Newer single-ended encoding techniques such as QSound use real-time DSP to plant perceptual cues into the mix itself. Some of them concentrate on minute amplitude shifts in narrow frequency bands, while others use dynamic EQ and delay on the frequencies most sensitive to our ears. Systems such as SRS treat individual tracks or the overall stereo signal with measured doses of processing that depend on dynamics and the nature of the source material.

With 2-speaker spatial-enhancement systems such as QSound, RSS, B.A.S.E., and SRS, listening position is critical. Although you don't have to be nailed to a certain spot, the effect drops off dramatically as you move several feet away from the "sweet spot."

Multi-channel encode/decode schemes such as Dolby take a different approach by literally steering audio information to pre-determined playback locations. This method allows listeners to sit in a variety of locations, which is advantageous in environments such as theaters.

MANUFACTURERS

Archer Communications (QSound)
2748 37th Ave. NE
Calgary, Alberta
Canada T1Y 5L3
tel. (403) 291-2492

Audio+ Design (Ambisonics)
Gotham Audio
1790 Broadway, 8th Floor
New York, NY 10019
tel. (212) 765-3410

Dolby Labs (Surround)
100 Potrero Ave.
San Francisco, CA 94103
tel. (415) 558-0200

Gamma Electronics Systems, Inc. (B.A.S.E.)
PO Box 801450
Santa Clarita, CA 91380
tel. (805) 253-4724

Hughes Audio Products (SRS)
29947 Avenida de las Banderas
PO Box 7000
Rancho Santa Margarita, CA 92688
tel. (800) 243-2733
or (714) 858-6000

Roland Corporation U.S. (RSS)
7200 Dominion Circle
Los Angeles, CA 90040
tel. (213) 685-5141

Siemens Audio Inc./Neve (AMS SoundField mics)
7 Parklawn Dr.
Bethel, CT 06801
tel. (203) 744-6230

QSOUND

A lot of ink has been expended on Archer Communication's QSound (see **Fig. 1**), a single-ended system used by an impressive roster that includes Madonna, Sting, INXS, and Julian Lennon. Rather than relying on computer models, QSound bases its transfer function on subjective criteria developed during what the company claims to be over a half-million listening tests. The QSystem produces repeatable high-resolution sound placement within a 180-degree horizontal arc in front of the listener.

Complete technical details are understandably hard to come by, but the QSound system involves real-time manipulation of amplitude at selected frequencies. Phase and timing shifts also are used. Of course, adding delay to any signal changes its phase, which results in "phasiness" (the familiar whooshing "phase shifter" sound, with an amplitude drop in bass frequencies), traditionally a drawback to spatial enhancement. In order to minimize this unwanted side effect, the QSound process tries to "correct" the signal by manipulating the altered phase back into coherence.

QSound's processing is applied to narrow frequency bands, with minute delays and amplitude swings of as much as 6 to 8 dB every 11 Hz or so within each band. By selecting and treating such narrow sections across the frequency spectrum, the QSystem claims to mimic human hearing.

Producer and engineer James Guthrie, who mixed the new Roger Waters album in QSound, feels that this is the time to experiment. "A lot of the effect is frequency dependent, so you'll need some trial and error to figure out what works," Guthrie says. "Once you get used to hearing this way, it becomes second nature, just like a stereo mix."

FIG. 2: Roland's RSS creates a binaural signal and adds a composite correction signal that compensates for crosstalk between left and right channels.

The QSound system offers eight inputs, configurable as mono inputs or four stereo pairs. In addition, these inputs can be static or dynamic. Static inputs give the engineer up to four placement positions on each side of the speaker. Dynamic inputs use the same positioning algorithms but allow continuous panning under joystick or programmable autopanner control.

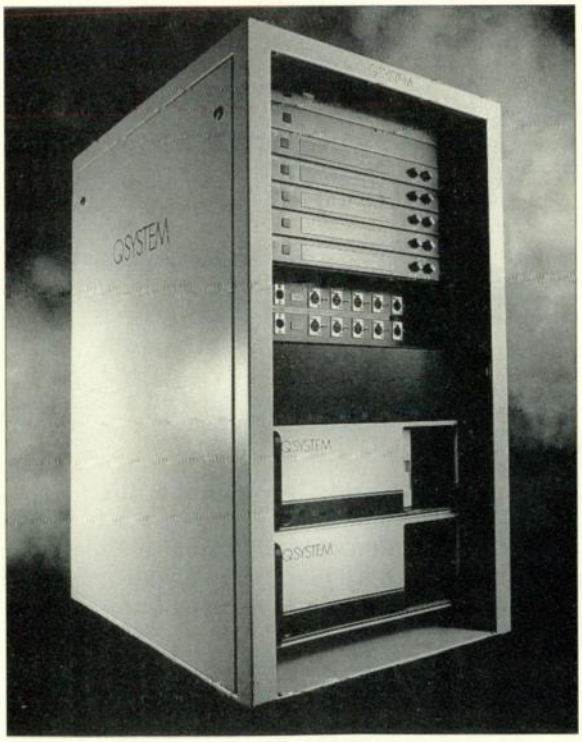

FIG. 1: The QSystem manipulates amplitude, phase, and timing to produce repeatable sound placement within a 180-degree horizontal arc in front of the listener.

The latest-generation QSystem, which should be hitting the streets by the time you read this, is substantially smaller and less expensive than earlier models. QSystem's daily system rental price just dropped to about $300 per day. A technician is provided for the first few hours to discuss patching and creative applications, and free 24-hour technical support by telephone is included.

ROLAND RSS

Roland Corp. is hot on QSound's trail with its Roland Sound Space system (see **Fig. 2**). The RSS approach also works in real time, but it concentrates more evenly on all three aspects of the perceptual mix (amplitude, timbre, and timing). The 3-D effect can be heard on a regular stereo system, and it requires no decoding.

The Roland system uses a combination of two techniques: *binaural processing* and *transaural processing*. Binaural recording is a relatively old tool in the quest for 3-D sound. Simply put, each ear hears only the left or right signal in a binaural recording. This is accomplished by recording with two microphones placed in a configuration that simulates human ears, often using a dummy head. Incoming signals are sent through a transfer function that is calculated either by measurements taken in an anechoic chamber, or by actual mics placed in real ear canals. In addition to producing a binaural signal from stereo inputs, RSS can create a binaural output signal from a monaural input.

Because it requires complete left-right isolation, binaural recording is intended for use with headphones rather than speakers. But when listening to speakers in a room, you hear the sound from both speakers in both ears. This creates a considerable challenge when attempting to create convincing binaural sound with two speakers.

Roland's answer to this challenge

A 28-note polyphonic, 30-voice workstation with 8-track sequencer, 26 drum sounds and a full-size key, 2-octave dynamic keyboard for around $600.

OK, so we had a little help.

The new Novation MM10 master keyboard makes playing and programming Yamaha's brilliant QY10 a breeze. It's also perfect for other home and studio recording setups.
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is to further process the binaural signal with transaural processing. This method adds a composite correction signal that compensates for the crosstalk between the left and right channels. The composite signal consists of left and right component signals minus the left-to-right and right-to-left crosstalk signals. The left and right signals are processed with digital finite impulse-response filters (FIRs) that add delay and EQ. RSS uses a set of these filters for each sound-location point. A weighting coefficient resolves the points to create a continuous, expanded soundstage. Finally, the correction signal itself must be accounted for so the final product sounds natural.

There is some subjective concern over what RSS does to the incoming signals. Its processing introduces some strong EQ and time shifts. If you listen to a single RSS-treated signal in mono, you might not recognize it. But spatial enhancement is a matter of perception, and the brain tends to "normalize" these sounds when hearing them in context.

RSS responds to remote MIDI commands. This means both elevation (top-bottom) and azimuth (front-back) across any of its four inputs can be manipulated by a sequencer or other MIDI device, which is handy for automated mixdown.

Engineers caution that the effect is best used sparingly. In addition, RSS tends to produce a more discernible effect on some frequencies than others. Rob Paustian, a New York-based engineer with remixes for Gloria Estefan, Erasure, and Michael Jackson to his credit, feels that RSS works best in the mid-bass region between 500 Hz and 2 kHz. "It does disturb timbre to some degree," says Paustian, "but I try to concentrate the treatment on frequencies at which it won't matter as much, such as effects and flybys."

The RSS system lists for $21,500, and you can expect to pay about $250 per day in rental.

AMBISONICS

The Ambisonics 3-D system has been used for almost seventeen years. It was developed from British academic research. Ambisonics isn't limited to 2-channel playback; the system also works in multi-channel applications.

Ambisonics is unusual in that its encoding system can be played back with or without decoding. Without the decoder, the soundfield of an encoded signal is subtly broadened; the effect is more pronounced with decoding. The decoder is relatively rare in the U.S., but amplifiers from Onkyo and Mitsubishi are starting to offer it. Consumer decoders also are available in the U.K. from Minim Electronics (tel. [44] 062-866-3724; fax [44] 062-866-7002).

FIG. 3: The complete 3-D Ambisonics effect is obtained using a special multi-element microphone such as this AMS SoundField Mk5.

The Ambisonics effect is best obtained by using a special multi-element AMS SoundField microphone (see Fig. 3) that can capture all the vectors of a soundfield. These vectors are forward (W), left/right (X), omnidirectional pressure response (Y), and up (Z). The Y vector, which is fed at equal gain, is said to increase the sense of localization. Together, the W, X, and Y vectors produce horizontal sound placement. There is no 3-channel recording format; you only hear two channels. The Z vector produces the vertical field.

Although you need the SoundField mic to achieve an up/down image, you don't need it to achieve horizontal Ambisonic sound placement. You also can process regular multichannel audio with a *transcoder,* which encodes it for Ambisonic compatibility. Using eight potentiometers, the engineer can place and pan up to eight mono signals anywhere within the horizontal soundfield, or rotate the whole field.

With a decoder and four, five, or eight speakers—a larger number of speakers delivers superior resolution—the effect is quite convincing. A complete Ambisonic encode/decode system (without the SoundField mic) lists in the $12,000 range.

GAMMA ELECTRONICS B.A.S.E.

Like the Hughes SRS, the Bedini Audio Spatial Environment, better known as B.A.S.E., is a single-ended system that expands the soundstage, but not in all directions. However, B.A.S.E. is more of a psychoacoustic enhancer than a localization synthesizer.

The Bedini system separates an incoming stereo signal (in the analog domain) into both mono and stereo components. The mono or center signal consists of elements common to both the left and right input channels. This center signal can be panned left and right. Using a control labeled "Mono Gain," the center image also can be made to appear closer or farther from the listener. According to the manufacturer, this "gain" knob is not a true amplitude control, but the company would not reveal how the "near/far" feature actually accomplishes its magic. The center image signal can be sent to a separate -10 dB output for independent processing.

The remaining stereo output signals contain only elements that are exclusively left or right. As you increase the stereo image control, you change the left/right spread, which widens or narrows the perceived soundstage.

At this point, the original stereo signal is dynamically redistributed, as the common elements are removed and directed to the center signal. According to the manufacturer, the result is a more clearly placed image within a broadened soundfield that can be perceived outside of a specific sweet spot.

Because you can isolate monaural information through B.A.S.E., it's possible to perform some neat tricks even after the music is mixed. Many lead vocals are recorded in mono, and because backing tracks usually are stereo, B.A.S.E. gives you the opportunity to adjust the vocal/instrumental balance while mastering.

Changing the balance between the left, right, and center signals could result in level drops in the final output signal. Therefore, an output level knob controls a 10 dB gain stage that lets you compensate for these amplitude drops.

B.A.S.E. is highly input-dependent: The wider the stereo spread coming in, the more pronounced the effect. If you're thinking of using B.A.S.E., you should be aware that the mono and

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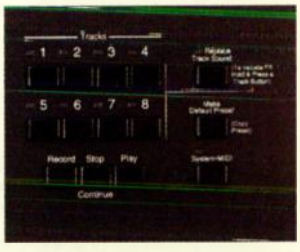
The KS-32 rounds out ENSONIQ's line of popular, affordable synth workstations – the 61-key SQ-1 PLUS 32 Voice, the 76-key SQ-2 32 Voice and rack-mounted SQ-R PLUS 32 Voice – by adding piano touch to their impressive array of performance features. Features like 32-note polyphony, 24-bit effects, and an onboard 16-track sequencer with recording and editing features designed to maximize your musical creativity.



With the KS-32, you can combine the sound you're playing with up to 16 internal or external sounds – all at the touch of a button.

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stereo components of the signal are separated, so stereo effects such as reverb will be manipulated along with other stereo information. For example, this could result in a bit too much reverb on a lead vocal part.

The original device was fittingly named "First B.A.S.E." (**Fig. 4**). The newest models are the 101B and 101C. The 101B includes *unbalanced* XLR connectors that allow you to mix and match signals from -10 dB to 0 dB inputs. The "pro" version is the 101C, featuring balanced XLR connectors with ground lifts on both the input and output, increased headroom, a hardware bypass, peak and signal LEDs, and a heftier power supply. The operational circuits are identical in both units.

At $3,000 for the 101B and $3,500 for the 101C, B.A.S.E. is not the least expensive of the soundstage enhancers—the Hughes SRS wins that honor—but it's more sophisticated than SRS and a lot less expensive than 3-D systems such as RSS or QSound. The company is working on an all-digital version of the hardware and a B.A.S.E. chip that can be integrated into consumer playback gear.

HUGHES SRS

At a list price of $299, the Hughes AK-100 Sound Retrieval System wins the cost-effectiveness derby hands down.

At press time, Hughes announced a new version, the Retriever (**Fig. 5**), which is functionally identical to the AK-100 and lists for a mere $179.

SRS simulates a transfer function by deriving sum (left plus right) and difference (left minus right) information from incoming stereo signals. A knob controls the amount of each side that is added back into the mix. Hughes claims this method is more transparent than the delay, reverb, or harmonic-regeneration schemes often found in home playback systems. A 3D Mono mode lets you create a stereo simulation from a mono feed.

Although the Hughes system was designed for home playback, it's not a "set and forget" device; it is adjusted for each piece of music. It can be used in-line or with a subgroup or effects bus and is useful for treating effects as well as instruments.

DOLBY PRO•LOGIC SURROUND

According to the specs from Dolby Labs, true Surround sound arguably is the most effective 3-D technique. Dolby offers two related product lines: Dolby Stereo and Dolby Pro•Logic Surround. The former is used for film formats, while the latter is a home 3-D sound system. Both systems use four channels—left, center, right, and Surround—that are encoded into the 2-channel mix. In 70 mm film applications, the four channels can be augmented with a second Surround channel for "Stereo Surround."

The center channel is sent to both the left and right channels of the 2-track, encoded mix. It is a separate signal and usually contains all the dialog plus any other onscreen sound that must be "tied" to the screen.

The Surround channel usually contains ambience and special effects and is directed to speakers behind the listener. To avoid decoding problems due to high-frequency noise, the Surround signal's frequency response is limited to the 100 Hz to 7 kHz range during encoding and decoding. The encoded Surround signal is added to the left, right, and center signals and is processed with phase shifting and Dolby B noise reduction. The decoder looks for information with the proper phase relationships and decodes them as the Surround channel. A time delay is used in the decoder to take advantage of the Haas Effect.

Dolby Pro•Logic Surround offers sonic flexibility, but it has drawbacks.

FIG. 4: Gamma Electronics' First B.A.S.E. was the company's first spatial-enhancement product. The system separates the input signal into a mono center image and elements that are exclusively left or right.

FIG. 5: The inexpensive new Hughes Retriever SRS system simulates a transfer function by deriving sum and difference information from incoming stereo signals.

The most important of these is that Surround information played through a receiver's Pro•Logic setting calls for a bandwidth of only 100 Hz to 7 kHz, which is hardly high fidelity. Most Pro•Logic decoders also offer a Music Surround mode that passes the full frequency response on the rear channels, though this technically is not Dolby Surround.

Electronic-music pioneer Wendy Carlos, who used Surround on her new *Switched-On Bach 2000* CD, feels that it poses the fewest problems of any spatial sound process. "To me, Dolby was the least offensive method, with the least damage to the timbre," she states. "Also, nothing's compromised during 2-channel playback; the encoding can be almost completely transparent."

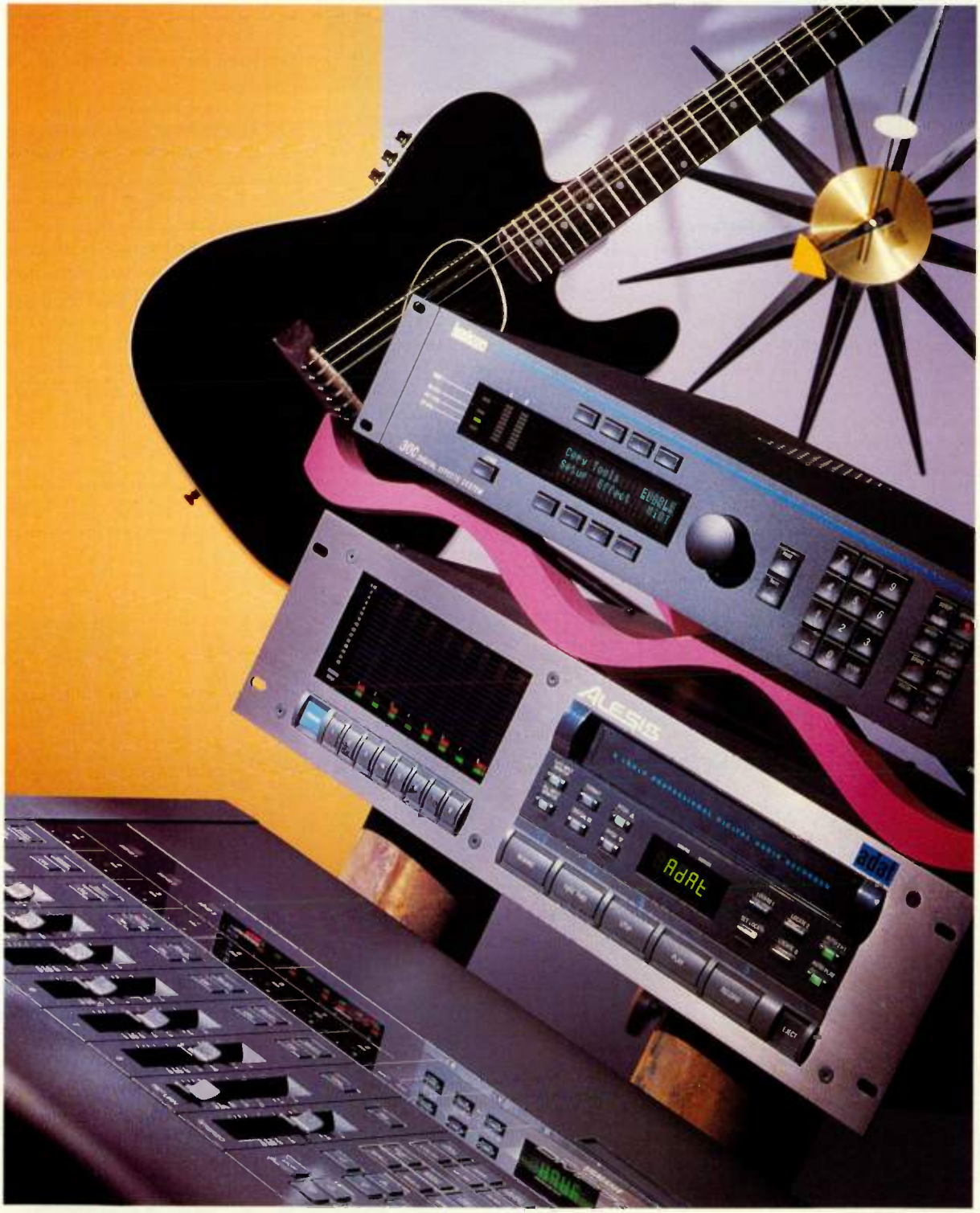
A SOUND FUTURE

Although the idea seems to have been around forever, spatial enhancement is still in its early stages. Is today's interest in 3-D audio just a passing fashion? Probably not, especially when you consider all the emerging applications, such as multimedia and virtual reality. Everyone seems to like the idea, when it works.

"This isn't a fad, it's a direction, so why not use it?" asks Wendy Carlos. James Guthrie feels that using something like QSound is a good way to get some needed depth. "I prefer to mix in analog because digital tends to sound a bit flat to me. It's a great way to get some air back into the mix."

Like any other aspect of music production, experimentation with 3-D audio is rewarding if you don't let yourself get too bogged down with it. Think of it as a seasoning, not the meal itself. Used properly, you can get some pretty tasty results.

Ron Goldberg *is a New York-based writer, which explains why he can't follow his real calling as a patron of the arts.*



MARK JOHANN

The Digital Home Studio

By Larry "the O" Oppenheimer

Digital technology is the fairy godmother of the home studio. Already, DAT recorders, inexpensive digital effects, and computer-based digital workstations have transformed bedroom "idea factories" into sophisticated production environments.

The obvious next step is for the home studio to go completely digital, with nothing but microphones, monitor speakers and non-electronic instruments tagging along in the analog domain. But here's where the magic wand falters: Current technology makes the all-digital home studio attainable, but it's not cheap, easy, or in some cases, even practical.

Is the digital dream an enlightened path to sonic perfection, or a nightmare of dashed promises?

Every studio requires the same basic tools: sound sources (keyboards, drum machines, microphones, etc.), a mixer, dynamics and effects processors, and a recording medium. The digital home studio posts added requirements for analog-to-digital conversion to accommodate microphones and other analog sources, and digital-to-analog conversion for monitoring.

In the analog studio, these tools often are a potpourri of models and manufacturers. A Tascam multitrack deck and a Soundcraft mixer may be supported by a Lexicon reverb, a Roland delay, a Symetrix compressor, multi-effects

boxes from ART and Yamaha, and so on. Interfacing problems usually are limited to 1/4-inch versus XLR connectors and +4 dBm or -10 dBV operating levels. Both of these situations can be overcome with relatively painless adjustments or adaptations.

Yamaha's DMR8 combines a 20-bit 8-track tape recorder with a 24-channel mixer and three SPX1000-style signal processors.

The digital studio is not yet as amiable. For starters, getting equipment to collaborate can be difficult. If you think sorting out pin 2 hot versus pin 3 hot conflicts is bad, wait until you consider digital interfacing (see "Keeping It Digital: Digital Audio Interfacing" in the October 1990 EM for more). The two standard digital audio formats usually found in home studio equipment are AES/EBU and S/PDIF. Both formats are self-clocking, 2-channel, and variable rate. AES/EBU usually appears on XLR connectors, while S/PDIF utilizes standard RCA or optical connectors.

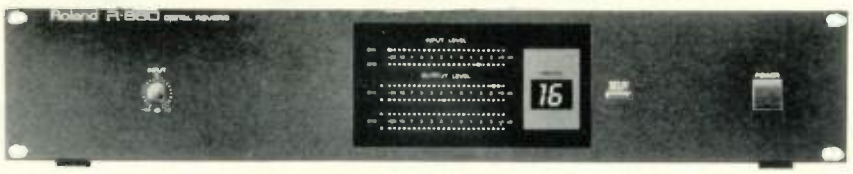
Unfortunately, if your digital mixer is AES/EBU and your DAT machine is S/PDIF, a simple "adapter" cable won't save the day. Not only do the two formats have different structures, but some manufacturers interpret the AES/EBU standard less strictly than others. (This sometimes causes interface problems between units employing the same format!) In addition, neither format has provisions for synchronizing multiple data streams, which makes multi-source applications rather difficult.

Formats that *can* handle multiple channels (with the exception of the relatively new and not widely implemented Multichannel Audio Digital Interface [MADI]) are manufacturer-specific solutions. Yamaha, Alesis, Sony, and Mitsubishi have created their own multitrack formats, which they're willing to share with any interested third parties, but they do not a standard make. However, some manufacturers have attacked the compatibility problem with conversion devices. Yamaha alone makes five products for interfacing their format with the Sony and Mitsubishi formats (as well as AES/EBU). Also, Lexicon's LFI-10 can overcome some problems resulting from differing implementations of AES/EBU.

SYSTEM SYNCHRONIZATION

The problem of system synchroniza-

The Marantz CDR600 recordable CD allows you to mix straight to compact disc.



Roland's R-880 reverb is one of the few signal processors with digital I/O.

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The MS-2000AH has more features to optimize and simplify setup than any competitive system. A continuously variable mic level on the transmitter and audio level metering on the receiver match the wireless to the voice of the performer. Output of the rack-mountable receiver is fully adjustable and equipped with the connectors to match any mic or line input. RF signal and diversity channel meters aid antenna setup. The internal power supply eliminates bulky plug-in adaptors.

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tion is even tougher. Digital audio relies on things happening at discrete time intervals. When two or more audio devices are digitally interfaced, one must provide the master timing reference and the others must slave to it. With a self-clocking interface, a digital audio input locks up to the incoming data stream and the destination device slaves to the source device. What happens, though, when several digital audio sources feed a mixer's digital inputs? How can a mixer slave to 16 different asynchronous masters?

One solution to the data stream synchronization problem is to slave everything in the system to a master clock. The master-clock concept is employed in the SDIF2 and Yamaha formats. SDIF2 uses three BNC connectors: Two transmit left and right audio data and the third carries a timing reference known as *word clock*, to which every device in the system must be capable of receiving and locking. The Yamaha format uses a multiconductor cable to separately transmit the audio channels and the master timing reference. Already, more than eight products have adopted the Yamaha format, making it potentially the most viable system for home-based digital multitrack.

However, synchronized systems are not hassle-free. Even if the data streams are clocked and locked, digital devices have finite *propagation delays* (the time it takes a signal to enter, be processed, and exit a piece of equipment). Signals that pass through a few digital processing devices may arrive at their destination a little later than more direct signals. Combating these delays requires that digital inputs be *delay tolerant*. A buffer must accept all arriving signals and clock them out synchronously. Therefore, it's extremely important that digital recordists check with the appropriate manufacturer to confirm that a device's inputs are delay tolerant.

Do all these format and synchronization problems torpedo the concept of a digital home studio? Yes and no. The technology exists, but it operates on its own terms. The digital recordist must be amenable to adapting to the medium and accepting some stringent limitations. Currently, there are three ways to configure a digital studio that are within the means of the home recordist.

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From top studio engineers to professional reviewers, musicians have had exciting things to say about the DP/4. First, they're impressed that it's the first "parallel multi-effects processor that can replace a whole rack of equipment" – a designation made possible by the DP/4's four custom 24-bit processing chips, each of which remains 100% dedicated to delivering top-quality sound.

"The DP/4 is capable of so many sound permutations that it's almost like a new instrument."
NICK BATZDORF,
Home & Studio Recording

Some have noted that "ENSONIQ has been able to cram every signal processing function known to man (and then some) into one box." About the 400 preset effects algorithms: "it's clear that a lot of thought went into their development" and that they're competitive in quality to those in single-effect units costing twice as much. Plus, they're "instantly usable and eminently programmable."

Musicians and engineers everywhere are learning to enjoy the signal routing flexibility of the DP/4's digital patch bay and the fact that its digital sub-mixing allows them to start mixing at the output stage – freeing up channels for their final mix.

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SD-1 32 Voice Music Production Synthesizer


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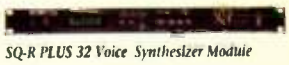

SQ-R PLUS 32 Voice Synthesizer Module

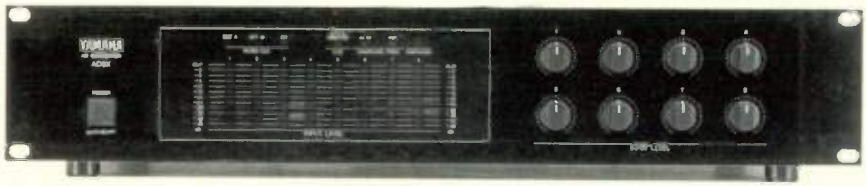
INTEGRATED SYSTEMS

The simplest approach would be to put everything into one box, since an integrated turnkey system obviates problems with interface formats. Yamaha's DMR8 currently holds the most promise for home studio use, although its $34,000 price tag puts it in the yuppie wish-list category. The DMR8 contains an 8-track, tape-based digital recorder, up to 24 mixing channels, three bands of parametric EQ per channel, three SPX1000-style processors on internal send/return loops, and an internal patching system that allows a digital insert on each input. However the DMR8 doesn't include separate A-to-D converters for microphones and other analog signals.

Other integrated systems (see the "Tape Killers: The EM Guide to Hard-Disk Recorders" in the September 1992 issue) include Korg's SoundLink, a $37,000 8-track hard-disk recorder with a built-in MIDI sequencer, and Roland's disk-based DM80, which is available in 4-track ($8,890) and 8-track ($11,890) versions.

Cool Factors. Forget all the scary stuff I said about format interfacing and system synchronization, just plug in and start tracking. (Well, you'll need an A/D converter, unless you have one of those few sources with digital outs.) Neatniks will love the fact that an entire studio is contained in a single package, because there are no messy patch bays, dust-catching effects racks, or unnecessary (and unsightly) cable runs. Portability is a major plus.

Bummers. Say goodbye to the analog realm's freedom of choice. Your tape deck, mixer, and signal processors are in one box, from one manufacturer. Pursuant to the dreaded interface problem (and the fact that most units lack send buses and multiple digital inputs for returns), you may not be able to connect other manufacturers' devices to your system. This means you're stuck with a single manufacturer's EQ, reverb, and dynamics processors. Make sure you like what you hear.



To convert your existing analog signals into the digital domain, you'll need converters such as Yamaha's AD8X.

WORKSTATIONS

Digital audio workstations usually consist of special-purpose hardware married to a personal computer that acts primarily as a control and display device (referred to as the system's "front end"). Many systems are modular and features can be increased as one's budget allows.

Cool Factors. Powerful sound edit-

ing features often are included as part of the package, and random-access audio is lightning fast. (No more waiting for your tape deck to seek out counter memory numbers, no changing tape reels, and so on.)

Bummers. Because hard-disk systems are better at manipulating sound than recording it, they are not practical as the sole multitrack recorder in a home studio. In addition, few workstations offer more than 4-track recording, and multitrack is considerably more expensive because of additional hardware requirements. For example, an 8-track *Pro Tools* system with two 1 GB disks, a data DAT backup system, an external hardware mix controller, and a mixdown DAT deck would set you back $20,000 to $25,000 (not including the Macintosh IIci front end).

Mixing capabilities often are limited by the availability of I/O channels (a system with eight tracks and four I/O channels can play all of the tracks only if no more than four sound simultaneously) and the lack of onboard effects processing, such as reverb, which demands substantial DSP horsepower. In addition, some musicians find it rather difficult to mix audio through computer keyboards and mice. The addition of an external mix controller, however, allows you to mix traditionally by tweaking physical knobs and faders. And remember, a workstation still requires a professional DAT deck or other mixdown medium that can produce a 44.1 kHz master recording from a digital input (which SCMS prohibits).

Alesis' ADAT 8-track digital recorder – and supporting developments – may prove to be the driving force that pushes electronic musicians toward all-digital studios.

COMPONENT SYSTEMS

A component approach to the all-digital studio would theoretically allow the most freedom in choosing brands and features. Digital component systems offer the flexibility that analog recordists have enjoyed for years and spread subjective sound considerations across a number of manufacturers.

Cool Factors. Someday Tom Wolfe may write a book about you. Component digital audio systems are at the pioneering stage, so those who brave

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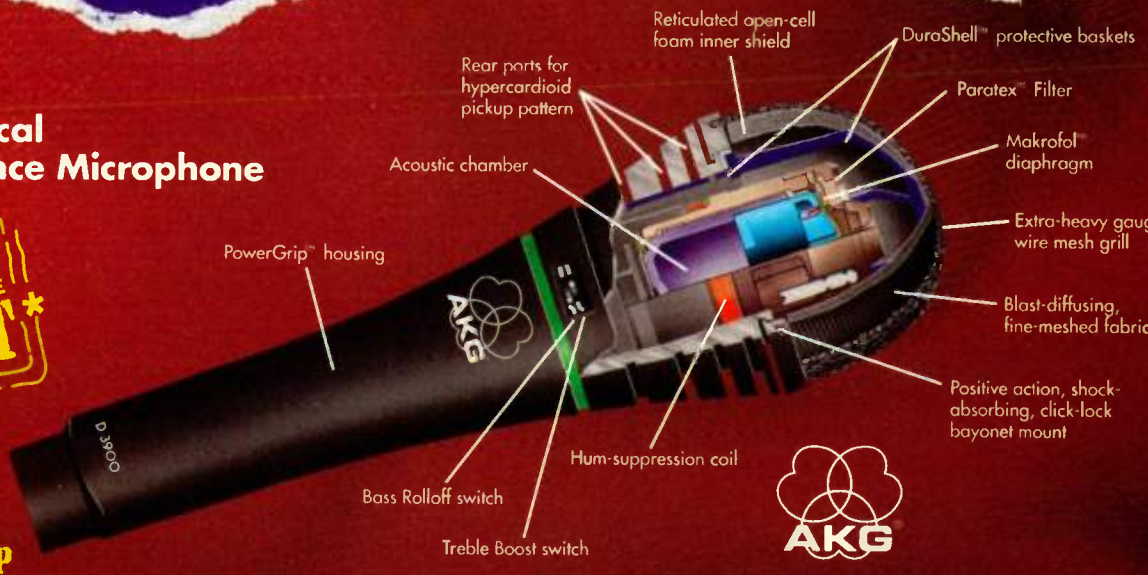

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the wilderness really have the "Right Stuff." Due to interface problems, we couldn't assemble a practical tape-based multitrack system around the Alesis ADAT and Yamaha's DMP7D digital mixer. However, many digital recordists do excellent work with a DMP7D linked to a hard-disk recorder (no interface hassles). Adventurous types can even produce "sound on sound" masters with a DMP7D and two DAT decks.

As far as multitrack is concerned, Alesis is planning to release the AI-1, a device that converts its proprietary multitrack format to AES/EBU (two channels at a time, of course), but at press time it wasn't available. Even so, the channel pairs will be unsynchronized unless the entire system—ADAT and destination—is locked together with time code. Theoretically, an 8-track ADAT/DMP7D system should work with four Alesis interfaces and four Yamaha interfaces handling translation chores. Unfortunately, that's a ton of cash to lay out for something as blatantly unsexy as format conversion. You'll also need eight channels of A/D conversion, which Yamaha's AD8X can provide for $3,500. All told, it's not exactly a practical system.

Bummers. It's no fun compiling a digital component system when your options are limited. Here's the current list of choices: Signal processors with digital I/O include the Korg A1 multieffects processor, Lexicon's 300 and 480L reverb/effects units, Roland's R880 reverb and R660 equalizer, the Sony SPD-1000 multieffects processor, TC Electronics' M5000 digital effects processor, and Yamaha's SPX1000 multieffects and DEQ-5 equalizer. In the world of synthesizers, Kurzweil's K2000 and Yamaha's SY99 offer digital outputs as an option. Akai's S1100 sampler has digital out standard (both this model and the S1000 have optional digital in) and Roland's S770 sampler offers standard digital in and out. In all instances, the inputs and outputs are stereo. Regarding mixers, the only affordable model for most home recordists is Yamaha's DMP7D.

THE FUTURE OF DIGITAL

At the moment, the digital home studio is more a conceptual bonbon than a practical reality. Is there hope for this situation to change in the future? The rate of technological progress is

astonishingly rapid, but it is not realistic to expect all of the problems with the digital studio to be quickly solved. In the future, silicon-based sample-rate-conversion will be able to solve many synchronization problems, but that's still a ways off. In addition, some contributing factors are economic rather than technical. For example, the primary reason that outboard digital equalizers and dynamics processors are in short supply is because it's cheaper to build them analog.

Additionally, years of research and feedback from the field have resulted in analog designs that sound amazing. In other words, people like the sound of Neve EQs and UREI LA-4 compressors, even if they do add coloration. In fact, the coloration effect is what makes these devices popular. It takes a huge amount of R&D for a digital audio engineer to typify these "coloration preferences" and design algorithms to suit. Right now, there simply isn't the demand to justify developing these products.

Digital mixers present an enormous technical challenge because of the previously described synchronization problems and the enormous number-crunching involved. It will probably be several years and multiple generations of DSP chips before inexpensive digital mixers reach the market. In addition, multichannel digital audio standards need to be agreed upon before any significant improvements in digital audio interfacing can be made.

Piecing together an all-digital home studio is just not practical at the moment. A few pieces have begun to fall into place, but it will be well into the decade before the entire puzzle is solved. Adding digital components to an existing analog studio, however, can make a significant impact on your recording right now. This is where the current excitement lies.

(Many thanks to the following people: Gary Hall [Sonic Solutions], Michael Gore [BASE], Toby Richards [Digidesign], Paul Young [Tascam], Don Morris [Yamaha], Marcus Ryle [Fast Forward Designs], and Will Eggleston [Lexicon].)

Larry the O *performs, produces, engineers, teaches, consults, and, of course, writes. He wants one of everything mentioned in this article.*

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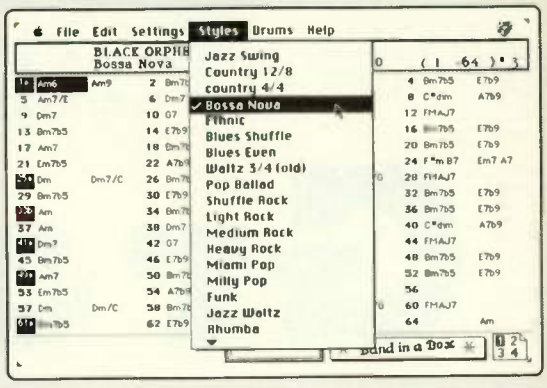

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On Solid Ground

Don't let a humming sound system sing back-up on your hit-to-be.

PART 2

By Neal Brighton and Steve Oppenheimer

A friend of ours recently decided to put together his own recording studio. He spent hours talking to salespeople at the local pro audio store and left with about 30 boxes of equipment. When he set up his studio, he didn't even bother to read the manuals. After all, the salesman had already told him everything he needed to know to get started. He took an old equipment rack and threw most of his outboard equipment into it. Next, he put the mixer and tape deck up on an old table, connected his audio lines with a bunch of guitar cords, wired up his speakers and power amp, and plugged the AC into whatever outlets he could find. Then he said, " This is it, I'm ready to make music!" Not!

Sure, he was able to turn on his keyboards and drum machine and get a sound, but the sound that came out of his speakers was like no patch he ever heard before. He had the hum from hell, and it was coming from every piece of equipment he turned on. At first, he thought that crook of a salesman sold him a bunch of cheap gear. Unfortunately, our friend didn't realize that any piece of gear sounds like garbage if it's improperly wired and poorly grounded.

GROUND LOOPS

In last month's issue, we discussed the fundamentals of house AC wiring and the principles of safe grounding. If you missed Part 1, go back and read it now. The issues covered this month are of secondary importance if your AC outlets are unsafe. (Back issues can be obtained from Mix

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Having established a safe electrical-system ground, turn your attention to preventing ground loops. A ground loop is formed when your equipment is connected to ground through more than one path (see Fig. 1).

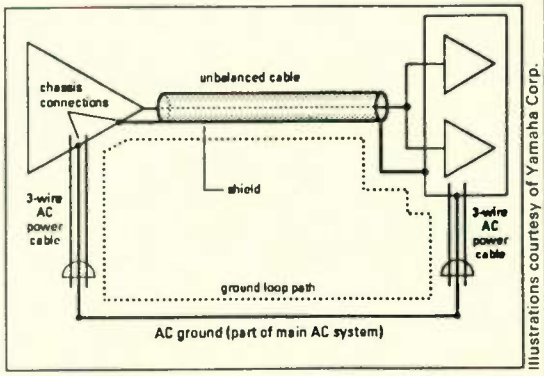
The situation is complicated by the fact that op-amp inputs, bypass capacitors, and other internal components connect to ground by way of the equipment chassis. In poorly designed gear, internal ground loops can occur. If an unwanted signal (such as RFI, noise, etc.) gets into the ground line, especially in preamps and other high-gain circuits, it could get into the audio path as well. Then it travels between components, gets amplified, and makes your trained ears extremely unhappy. Sometimes there's nothing you can do about this situation short of having a professional redesign the device's internal grounding, or not using the equipment at all.

Once a ground loop forms, it acts as an antenna, aggravating the situation by picking up radio frequency interference (RFI) and electromagnetic interference (EMI) from nearby strong AC fields. Ideally, an audio cable shield doesn't carry signals, but in real-world situations, signals flow through the shield. This creates lines of force that can be induced into the hot lead of other cables, causing noise.

RACK-MOUNTING

If you have your equipment on a tabletop, I strongly recommend you spend a little money and buy or build a rack. You spent some bucks for all that equipment, and you should protect your investment.

Make sure all unbalanced equipment is isolated in the rack. If you have both balanced and unbalanced equipment, try to keep them in separate racks, or face the



Illustrations courtesy of Yamaha Corp.

FIG. 1a: The devices in the studio are grounded through the cable shield, the chassis, and the AC ground, which can form a ground loop.

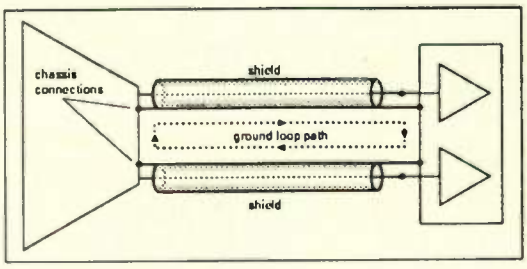


FIG. 1b: When a stereo device feeds a mixer through unbalanced lines, another ground loop can be formed.

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possibility of unavoidable ground loops. You don't want the metal housing from each piece of rack-mounted gear to touch its neighbor and cause a ground loop, so if you are using a wooden rack, make sure you leave a bit of space between each piece of equipment.

Rack-mount gear also can find a path to ground through the rack's metal mounting rails. The most common insulation method is to use nylon washers on the front and back of the gear's rack ears. You also can run some electrical tape down the rails. Even then, rack screws can touch the rack where they go through the holes, especially since the insulating paint scrapes off the screws with repeated use.

The solution is to use nylon washers in the form of collars that go inside the screw holes. (These washers often are used for mounting voltage regulators to heat sinks.) Check your local electronics and industrial hardware supply stores. You also can use nylon mounting bolts to secure lightweight equipment that won't be moved. However, nylon bolts aren't very strong, so don't use them for touring racks or hefty gear such as power amps.

Once your equipment is in the rack, turn it around and look at the back. See that bunch of AC cords just hanging there? They are bad news when you start plugging in audio cables. AC power cords emit electromagnetic fields that can cause EMI in audio cables.

The best way to get around this problem is to clean up your wiring act. Your friend in this endeavor is the cable tie, which can be bought at any electronic parts supply house. (If you rewire your gear often, make sure to get reusable cable ties or use regular plastic garbage bag ties.) Run all power cords down one side of the rack, tying them together as you go, and terminate them at a rack-mount power conditioner or a power strip bolted to the rack's left rear side. (Most standard AC cables connect on the equipment's left side as you face the rear, but there are exceptions, as shown in **Fig. 2**.) Bunch the AC cables; do not bundle them into a loop. Run your audio cables along the opposite side. If you have an open-frame rack, don't wrap the cables around the support poles or you will create an electromagnet. Beware of external "wall-wart" power supplies, as they are a major source of EMI. If these external supplies convert to DC, keep them away from AC cables, treating them like audio cables.

If all your equipment is plugged into the same grounded circuit, you reduce the possibility of ground loops. But if different parts of your rack are plugged into different circuits with different grounds, you will encounter problems when you connect their audio signals through the patch bay or mixer bus. This is particularly important if you are trying to use two pieces of equipment that are in different rooms with different AC outlets.

When all this careful wiring is done, you should have one power cord coming out of your rack and no mess. You should have AC power running down one side of your rack and audio cables down the other (see **Fig. 2**). Keep speaker cables away from both audio and AC cables. MIDI cables can emit RFI as well, so keep them away from audio lines. If necessary, you usually can get away with running AC and MIDI cables together.

Also remember that anything with a power transformer radiates a magnetic field that can cut right through the shielding of your audio cables, so make sure your power amp and the power supply for your mixer are at least a few feet away from your equipment. The magnetic fields drop off exponentially, so even a little distance between cable runs can help a lot.

AUDIO CABLES

Aside from the chassis ground path, electrons can go to ground through audio cables. You can take several steps to avoid ground loops here.

If your studio is a -10 dBV unbalanced system (usually RCA and $^1/_4$-inch phone plugs), keep the entire studio that way. Don't try to wire one or two pieces of equipment with balanced lines. Keep your mixer, outboard gear, and tape deck physically close together so cable runs are as short as possible. In some cases, the best you can do with an unbalanced system is bundle the audio cables close together to reduce the area of an unavoidable ground loop, which minimizes the ground loop's potential to act as an antenna.

In a balanced-line system, the shield doesn't carry the audio signal. One way to stop a ground loop in a balanced

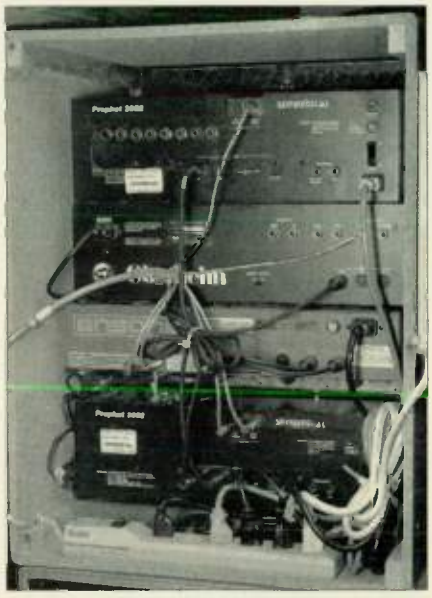


FIG. 2: A properly wired rack.

system is to cut the shield at one end of an audio cable, eliminating one path to ground. This is called a *telescoping shield* (see **Fig. 3a**). This cannot be done with a single-conductor, shielded, unbalanced-line system. However, if your system is unbalanced but your cable has two conductors plus the shield, connect one conductor to positive and one to negative at both ends, and the shield to negative at one end. If a device has a ground-lift switch or removable link in the terminal strip that disconnects the signal ground from the chassis ground, use that instead of cutting the shield (see **Fig. 3b**).

MIDI cables also have a ground line (pin 2, which is the middle pin), so when you connect them to different boxes, it is possible to create a ground loop. If your equipment is wired according to the MIDI specification, this shouldn't happen, but it is possible and should be kept in mind when debugging your studio.

CABLE QUALITY

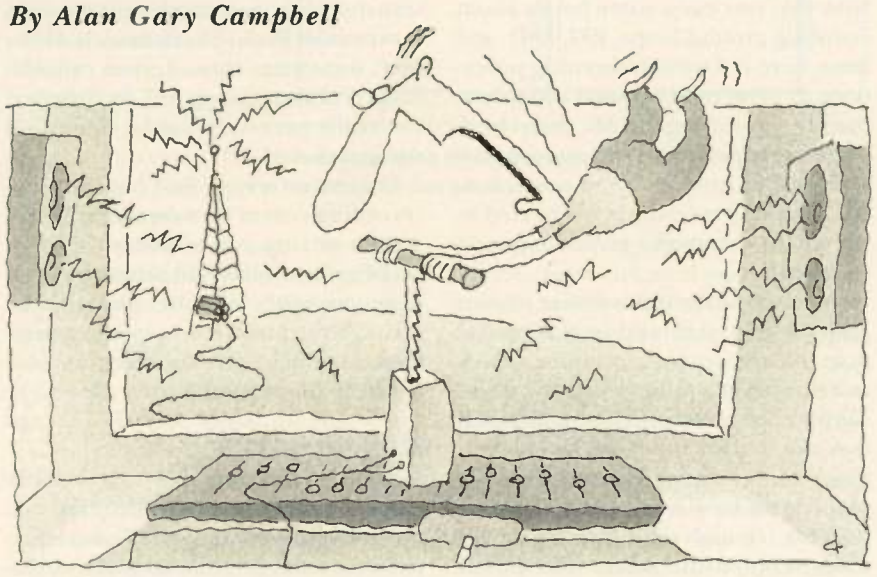
The quality of your audio cables can make a big difference in how your studio sounds. Beware of cables with poor or no shielding. Whether your studio uses +4 dBm balanced lines or -10 dBV unbalanced lines, all cables should be properly shielded.

If a cable has a poor shield, it allows EMI to enter the cable conductor(s). This interference usually manifests itself as a buzz and can be quite loud. There are three common types of shielding: braided, stranded, and foil.

Questions & Answers

By Alan Gary Campbell

Our service seer discusses building Faraday cages, quieting noisy mixers, and sending MIDI over long cable runs.



JACK DESROCHER

Q. What can I do about the FM radio interference on my el cheapo mixer? I've moved it and disconnected each input one by one, with the same results.

A. Unfortunately, radio interference is fairly common, especially in urban areas (with their crowded bands) and in outlying areas near transmitting towers. Not all manufacturers take equal care to properly shield equipment against radio frequency interference (RFI); off-brands and inexpensive gear often are affected. Equipment housed in a plastic enclosure is especially susceptible.

Take your mixer to an authorized service center to determine if it is malfunctioning or damaged. A problem as simple as a loose shield connection or a cracked bypass capacitor can provide an inlet for RFI. If the unit checks out, contact the manufacturer to determine if the model in question is known to have RFI problems. If so, ask whether an update or modification is available to fix it.

You can properly identify the source by monitoring the interference while listening to FM stations, looking for a match. If you are certain you are experiencing broadcast FM interference, the station in question may be responsible for solving the problem, depending upon the specific circumstances. In most cases, station personnel are eager to assist with problems of this sort, in the interest of good public relations, especially when they are approached in a positive manner. Write the engineer or the station manager. If this does not yield a reply, contact the FCC.

Interference from FM stations is not as prevalent as interference from other sources, such as CB transmitters operating at illegally high power levels. Interference from illegally overpowered CB transmitters should be reported to the FCC.

Unfortunately, it may be difficult or impossible to add effective internal shielding to many mixers, especially inexpensive ones. In such cases, the only way to ensure freedom from RFI is to shield the entire studio or other room in question. This task is usually accomplished via a *Faraday cage*, a grounded electromagnetic shield grid that completely envelops the room. At a practical level, this generally involves the installation of chicken wire (wire mesh) within the walls, ceiling, and floor. This grid is connected to a low-impedance earth ground at a single point.

Obviously, creating a Faraday cage is most easily done during the construction or remodeling of a room, but its importance should not be underestimated. Equipment that appears to offer usable but not high performance as a function of design may be RFI-degraded. Wendy Carlos reported that some of her Moog modular equipment provided only marginally stable operation before it was installed in a Faraday cage-shielded room.

A Faraday cage shields out not only man-made electromagnetic radiation, but naturally occurring radiation, as well. The effect on health when this radiation is absent is a matter of some controversy. Low-frequency geoelectromagnetic fields are not affected.

Q. Is there a simple way to reduce the output "hiss" in an inexpensive mixer? The noise really shows up in DAT recordings. I'm aware that low-noise operational amplifier ICs and other components used in better gear might be retrofitted or substituted.

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ART

THE SOUND OF PERFECTION

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A. Inexpensive mixers and the output stages of synthesizers often use garden-variety operational amplifiers (op amps), resistors, and capacitors. In some applications, particularly synths, the output level is so high that, in theory, it completely masks any noise present. In fact, the noise that comes from a mixer or synth output may have more to do with the overall circuit design than with the choice of op amps.

Nonetheless, in a mixer it is likely that some audible improvement would be obtained by replacing standard op amps, such as the 4558 and 4136, with low-noise types. In older mixers, especially inexpensive units, replacing op amp types not intended for low-noise applications, such as the 741 or 1458, will yield a marked improvement. The replacement op amps may have a significantly different pin-out from the originals, however, which will require modification of the circuit boards. This can involve tricky and tedious trace-cutting and jumper-wiring, which in itself can be a source of noise. Do not attempt this unless you know what you're doing.

To reduce the noise still further would require replacing any carbon-composition or carbon-film resistors with metal-film types. Also, any electrolytic capacitors in the audio path should be replaced by polyester or, preferably, polystyrene types.

A much simpler solution for mixing a limited number of line-level outputs with an absolute minimum of noise is to use a passive, resistive mixer. A do-it-yourself passive mixer project was described in "Line Mixer Duo" in the February 1990 EM. (Back issues are available for $5 from Mix Bookshelf; tel. [800] 233-9604 or [510] 653-3307.)

Q. I need to transmit MIDI lighting controller data over a considerable distance from the control booth to the stage, up to 200 feet. Is there some type of circuit or commercial device that boosts the signal to cover this distance?

A. Anatek (tel. [604] 980-6850) claims its MIDIMatch line driver can send MIDI data up to 4,000 feet through any 2-conductor, shielded audio cable that uses XLR connectors. It lists for under $200. According to JLCooper (tel. [310] 306-4131), its MLA-1 MIDI Line Amplifier (under $300) can drive four independent, 1,000-foot MIDI lines.

You might not need these devices, though. In many applications, MIDI cables can be run in excess of 500 feet without buffers or repeaters with no data errors or other problems, even with higher-than-normal levels of electromagnetic interference. (The idea of "MIDI delay" due to cable length is ridiculous, as the electrons in the cable travel at nearly the speed of light.) I strongly suggest you try the passive

Anatek MIDIMatch Line Driver.

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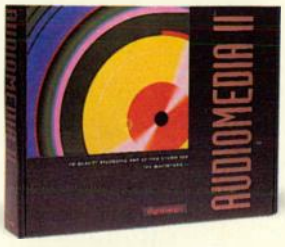
And We Do Mean Anyone.



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Tiny Wunderboxes Descend Into Hands Of Astonished Musicians

"I Knew I deserved a miracle, but *three* is beyond Belief!"

By Mickey O'Callahan

Special Correspondent

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Scientists Baffled by Expressive Quality of Flying Wedge 16-bit Stereo Boxes: "Whoever built these little things obviously knows something the rest of us don't."

While musicians rejoice the unexpected arrival of these digital processors, members of the world's scientific community are scratching their heads. How can such such tiny parcelsproduce such expressive tone?

According to Dr. Niels Hartvig-Nielsen, of the Institute of Advanced Intelligence in Ludevisk, Finland: "First we were impressed by the efficient industrial design. Then we plugged
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he sighted the first wunderbox, which "zoomed
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rs in Wolfsnarf heard such beautiful sounds."

Musician: "I Still Eat Tuna, But Now I Don't Sound Like One!"

Reports from correspondent
around the globe indi
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FIRST SIGHTINGS OCCUR ON
OF ELVIS' DEATH!

Mere Coincidence — or Is The ***ying to Send a Message?***

Those who remember Elvis Presley fondly tend to dismiss accounts of hi
recent sightings. But even the most skeptical among us would find it hard to di
the miraculous appearance of three different and mysterious boxes—on the anni
his demise! Chris Albi and Neil Hamilton, long-time bodyguards for th
edged in their unauthorized biography "Viva Las El
electronic wonders. "I can still hear him saying 'I
Albi, who is "temporari
Hamilton, a motorcyc

approach before investing in additional equipment.

To achieve long-distance performance, you must use high-quality, low-capacitance, well-shielded cable. Cheap cable is out!

In field tests on various cable samples available to me, the performance was not significantly reduced by substituting standard TTL gates as MIDI output driver ICs, as some equipment does, instead of the TTL buffers normally specified. Of course, if the cable length were further extended, the total cable capacitance would eventually be too great for any MIDI output driver to handle, and the MIDI data pulses would become rounded off and unreadable at the receiving end. This would interrupt the MIDI link, but would not harm the equipment.

Q. Can equipment that is plugged in but turned off be damaged in an electrical storm? Can lightning actually jump from an outlet to a disconnected AC cord?

A. All too often, electronic equipment that is turned off but plugged in is damaged by high-voltage surges during electrical storms. Power lines and poles take fairly frequent lightning "hits," and the power grid provides a ready discharge path that leads right to your outlets. Under such conditions, the electrostatic field at the terminals of a power switch can be great enough to ionize the air gap between terminals or vaporize internal insulation. This creates a temporary conduction path that essentially bypasses the power switch, allowing destructive high-voltage energy to enter the power supply and other circuitry. (This is a gross oversimplification of the process, but you get the idea.)

These surges can cause considerable damage, so it is important to unplug equipment during storms and during periods when it will be left unattended. Of course, in a club or concert it is not always practical to power down and unplug the gear. In such situations, an AC line conditioner is a wise investment. Note that no commercial device will protect equipment from a severe, nearby lightning hit.

An electrostatic field that is strong enough can cause just about anything to happen. But discharge from an outlet to nearby unplugged gear is no more likely to occur than a similar discharge to any nearby object of comparable mass, density, conductivity, and potential.

Q. I've seen what appear to be heat sinks for vacuum tubes. Is this a newfangled idea? What are they for?

A. Tube heat sinks have been available for some time, but their common application seems a recent phenomenon. They are intended to increase tube life by dissipating waste heat more efficiently than the tube envelope can. This also can yield improved performance.

Given the usual expense and problematic availability of tubes, heat sinks are a particularly good idea, especially for the hefty tube of guitar-amp output stages.

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

IBM OS/2 2.0

By Bob Lindstrom

IBM embraces multimedia in the latest incarnation of its 32-bit operating system.

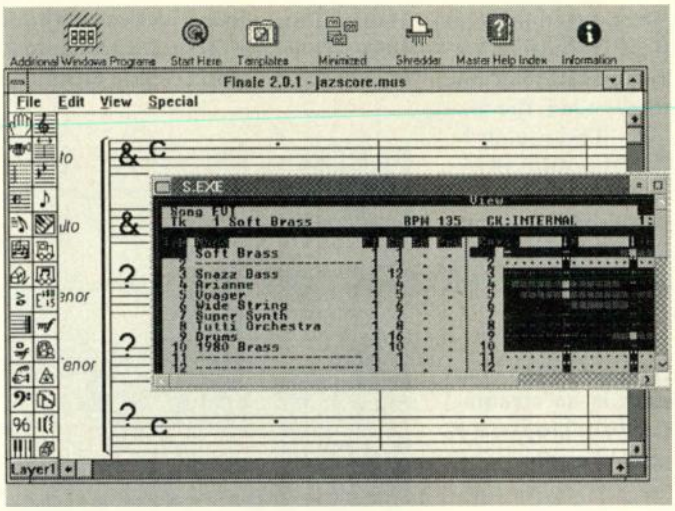


FIG. 1: OS/2 allows you to run DOS- and *Windows*-based music programs at the same time.

If you've recently upgraded to an 80386 or better PC with Microsoft *Windows 3.x*, you can appreciate the speed and convenience of combining today's sizzling computing power with a graphical user interface. But while 32-bit 80386 or 80486 hardware represents the ultimate power in today's go-fast PC computing, under the hood you're still driving it with 1982-vintage, 16-bit software.

Not long ago, IBM offered a solution to this hardware/software gap by releasing OS/2 2.0. This long-awaited and long-delayed alternative to MS-DOS combines a full 32-bit operating system with an integrated graphical user interface.

To its credit, OS/2 often outperforms DOS, out-interfaces *Windows*, and outlines a new future of 32-bit PC-based computing. The drawbacks, especially on the music front, are the lack of OS/2-specific music software, some compatibility problems, and hefty RAM and hard-disk storage demands. Nonetheless, the prowess and multimedia potential of OS/2 2.0 make it a tantalizing option for computing musicians.

NEAT STUFF

As a graphical interface, OS/2's Workplace Shell is rich and flexible. It's more configurable and capable than *Windows 3.x* and is the closest PC users can get to the Apple Macintosh interface. All file manipulation is accomplished easily from within the shell. Startup work environments are infinitely changeable, and there are many ways to launch and switch between programs.

IBM is positioning OS/2 as an integrating software platform because of its ability to run MS-DOS-, *Windows 3.0*-, and OS/2-based software. *Windows 3.0* applications can run in Standard mode directly from the OS/2 Workplace Shell, either in a window or in a full-screen *Windows*-OS/2 session. Enhanced mode is not supported.

Similarly, multiple MS-DOS sessions can run under OS/2 (full-screen or windowed), each with its own CONFIG.SYS setup and memory management. I've effectively switched between two or more MS-DOS-based sequencers. However, I've also caused the MPU-401 interface to glitch beyond functionality and had to interrupt and close active windows.

One of the keys to OS/2's flexibility is that it is a true preemptive, multithreaded, multitasking operating system. This allows you to run several independent programs simultaneously, whether they are DOS-based, *Windows*-based, or OS/2-based (see **Fig. 1**). Multitasking applications believe they have complete control of the system because OS/2 manages the system resources. You can save MIDI files from your sequencer and immediately load the file into a notation program without exiting or rebooting either program. And because OS/2 runs in '386 Protected mode, a renegade application that crashes will not bring down the entire system.

For application programmers, the multi-threaded ability of OS/2 permits development of programs in separate units of execution known as *threads*. The sequencing thread of a MIDI program, for example, might be separate from the notation thread, yet both could multitask, share data, and appear seamless to the user. When combined with the convenience of a 32-bit, large-memory model, OS/2 offers programmers an environment to create unusually powerful multimedia applications.

MULTIMEDIA HORIZONS

Musicians who have used the Commodore Amiga or the Macintosh under System 7.0 already understand the remarkable flexibility a multitasking environment can add to multimedia projects. They permit you to manipulate and synchronize software and hardware from any vendor into tight, integrated presentations.

To launch OS/2's multimedia bid, IBM released the *Multimedia Presentation Manager/2* (MMPM/2) and the *Multimedia Presentation Manager Toolkit/2*. These sets of user utilities, programming modules, user interface controls, and system software begin to tap the multitasking abilities of OS/2, combining MIDI, digital sampling, CD-ROM, videodisc, and graphics (see Fig. 2).

Under MMPM/2, OS/2 users can play a MIDI file while spooling out a digital sample of a narrator describing the music, synching the whole thing to laserdisc video. Or you could be listening to digital samples when your voice-activated appointment system interrupts to tell you that it's time for dinner. With OS/2 and MMPM/2 controlling the data flow, device sharing, and overall synchronization, no single application can dominate the system or derail real-time processes.

THE TECHNOLOGY

Structurally, OS/2's multimedia support consists of three pieces: the Media Control Interface, the MMI/O Interface, and the Stream Programming Interface. These parts are designed to make the coordination of multimedia data and devices as transparent to the end user and application programmer as possible.

The Media Control Interface is a 32-bit, device-independent programming interface that controls and communicates with all the multimedia devices in your system. It currently supports a number of logical devices, including a software amplifier-mixer (shipped with MMPM/2), audio waveform recording and playback, MIDI playback, CD audio, CD-ROM/XA (CD-ROM with interleaved audio/video/data), and videodisc.

The interface's *Media Device Manager* knows what the devices can do but not what they are. Nor does it care if you have a Korg Wavestation or a Creative Labs Sound Blaster at the receiving

end of your MIDI player. MIDI software that uses the Media Control Interface will communicate effectively with any hardware supported by one of the interface's Media Control drivers. The drivers are separate from the Device Manager and may be added individually to the MMPM/2 system.

The Media Control Interface can be controlled by writing programs to the command interface, or through use of text-based scripts processed by its String Interface. The String Interface is similar to OS/2's *REXX* support, or *ARexx* on the Amiga. The scripting commands allow you to send device commands with ASCII text strings. This enables any application to incorporate multimedia control simply by incorporating the ability to transmit script files to the String Interface.

A red flag for MIDI users is that the initial release of the MMPM/2 Media Control Interface *only* supports IBM's M-Audio card for MIDI playback and does not support a device for MIDI recording. (Fortunately, according to MMPM *Toolkit/2* project leader Evi Larsen, the system software is prepared to support MIDI recording.) Oddly enough, there is no MPU-401-compatible driver. Until one is created, MMPM/2 has no way to communicate with your outboard MIDI equipment. However, this does not stop you from running DOS-based and *Windows*-based MIDI software under OS/2.

The second cornerstone of MMPM/2, the Multimedia I/O Interface (MMIO), buffers applications from the need to perform data-specific processing. It allows drivers and applications to access and use data objects (sound, graphics, digital audio/video) regardless of file format or storage system (see Fig. 3). As a result, with the addition of separately programmed I/O Procedures (IOProcs), an MMPM/2-compatible application can address any current or future file and storage format. An MMPM/2 sample-playback utility could load and display a digital sample without caring whether it was in raw data, .SMP, .WAV, or some other format. The IOProc for each format will intercede to access and manipulate the file into a form usable by the program. This ensures maximum flexibility and minimal frustration when assembling multimedia presentations from several different data sources.

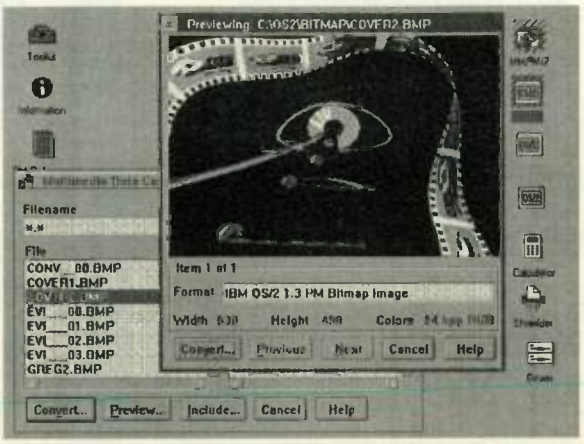


FIG. 3: The MMPM/2 Data Converter applet utilizes the MMI/O subsystem of MMPM/2 to provide users with data independence. Other MMPM/2 subsystems (SPI and Media Control Interface) provide hardware independence to applications.

The third part of MMPM/2 is the Stream Programming Interface (SPI). This part of the system is never seen by applications but manages the real-time flow of data. The SPI moderates and synchronizes data flow without application intervention. Among other functions, it allows MMPM/2 to play two independent digital samples with the same device, even though neither program knows the other is operative. The SPI acts as traffic cop and streams out both samples without audio breakup.

At the present time, "MMPM/2 is more of a programming platform than an end-user interface," according to IBM senior technical staff member Scott Winters. Winters indicated that Creative Labs is developing a Sound Blaster-compatible MMPM/2driver. Future IBM-developed enhancements scheduled for 1993 include software-only motion video playback and authoring and hardware-supported video capture using IBM/Intel's DVI (Digital Video Interface) card.

"This is our stake in the ground," said project leader Larsen. "We could have waited longer and provided more features and support, but we wanted to get something into the hands of users and developers so they could start thinking about how to use the system. This is only the beginning for multimedia in OS/2."

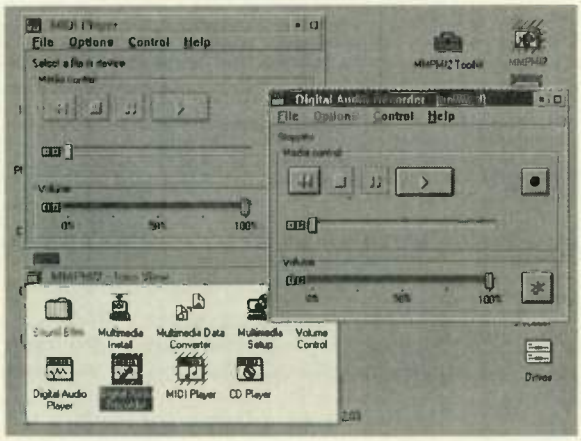


FIG. 2: The Digital Audio Recorder and MIDI Player applets included with MMPM/2 give you sound and MIDI functionality at the system level. Other player applets are available for digital audio and CD audio.

NOT-SO-NEAT STUFF

Unfortunately, not everything is perfect in the land of OS/2. Though OS/2 probably is the best operating system if you want to run multiple DOS applications, it won't show its true power until OS/2-specific music and multimedia applications become available. That could be several months (or even several years) from now, assuming MIDI developers see a commercial opportunity in OS/2. The MMPM/2 and MMPM *Toolkit/2* are persuasive arguments for moving multimedia applications to OS/2.

Currently, OS/2 has *Windows 3.0* compatibility only in Standard Mode. It will access the *Multimedia Extensions*, however. I effectively ran Passport Designs' *Trax* for *Windows* in a full-screen *Windows*-OS/2 environment. Some *Windows* applications may run slightly slower in full-screen *Windows*-OS/2 mode than under *Windows 3.x* (though some run faster), and in some cases, they run considerably slower in an OS/2 window.

Applications multitask superbly

under MMPM/2—I had two self-running games, M-Audio MIDI playback, digital audio playback, and a word processor operating in real-time perfection—but MIDI clock rates currently are unstable in OS/2. Even mouse movement will tamper with MIDI clocks if you're running applications in an OS/2 window. For time-sensitive DOS and *Windows* programs, only full-screen OS/2 modes are acceptable. Adjusting the copious settings did not alleviate the problem.

The minimum system to run OS/2 with MMPM/2 is an 80386SX or better, 4 MB of RAM, and a hard disk with 30 to 33 MB of free storage space. For multimedia, add the IBM M-Audio Capture and Playback Adapter or some other MMPM/2-supported sound device. If you're using the MMPM *Toolkit/2*, you'll need 30 to 45 MB of total hard-disk space and an IBM CD-ROM drive or other CD-ROM drive supported by an OS/2 device driver. That's a pretty tall order to fill on the hardware side.

ARE WE THERE YET?

For end users interested in MIDI or multimedia applications, OS/2 is more a foundation for the future than a solution for the present. Existing and upcoming multimedia support will pave the way for outstanding creative applications, but the system possesses limited user benefits until the applications arrive.

For software developers, OS/2 may bring to the table most of the capability and the power that has been needed in an up-to-date operating system. Whether IBM can attract developer and end-user support remains to be seen, particularly in light of Microsoft's ongoing promise to release *Windows NT* (New Technology), a 32-bit version of *Windows*, within the next twelve months.

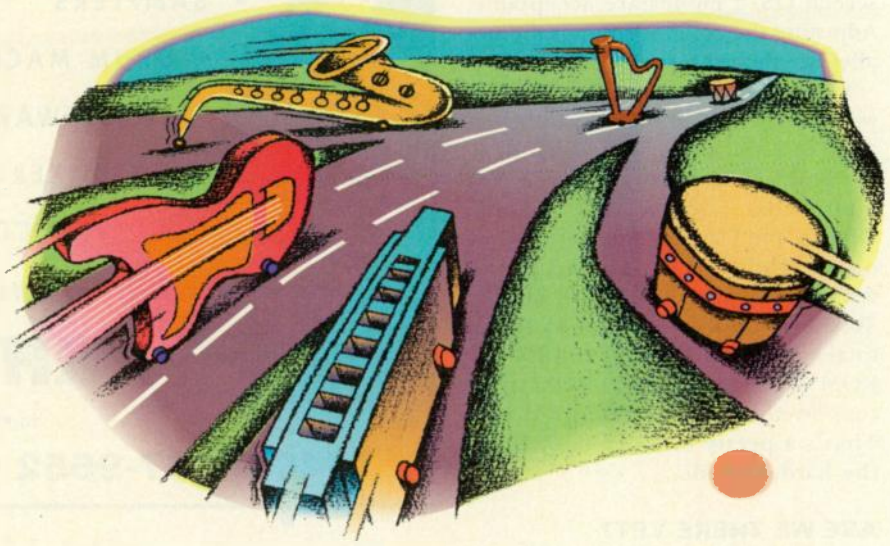
While Big Blue and Big Bill (Gates) slug it out in the marketplace, high-power computer owners must remain patient and take comfort from the assurance that the 16-bit DOS boat anchor is soon to be an operating system of the past, and multimedia is the wave of the future. In the meantime, OS/2 is an encouraging promise of things to come.

Bob Lindstrom *is creative director at Dynamix, a computer game company.*

Multitrack Recording

By Neal Brighton

Basic engineering skills keep instruments on the right track.



DAVE EMBER

With modern techniques like MIDI sequencing and hard-disk recording taking prominent roles in current music-making, it's easy to forget the importance of tape-based sound recording. Fact is, if you record vocals, guitars, or other non-MIDI instruments, you'll use a process that dates back 40 years: multitrack recording. Technology certainly has affected recording, primarily by greatly improving multitrack recorders, but the basic techniques remain unchanged.

I'll base my discussion of multitrack recording on 4-track cassette recorders (see **Fig. 1**), although the techniques also apply to larger systems. If you are unfamiliar with the equipment and terminology of multitrack recording, I recommend that you read "Multitrack Recording: The **EM** Primer" in the January 1991 issue of **EM**.

PRE-PRODUCTION

Before pushing the Record button on your tape deck, think about the final product. How do you want the tape to sound? How many instruments are required? Develop a preproduction plan so you know how to best utilize your equipment to accomplish your goals.

Let's say you want to record a standard rock tune (drums, bass, rhythm guitar, lead guitar, lead vocal, and synths), and you want your demo to sound like Nirvana jamming with Guns 'n' Roses. How do you get started? First, you must develop a *track sheet*, which is simply a piece of paper that outlines the instrument or combination of instruments that you will record on each track of the multitrack.

In the example in **Fig. 2** (see p. 82), there are five parts to record in addition to any synth sounds you want to add. The synths can be sequenced and synchronized to tape, so you don't need to allocate any tape tracks to keyboards. However, most ministudios have only four tracks available on cassette tape. If you intend to synchronize a sequencer to the tape, you must use one tape track for the sync tone, leaving only three tracks available for instruments and vocals. How can you record five parts on three tracks?

The answer is *bouncing* (also called *submixing*), a process in which two or more recorded tracks are re-recorded onto an empty track, allowing the original tracks to be used for new parts. If you decide to bounce tracks, you must predetermine the final mix of the bounced parts. Once you erase the original tracks, you're committed to the mix. This makes pre-production even more important.

Bouncing is not without problems. On a 4-track cassette, the bounced parts usually must be transferred to a single track, eliminating the possibility of placing each instrument in a different stereo position in the final mix. Also, each bounce represents another generation of recording, which leads to more noise and lower signal quality. Finally, try to avoid bouncing signals to adjacent tracks (track 1 and track 2 submixed to track 3). Sometimes a *feedback loop* occurs due to signals bleeding between the multitrack tape heads. This *crosstalk* can cause audible squeals and massive level boosts.

The synth parts are recorded within the sequencer and referred to as *virtual tracks*, because they play along with tracks recorded on tape, but are not recorded onto tape themselves. (For more on synchronizing sequencers to tape, see "Sync or Swim: Synchronizing to Tape" in the January 1991 **EM**.)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Virtual tracks are mixed down along with the tape tracks onto your 2-track mastering deck.

If you intend to include sequenced synth tracks as part of your song, record or *stripe* the sync tone (either FSK or SMPTE) onto tape before you start recording any other tracks. People using FSK need to determine the length of the sequence before recording the sync tone; those using SMPTE can simply stripe the length of the tape and worry about song lengths later. Remember not to use any noise reduction on your time-code track. Noise reduction can cause your computer or drum machine to misread the time code, especially if you are using FSK.

FIG. 1: The Tascam 464 Portastudio is an example of a typical 4-track cassette ministudio.

BASIC TRACKING

Basic tracks, or *basics*, are just that: the musical building blocks upon which a song is built. In most scenarios, these tracks consist of the rhythm section parts (drums, bass, rhythm guitar, backing keyboard). If you're recording your band or working with friends, you many want to record these parts "live," with all instruments playing at the same time. This method helps you capture that elusive quality of real-time musical interaction. If you're working solo, you record each part on its own, often while listening to a basic drum-machine pattern.

For recordings done at home, keep the microphone as close to the sound source as possible. This technique, called *tight* or *close miking*, helps reduce ambient noise such as cars passing by. Following are some specific miking techniques (for more ideas, see the sidebar, "Tips and Tricks").

Drums. Point a dynamic mic such as the Shure SM57 close to the drum skin. Use two condenser mics such as the Audio-Technica ATM31 to pick up overhead cymbals and hi-hat. If you have only one or two mics, try placing them above the drum set. Two inexpensive PZM mics such as the Crown Sound Grabbers can be taped to the walls on either side of the drums as well.

Acoustic Guitars. Place a condenser mic pointed slightly off-axis to the sound hole about eight to ten inches away. Point the mic toward the fretboard.

Electric Guitar Amps. Place a dynamic mic eight to ten inches away from the cone of the speaker, either straight on or at a slight angle to the cone. (For more on recording guitars, see "Recording Musician: Tracking Guitar" in the September 1992 **EM**.)

Piano (Grand). Place a condenser mic near the high-pitched strings and a dynamic mic near the lower strings.

Piano (Upright). Place a condenser mic at each end of the soundboard with the lid open.

Vocals. Select a dynamic or condenser mic, depending on the vocalist's style of singing. You may need a wind screen or pop shield. The position of the mic also is highly dependent on the individual vocalist; experimentation is the key to successful vocal recording. (For more on vocal recording, see "Recording Musician: In Good Voice" in the February 1992 **EM**.)

If you record more than one instrument at a time, or one instrument and vocals, it is important to acoustically isolate each instrument as much as possible to minimize *microphone bleed* (one mic picking up the sound of another mic's sound source). By maintaining this separation, you can re-record and fix mistakes on the individual tracks without requiring all the parts to be played again. Isolation can be achieved by putting different instruments in different rooms, putting baffles in front of speakers, or taking instruments such as electric guitars, basses, and keyboards straight into the mixer without using a microphone at all. (In some cases, this last technique requires a direct box.) The better your isolation, the more flexibility you will have later.

Before recording any non-MIDI parts, you'll need to sequence some or all of the synth parts. This lets you test the time code on tape and gives you something to follow as you record the tape parts. You might want to sequence a "scratch" keyboard part that outlines the equipment in the past.

TIPS AND TRICKS

BASIC TRACKING

1. Run the bass through a compressor before recording it to multitrack. This gives you a punchier sound when you mix.
2. Never record "hot" parts (meter heavily in the red) next to a sync track. Crosstalk can cause your time-code reader to get totally lost.

OVERDUBBING

1. While recording vocals, use a wind-screen, run the signal through a compressor with a small compression ratio, and use a de-esser if possible.
2. Write down everything on your track sheet: type of mic, EQ setting, any outboard gear, etc. Overdubs can and will be done repeatedly, and it's helpful to remember how you set up

MIXING

1. Subtracting from a mix always works better than adding. Fewer effects, less bottom on EQ, and fewer instruments result in cleaner, well-defined sounds.
2. Use a "ping-pong" delay on a single sound source to make the sound move from left to right in the stereo field (about 20 ms delay time).
3. Take ear breaks when you mix. Your ears tend to get fatigued when you sit in front of speakers for long periods of time.
4. Always have another person listen to your mix.
5. Write down what you did; you may want to do it again.

the entire arrangement. This part can be erased later or replaced by other parts after the basics and/or overdubs are done.

If you are using a click track or synchronized synth parts, have musicians in different rooms, or the musicians are in the same room as the engineer, headphones are essential. Most mini-studio mixers offer a direct headphone output, which can be connected to a *headphone splitter* so that several musicians and the engineer can all use headphones.

In our example, the drums and bass are recorded while playing together. The drum part is provided by a drum machine and recorded on track 2, while the bass is connected directly into the mixer and recorded on track 3. (The drums are not recorded on track 3, because the sharp attacks might bleed over to the time-code track and confuse the time-code reader.) After you record these tracks successfully, they are bounced to track 1, which leaves tracks 2 and 3 available for overdubs.

OVERDUBBING

Overdubbing is the process in which additional parts are recorded after the basics are down on tape. You can do anything from adding lead and background vocals to re-recording parts of the basics or your entire arrangement. For example, you might record a drum machine during the basic tracking for reference, but replace it with a live drummer during overdubs.

In this process, headphones are a necessity because you need to hear what is already on tape to play along with it. One of the most important things to remember about overdubs is that noise from other instruments and sound sources should be kept as low as possible. Consequently, don't let the headphones get so loud that they bleed into a microphone.

During basics and overdubs, keep the recording level as hot as possible without distortion or excessive crosstalk between tape tracks. (The exception to this rule is the track next to the time-code track; use it for quieter background parts.) This keeps the *signal-to-noise ratio* as high as possible, resulting in a clean, quiet sound. It will take some experimentation to determine the right recording levels for your equipment, but the results are defi-

Basic Tracks	Overdub 1	Overdub 2	Final
1	1 bass + drum submix	1 bass + drum submix	1 bass + drum submix
2 drums: Roland R8 (direct mono mix)	2 lead vocal (Shure SM58)	2 lead guitar: Les Paul (Marshall through SM57)	2 lead vocal/lead guitar (shared track)
3 bass: Fender Jazz (direct)	3 rhythm guitar: Strat (direct through Boss chorus)	3 rhythm guitar	3 rhythm guitar
4 sync tone (no noise reduction)	4 sync tone	4 sync tone	4 sync tone

FIG. 2: Comprehensive track sheets are invaluable if you ever need to re-record parts or update a demo in a commercial studio. Note that the drum and bass submix (or "bounce") was predetermined for track 1, and that the lead guitar shares the lead vocal track because no singing appears during the solo section.

nitely worth the trouble.

Try not to use EQ or record effects like reverb during basics or overdubs, particularly if you aren't sure of your final sound. These are better left to the mixdown stage when you can try different settings before committing them to tape. If you are sure of your final sound, or you aren't using effects much anyway, go ahead and *print*, or record, them to the multitrack. Also, if you only have one or two effects processors, try recording some of the basics and overdubs with effects and leave others *dry*, or without effects. You can then use the processors to create different effects for different parts during mixdown. Of course, this technique requires you to have a very clear idea of the final sound.

A useful piece of outboard gear for both basics and overdubs is a dynamics processor. These devices provide such functions as gating, expanding, compression, and limiting of audio signals and thus help reduce the noise level and prevent distortion. Unfortunately, many home studio operators ignore dynamics processors in favor of another reverb or multi-effect processor. (For more info on dynamics processing, see "Pumping Gain: Understanding Dynamics Processors" in the March 1991 EM.)

In our example, the rhythm guitar feeds directly into the mixer through a chorus effect pedal and is recorded on track 3, while the lead vocal is recorded onto track 2 with no EQ. The lead guitar plays through an amplifier and is recorded with a microphone during the next overdub, also on track 2. Because the lead vocal is already on track 2, you must *punch in* during the guitar solo section where the vocal doesn't appear. When punching in, you run the tape and hit the record button after the lead vocal stops and before the guitar solo begins. After the solo, you must *punch out* of record to avoid erasing the rest of the recorded vocal part.

MIXING

Mixing is the final process that combines all the tracks (tape and sequenced synths) and records them on a 2-track stereo master. Mixing is the difference between a good-sounding song and a really great-sounding song. A good mix has a good stereo image (left to right) and a sense of depth (front to back).

I usually start with the rhythm section. I use one reverb and quickly put together a mix of all the basic tracks. Then I add the main instrument in the mix (usually the lead vocal or lead guitar), and work everything else around it. Remember, you are mixing a song; you are not trying to create the perfect snare or guitar sound, so listen to the overall mix and don't get hung up on any one part for too long. Once all the elements are in place, with approximate relative levels and stereo placement, you can go back and fine-tune things. This process may include changing the reverb on the lead vocal, re-EQing drums or guitars, etc.

The stereo placement of each musical part strongly depends on the musical arrangement and type of music. Here is my rule of thumb: Don't place instruments in exactly the same place in the stereo field. Even slight panning can prevent instruments from "piling up" at the same location. Traditionally, the bass, kick drum, and lead vocal are near the center. Any stereo instruments such as synths should be panned hard left and right to preserve their stereo image. Front-to-back placement primarily is determined by the volume and reverb level of each part. Loud, dry sounds with little reverb sound "up front" and "in your face." Less volume and more reverb push the part back in the mix.

EQ is best applied by cutting rather than boosting. If the sound is too dull, cut the low end instead of boosting the high end. This avoids increasing the level of hiss in the sound. Conversely, if the sound is too bright, cut the high end rather than adding bass. For some reason, many people add bass to everything; try to avoid this temptation.

When I mix, I like to consult CDs as references. Listening to other mixes is one of the best ways to learn how close you are to a really great sound. Another helpful technique is listening to your finished mix on different stereos and in different environments.

END SESSION

While multitrack hardware is constantly updated, the basic techniques will be around for a long time. Pre-production, basic tracks, overdubs, and mixdown sessions will still be going strong long after analog tape decks have died. At the rate keyboards and computers are changing, it's nice to know that you won't have to relearn the basics of multitrack recording next year, or the year after that.

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

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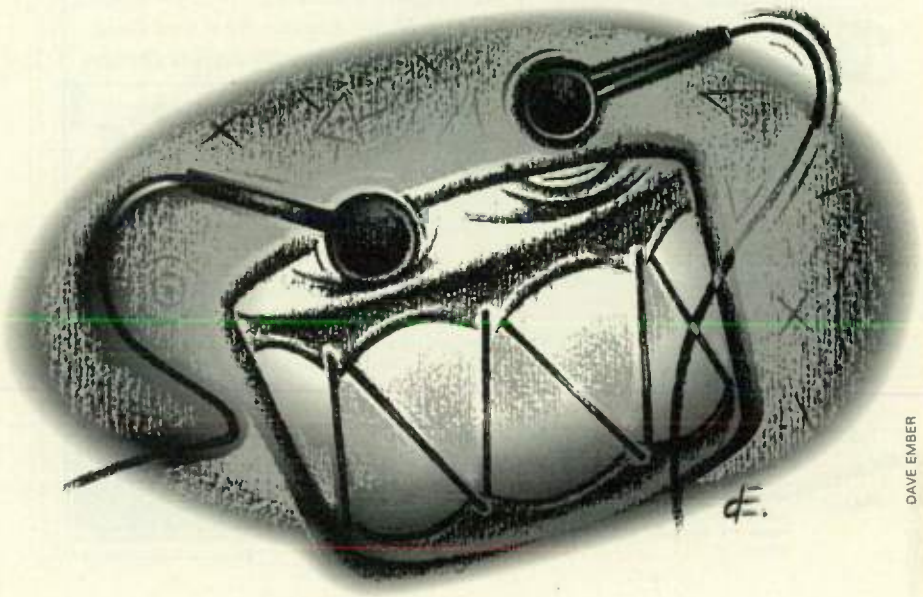
Tracking Drums

By Michael Molenda

Before you can get into the groove, you have to get the groove on tape.



DAVE EMBER

Poor Ringo. During the early years of Beatlemania, the legendary drummer was recorded with one mic on his kick drum and one mic hanging over his head. Two microphones captured the beat that drove the band that changed rock 'n' roll. Today, some engineers use two mics just to record a snare drum. Was Ringo robbed?

Hardly. The Beatles' primary recording engineers, Norman Smith and Geoff Emerick, had the ears and imagination to wring one hell of a boom-boom-snap from two microphones. And although the current style of slaughterhouse snares (often mixed louder than the lead vocal) was undeveloped in the 1960s, Ringo's drums can still rock the house.

Home and project studio owners should be inspired that the limitations of early pop recording didn't prevent Smith and Emerick from laying down a timeless thump. Good ears, decent microphones, and a little forethought empower virtually anyone to record crushing drum tracks.

PREPARATION

Drums can take forever to record because even basic kits contain a jungle of hardware that creaks, rattles, and moans. Microphones record every sonic blemish, so pristine drum tracking requires taming mechanical noises.

When the drums are set up, check the kit for loose connections. If cymbal or tom stands rattle, wrap some foam around the noisy joint and tape everything down with heavy-duty vent tape. Whining kick-drum pedals may be silenced by spraying the moving parts with a lubricant such as WD-40.

Once everything is battened down, have the drummer play a simple beat, occasionally throwing in tom-tom fills and cymbal crashes. If everything sounds great, buy a lottery ticket immediately, because you're blessed with incredible luck. Most likely you'll hear a symphony of obnoxious drum overtones, a paper-thin snare, and more squeaks and rattles.

At this point, it's senseless to drive yourself crazy tracing minute problems. Go for the big ones. Find the new rattles exposed by the drummer's performance and tape them down. If overtones are excessive, have the drummer retune the offending drums until they produce a clean, full-bodied sound. Be prepared to jump in and help because many drummers are clueless about timbre. (I've never regretted paying a renowned session drummer to teach me how to tune drums.)

If tuning and retuning won't kill offensive overtones, place two fingers on the drum head until you find a position where the overtones are muted. Now, cover the "hot spot" with a single piece of vent tape. Although this is an over-simplified remedy, the tape should muffle annoying tonalities. (Some drummers use commercial "ring killers," homemade muting templates cut from old drum heads, and even feminine hygiene napkins to diminish overtones.)

There's a reason for all this preparation: Drum kits that sound great acoustically usually retain that quality under the bitter scrutiny of microphones. You'll appreciate the energy spent hunting down noises and overtones when it's time to mic individual drums.

THE SNARE

Recording an absolutely slamming snare sound is the best way to get a nervous producer and/or band off your

back. I read about this trick years ago in an interview with master engineer Tom Lord-Alge, and it has never failed me (thank you, Tom). It's somewhat puzzling *why* a meaty snare engenders trust, considering that a good recording is composed of much more than a thwack. But don't waste time pondering psychology when you could be testing mic positions.

The classic snare miking technique involves positioning a dynamic mic an inch or two over the snare rim opposite the drummer and one inch above the top drum head. My favorite snare mic is a Shure SM57, because it records the impact of stick-to-drum without accentuating overtones. Your style may favor broader timbres, so be sure to experiment with different microphones.

Some engineers also mic the bottom head to capture the rattle of the snare springs. You can use another dynamic mic for this position, or even experiment with a condenser. (Be sure to pad the mic input at least -10 dB to avoid frying the condenser's diaphragm with massive sound pressure levels.)

Trick bag. In modern music, an isolated snare treated with an individual reverb (or even mixed "dry") enhances sonic impact. Unfortunately, getting a live snare sound without cymbals and toms bleeding into the mic is problematic. Noise gating to tape is risky, because the high input threshold required to shut out cymbal crashes can clip the snare signal if the drummer drops the intensity of his or her strokes. An expander is a more practical tool.

Simply put, expansion diminishes the level of signals under a user-set threshold. What makes this device perfect for drums is that it treats signals more gently than the brusque on/off action of a noise gate. To a noise gate, a loud cymbal crash is a loud cymbal crash. Depending on the predetermined signal threshold, the gate either shuts down the crash or lets it through. If the drummer smacks a cymbal harder than expected, the gate opens and a painfully loud sizzle bleeds into the snare mic.

Because an expander "quiets down" unwanted signals, cymbal explosions (and tom fills) are not catastrophic. When the expansion threshold is set to cut signals below the level of the snare

hits, the kick drum, cymbals, and toms appear discreetly in the background. During mixdown, when expansion already has recorded snare levels much hotter than peripheral sounds, careful noise gating can complete sonic isolation.

KICK DRUMS

Rap music has thrown down the gauntlet regarding kick drum sounds. Today, anyone recording acoustic drums must acknowledge the sonic power of heavily processed electronic percussion. This doesn't mean the kick drum on a folk/rock ballad should blow the doors off a Volvo, only that maximum impact is preeminent.

Really getting down with a kick drum requires a large-diaphragm dynamic mic, such as an AKG D12E, an Electro-Voice RE20, or a Sennheiser MD 421. For pop sounds, convince the drummer to remove his or her front drum head. (Double-headed drums add overtones that usually are appropriate only for jazz.) Pushing a foam pad or blanket against the rear head minimizes rings and improves the thud factor. Moving the mic closer to the drumhead adds more thump (the mic is closer to the beater), while moving it away records more overtones.

Trick bag. If you *want* to blow the doors off a Volvo, dinosaur stomps can be recorded by compressing the signal, boosting the EQ at 100 Hz, and then running it through a noise gate to shut down the boom a few milliseconds after the initial impact. I've blown a few speaker fuses this way, but what a punch!

More subtle kicks are produced by diminishing extraneous snare, tom, and cymbal sounds with an expander. This procedure allows the kick drum to be the loudest sound recorded on tape, an obvious advantage if you desire a pounding track. Further isolation can be gained by draping a heavy blanket over the kick drum and microphone to make a "sound tent."

TOMS

Tom fills add spice to a track. Much of their power depends on the creativity of the drummer, but it certainly doesn't hurt if you make each drum sound like a cannon. Shure SM57s often are used in live performance miking, and serve admirably in the budget studio. However, you can record bigger booms with a Sennheiser MD 421 or similar model that hears more low end.

Place the microphone approximately four to six inches over the top drum head, listening critically for a harmonious blend of drum tone and percussive impact. You probably won't be surprised to discover I utilize expanders on tom tracks to wipe out snare and cymbal bleed. The cleaner the tom tracks, the more they'll punch out of the mix during drum fills.

HI-HATS

Since the hi-hat often is the linear timekeeper in popular music, it's important it be crisp and articulate. I usually use a condenser, such as an AKG C414, Audio-Technica AT4033, or Sony ECM-23FII, positioned three inches from the top hi-hat at a 45-degree angle. It helps to minimize bass frequencies while recording, so kick drum and tom sounds are de-emphasized. Moving the mic a few feet away from

the hi-hat provides a hi-hat/cymbal perspective that can be used instead of an overhead mic if you're short on microphones or inputs.

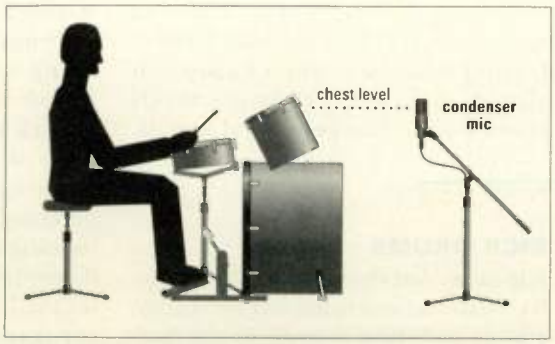


FIG. 2: A single condenser mic placed at chest level about ten feet in front of the kit gives a very clean room sound when you have a limited number of tracks.

OVERHEADS

Overhead mics record more than just cymbal crashes: They document the spatial characteristics of a drummer's personal kit configuration. This perspective is as important to the drummer as a guitar/amp marriage is to the guitarist.

One of the classic overhead positions is two condenser mics on boom stands, placed about three to five feet over the drummer's head. A left-side mic is pointed at the left-side cymbals, and a right-side mic is aimed at the right-side cymbals. A variation, often called the

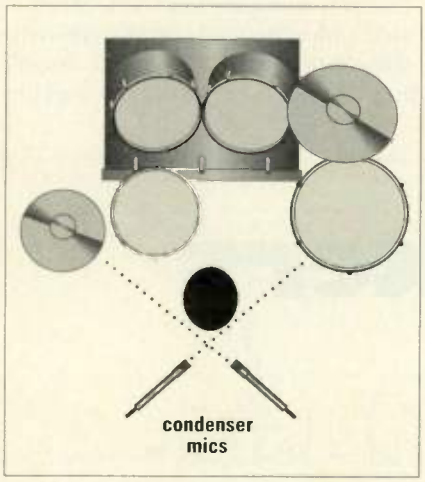


FIG. 1: Two condenser mics placed in an X-configuration behind the drummer's ears provide an alternative to traditional overhead mic placements.

"X" position, requires moving the boom stands close together over the drummer's head and pointing the left mic towards the right cymbals, and vice-versa.

Trick bag. A subtle alteration of the X-pattern involves lowering the mics until they rest behind the drummer's ears (**Fig. 1**). I've found this position enhances the organic sound of the drums and provides an interesting "drummer's perspective" of the stereo field. Even though the mics are lower, cymbal crispness is uncompromised. An added benefit is that toms appear quite robust in the overheads, often making it unnecessary to EQ the individual tom tracks. (Remember, less processing equals cleaner tracks.)

Want to join the "Back to Mono" movement of legendary producer Phil Spector? Position a condenser mic—I use an AKG C414—approximately ten feet in front of the drums at the drummer's chest level (**Fig. 2**). This position records the entire drum kit and sounds great when blended with the individual drum tracks. I've often used this position as my sole "overhead" mic when tracks are limited. I simply pan the kick and snare to center, then place the hi-hat to the right and the mono room mic to the left.

FADE OUT

Drums are such an integral component of rock music that scores of anecdotes exist regarding bizarre recording techniques. Elvis' drummer, J.D. Fontana, once remarked he cut many tracks by slapping cardboard boxes. New wave godfather Nick Lowe expressed an affinity for the "telephone book" snare. And, according to a Dick Clark biography, when the drums were too loud during the session for "The Monster Mash," the engineers simply moved the kit back and draped blankets over it.

The key issue of drum tracking is to do whatever it takes to drive the song. If you keep your creative eyes open, you'll find most limitations are merely challenges. After all, if you can't get a good snare tone, you can always pound on the local telephone book.

Even after enduring hundreds of drummers who should have been impaled on their drumsticks, **EM** *associate editor* **Michael Molenda** *still loves the sound of an arrogant snare drum.*

CR-1604 FANATICAL ENGINEERING PART 2

THE FIRST COMPACT MIXER WITH ENOUGH GUTS TO STRIP IN PUBLIC.

Like sports cars, mixers all look pretty whiz-bang impressive on the outside. But, as when choosing a car, it pays to look under the hood before you drive off with a new mixer. Because the board you buy now will have a direct effect on your creative musical output for years to come. That means looking deeper than just price, number of channels or even published "specifications." It means considering a mixer's overall design approach, architecture and philosophy. It also means identifying features that you may only come to appreciate (or miss) after you've lived with a particular board for a while.

BECAUSE Mackie specializes in mixers, we're fanatics about details others overlook. That's why the CR-1604 has studio-grade discrete microphone preamplifiers, a robust internal power supply, UnityPlus gain structure and EQ points that make musical sense. It's why our mixers are ground plane RF shielded, why they have such astonishing headroom ...and why numerous top producers are using CR-1604's to lay down tracks direct-to-digital, bypassing megaback consoles until final mixdown.

STUDIO-GRADE MIC PREAMPS. Only the CR-1604 incorporates discrete, large-emitter-geometry transistor preamplifiers instead of simple IC's. Which is why our mic preamps deliver an honest −129dBm E.I.N., 0.005% THD, yet can handle +14dBu max inputs without a pad.

TRIM matches any signal from instrument levels to −10dBm semi-pro to +4dBu pro gear.

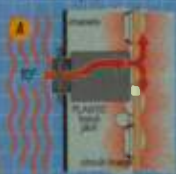
ALL OUTPUTS have enough level to drive any balanced or unbalanced input. Naturally all outputs/inputs are fully protected and buffered.

7 SENDS via 4 knobs with plenty of gain above unity for special effects; **4 STEREO AUX RETURNS** with super-high headroom, low noise and enough gain to work with all levels.

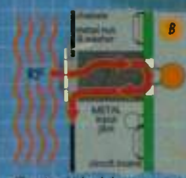
MUSICALLY USEFUL EQ at 80Hz, 2.5kHz and 12.5kHz.

RUGGED, COLD-ROLLED STEEL CASE

EXCLUSIVE: PROTECTION FROM RF. Hiss, buzzing hash and whine generated by computers, cellular and cordless phones, TV & radio stations, microwave repeaters, video gear, and other studio equipment. Conventional mixers with plastic jacks are grounded internally to a circuit board, turning circuit traces into internal, mini re-transmitting antennas (drawing A at left).



The CR-1604 nails RF right at the end of the metal jacks with blocking capacitors that route RF back to the metal chassis ground plane (drawing B at left). Proof: A *Radio World* magazine reviewer detected no audible RF through a very radio frequency-prone microphone when he intentionally positioned a CR-1604 on a transmitter hill under four TV and three FM transmitter antennas plus several micro-wave repeaters.



INSTRUMENTATION-GRADE BUILT-IN POWER SUPPLY not only eliminates inconvenient "wall warts & line lumps" (plus their hum-inducing magnetic fields) but provides power for extras like +48V phantom mike power, 12V BNC lamp socket, hi-output headphone amp and enhancements like our XLR10 mic preamp expander & internal full-fader/muting MIDI automation board.

DOUBLE-SIDED FIBERGLASS CIRCUIT BOARDS. Exclusive, patent-pending flat mounting provides rigid, multi-point suspension, and isolates controls from external physical impact, a common source of damage in conventional mixers which couple brittle, phenolic pots directly to equally brittle phenolic circuit boards.

BUS 3&4 ASSIGN. Four buses in the space of two conserves space without compromising versatility. Perfect for dual stereo pair output to a 4-track deck, bouncing multiple tracks onto two more tracks or previewing a sound source that hasn't been brought into the mix yet.

BETTER-THAN-DIGITAL −90dB S/N ratio with 108dB dynamic range (vs. digital with −90dB S/N and 90dB dynamic range) so you're ready for that A-DAT, DAT, or hard disk recording system in your future.

STEREO IN-PLACE SOLO maintains stereo perspective for all soloed channels and returns.

Hi-accuracy **SEALED ROTARY CONTROLS** prevent external contamination. Co-molded mechanical parts contain no easily-shattered phenolic.

MIX AMPS WITH DOUBLE THE HEADROOM. Conventional mix amps can overload and distort when you start pouring on the channels. Our gain structure lets you cram the CR-1604 with 16 hot signals and still have more headroom than other mixers running just 8 inputs. No wonder numerous, famous 'n' fanatical percussionists swear by their Mackies.

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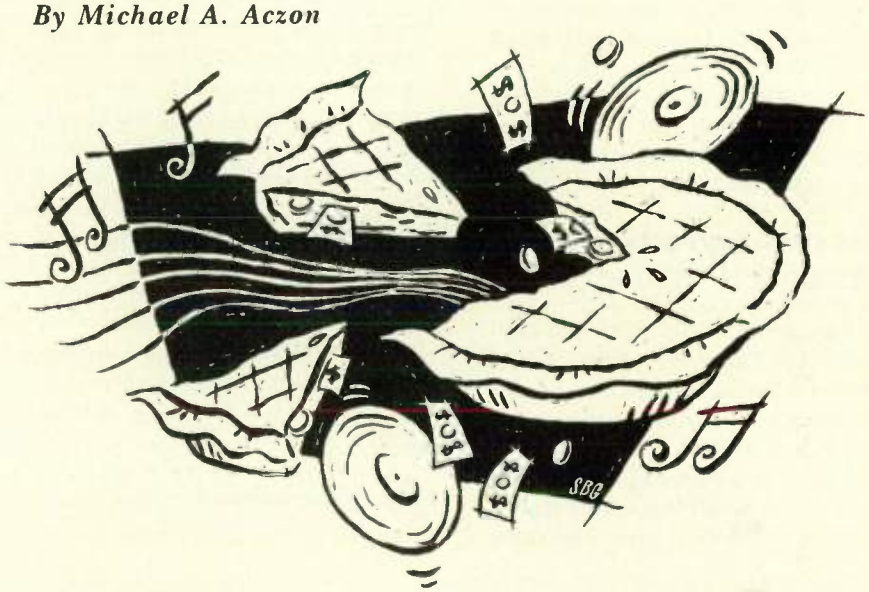
Performing Rights Societies

By Michael A. Aczon

These songwriter's friends make sure you get your piece of the royalty pie.



SUSAN GROSS

The working musician often spoons up a veritable alphabet soup of acronyms, such as MIDI, FSK, SCSI, and SMPTE. However, anyone planning a career in the music business should pay special attention to ASCAP, BMI, and SESAC. No, these are not designations for new and more powerful music software tools; they identify the major domestic performing rights societies.

Many musicians are confused about the role of performing rights societies within the music industry. Such bewilderment is easily cured: Performing rights societies are absolutely vital to a songwriter's career. If you value your composition chops, read on.

LICENSING LIABILITIES

Copyright holders of musical works own a number of exclusive rights (see "Working Musician: Comprehending Copyright" in the February 1992 EM). Among these is the exclusive right to publicly perform the work. In theory, no one can perform a song in public without permission of the copyright holder.

However, it's difficult enforcing this exclusive right when songs can reach the public through radio and television, aerobics classes, and even telephone "on hold" services. For the solitary copyright holder, the task of identifying countless venues and licensing a work to each is as hopeless as clutching a fistful of sand. The majority of songwriters don't have the time or clout to collect all the royalties accumulated by their work. And the fact is, even industry hitmakers lack the means to chase pennies across the airwaves. But never fear, runaway royalties always bring performing rights societies to the rescue.

HOW DO THEY HELP?

Performing rights societies are organizations that handle the administrative details associated with the commercial exploitation of musical works. When songwriters and publishers join a performing rights society, they grant the organization the right to act in their behalf throughout various business transactions. These dealings include: compiling data regarding member compositions being publicly performed; licensing the use of the compositions to various users; keeping track of how much and to what degree the compositions are used; collecting the money generated from use of the compositions; and distributing the revenue generated from the compositions to its members.

Performing rights societies deal only with non-dramatic public performances known as *small rights*. Uses of musical works that are not licensed through performing rights societies include *grand rights* (dramatic works for ballets, musicals, operas, etc.), *mechanical rights* (compositions reproduced on phonorecords), and *synchronization rights* (compositions on film or video soundtracks). These rights are negotiated directly between the user and the music publisher. However, once any of these media is utilized by a licensee of a performing rights society (a CD is played on the radio or a movie is aired on television), the organization's machinery kicks in to collect and distribute royalties.

WHO ARE THEY?

There are three major performing rights societies in America: ASCAP (American Society of Composers, Authors and Publishers), BMI (Broadcast Music Inc.), and SESAC (Society

of European Stage Authors and Composers). Today, each society is best-known by its acronym.

ASCAP was founded in 1914, when a number of songwriters and publishers banded together to enforce the payment of performance rights by music users. SESAC was formed in 1931 as a privately owned company specializing in European catalogs. Partly due to ASCAP's resistance to licensing country music, a group of broadcasters formed BMI in 1940. Of course, these past philosophical differences have long since disappeared, and each society now represents all musical styles with equal enthusiasm.

CHARTING REVENUE

While methods of licensing, royalty collection, and song tracking vary, today's performing rights societies serve similar functions. Each society grants a *blanket license* allowing each user access to every composition in its catalogue.

The cost of these licenses varies. For example, a major metropolitan radio station pays a much higher fee than a one-room aerobics studio. Also, fees

PIECES OF THE PIE

Betty Novice, a non-affiliated writer who has never had a song commercially recorded, collaborates with noted BMI songstress Paula Pro. Pro is signed to one of the industry's largest music publishers, ProStar Publishing (a BMI affiliate).

The Novice/Pro song is recorded by hitmaker Fred Rocker, who owns an ASCAP-affiliated publishing company, Rocking Chair Music. In order to cut himself in on publishing revenue, Rocker negotiates with Novice for 10 percent of her half of the total publishing royalties. Giving up publishing rights has become an "entry fee" for most new songwriters. Things are different for ProStar Publishing, however. Because it is a large firm with massive industry clout, ProStar declines to share its publishing rights with the shrewd Rocker.

Upon confirmation of the song's inclusion on Rocker's upcoming album, Novice forms her own publishing company, Novel Tunes, and affiliates with ASCAP. Upon release of the record, Novel Tunes must submit proof of release (a copy of the record) to ASCAP. Additionally, all parties must notify their affiliate performing rights societies of the various royalty splits.

Within a year, Rocker's album goes triple platinum (3 million domestic sales), and the royalty flood is distributed as follows:

Writer Distribution: Betty Novice (paid by ASCAP), 50 percent. Paula Pro (paid by BMI), 50 percent.

Publisher Distribution: Novel Tunes (paid by ASCAP), 45 percent. Rocking Chair Music (paid by ASCAP), 5 percent. ProStar Publishing (paid by BMI), 50 percent.

SONGWRITING ANGELS

ASCAP (East)
1 Lincoln Plaza
New York, NY 10023
tel. (212) 595-3050

ASCAP (West)
7920 Sunset Blvd., Suite 300
Hollywood, CA 90046
tel. (213) 883-1000

BMI (East)
320 West 57th St.
New York, NY 10019
tel. (212) 586-2000

BMI (West)
8730 Sunset Blvd., Third Floor
Los Angeles, CA 90069
tel. (310) 659-9109

SESAC
156 West 56th St.
New York, NY 10019
tel. (212) 586-3450

are adapted according to degrees of use. A featured work is weighted differently from background music. The societies then survey their licensees' use of the compositions by methods ranging from playlist logs (which are kept by the licensees) to the actual sampling of air time.

In addition, domestic performing rights societies have forged relationships with their foreign counterparts to collect revenue on each other's behalf. All income is paid, after operating costs and payments to foreign societies are subtracted, directly to the members of the societies. Half of this revenue is distributed to publisher members, and the other half goes to writer members (see sidebar "Pieces of the Pie").

DECISION TIME

Auditioning a performing rights society is as important as choosing the right drummer or record company. The nature of the licensing business gives performing rights societies access to every record company, publishing firm, successful songwriter, and radio station in the United States (and beyond). And as a member, their contacts can be your contacts.

In addition, ASCAP and BMI sponsor artist showcases to find the hit songwriters of tomorrow. Write or call them for information on their services and outreach programs (see sidebar "Songwriting Angels"). Be sure to talk to friends who already are affiliated to get their perspectives on each of the societies. Like all artistic decisions, going with your heart usually yields the best results.

Of course, simply affiliating with a performing rights society doesn't bestow the golden key of success. You must hone your people skills to get society representatives interested in your career. And remember, the lowly ASCAP (or BMI) intern who loved your tape could be a major-label A&R president within a month.

Michael A. Aczon *teaches a music publishing class for S.F. State University's MRI (Music & Recording Industry) program and practices entertainment law in San Francisco.*

Reviews

Alesis ADAT 8-Track Digital Audio Recorder

By Michael Molenda and Neal Brighton

The $3,995 miracle is finally here, and it works!

Every musician in the world is going to own one of these things; count on it. A truly user-friendly digital multitrack for under $4,000. No computer interface, no learning curve, and no bizarre connections. ADAT is more than a technological innovation, it's a social force.

ADAT is not *just* a tape deck; it records eight tracks of digital audio onto an S-VHS videocassette. Analog-to-digital conversion is 16-bit with 64 times oversampling. The sampling rate defaults to 48 kHz but can be varied from 40.4 to 50.8 kHz (-3 to +1 semitones), using a front-panel pitch control.

The Alesis ADAT's friendly front panel features familiar tape-transport controls, track-select buttons, and autolocate switches. Metering is handled by the eight 15-segment LED bar graphs at left, and a real-time tape counter is in the center.

Think of it: The professional 24-track studio is no longer the altar of master-quality sound. ADAT bestows upon anyone with recording chops the ability to track commercial, CD-quality, multitrack masters in their bedroom or garage. As a matter of fact, there's no reason for musicians to record anything *but* masters when digital quality is openly accessible. Is this what Sly Stone meant when he sang "Everybody Is A Star?"

HOW IT LOOKS

The face of affordable digital multitrack is friendly; ADAT utilizes the familiar tape-transport controls, track-select buttons, and autolocate switches that recording engineers have used for decades. Metering is handled by eight 15-segment LED bar graphs, and Alesis will offer an optional 32-channel remote meter bridge.

An LED display under the S-VHS cassette loading door acts as a real-time counter and provides format and error information. A digital-recording switch enables a set of rear-panel optical I/O ports. Switches for autolocation functions, input monitors, formatting, and pitch complete the handsome black front panel. The whole package fits in three rackspaces and weighs about fifteen pounds.

The rear panel (see **Fig. 1**) offers connections in a spacious and well-centered design. Unbalanced 1/4-inch inputs and outputs handle -10 dBV levels, while a 56-pin ELCO connector services the +4 dBu I/O. A pair of 1/4-inch jacks for the LRC remote control and optional punch in/out footswitch reside next to a pair of 9-pin D connectors (similar to those in PC-compatible computers) that carry Sync In and Out, MIDI In and Out for MIDI Machine Control and Alesis' proprietary SysEx, sample-address data, and word clock I/O. A third 9-pin D connector services the remote meter bridge. The fiber-optic I/O ports allow digital copies to be made from one ADAT to another.

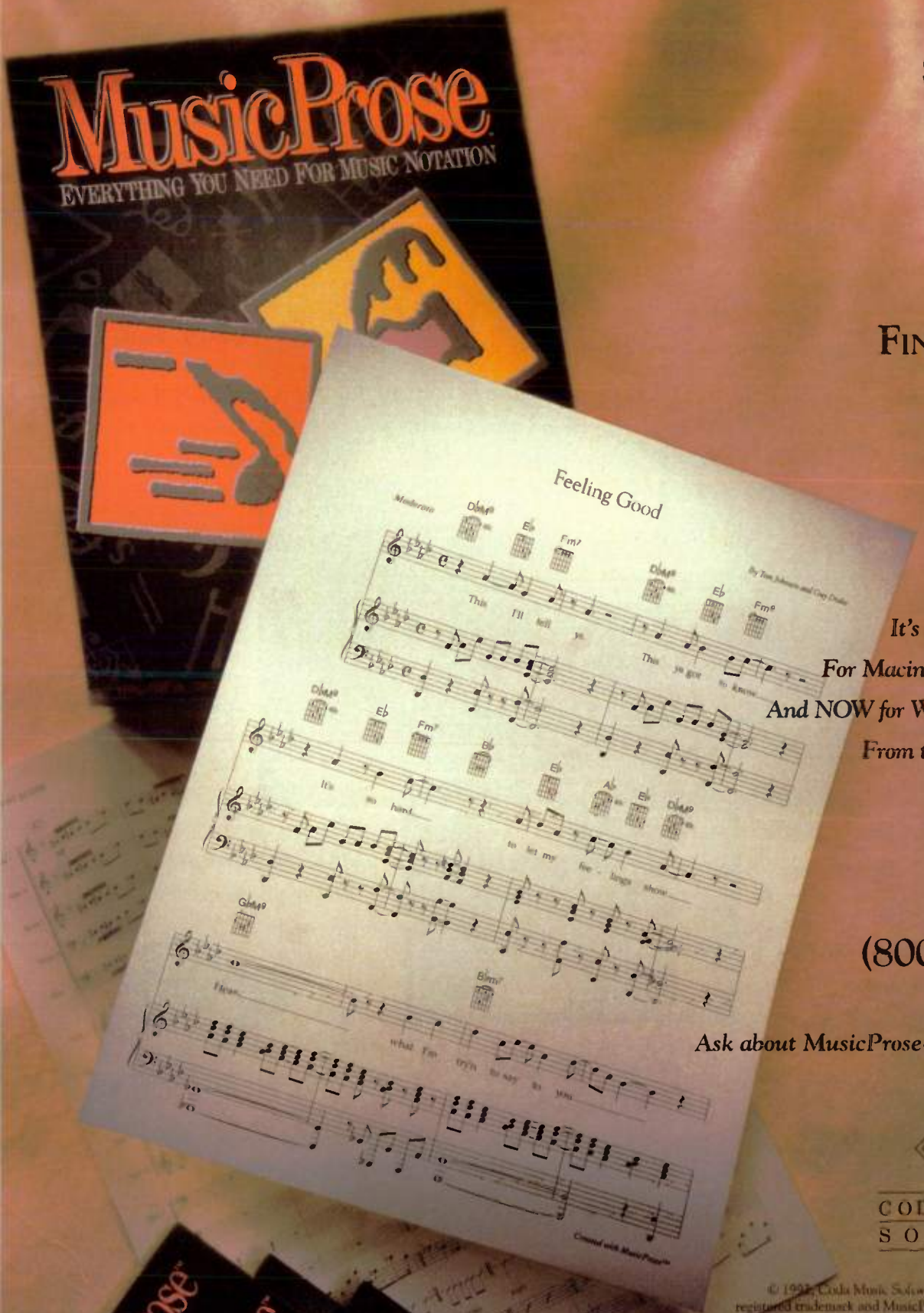
At this year's AES, Alesis is expected to release the BRC remote control, which will control up to sixteen ADATs, with SMPTE and MIDI sync, digital-domain assembly editing between decks, and transport-status monitoring. The company also will offer an AES/EBU interface, an S/PDIF interface, and a 44.1/48 kHz sample-rate converter.

THE S-VHS FACTOR

Besides the digital I/O, several significant ADAT features won't be familiar to analog recordists. First, there's the tape drive. ADAT uses an accelerated

PETER DIGGS

THE RIGHT PLACE TO START



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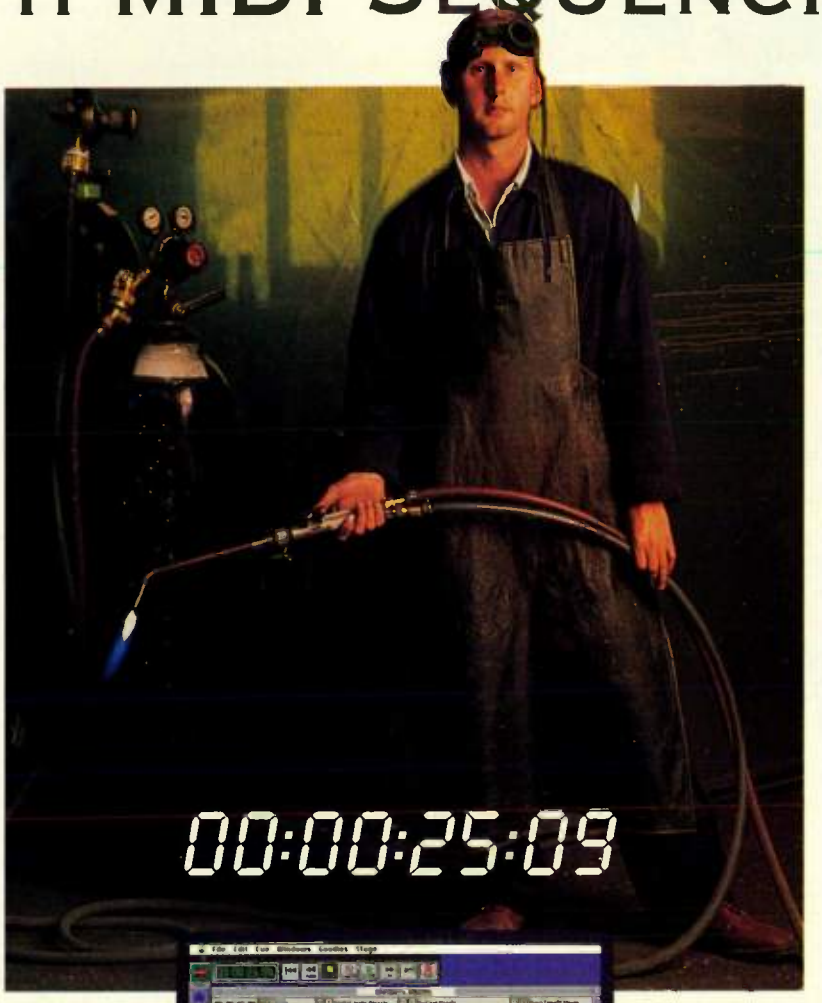
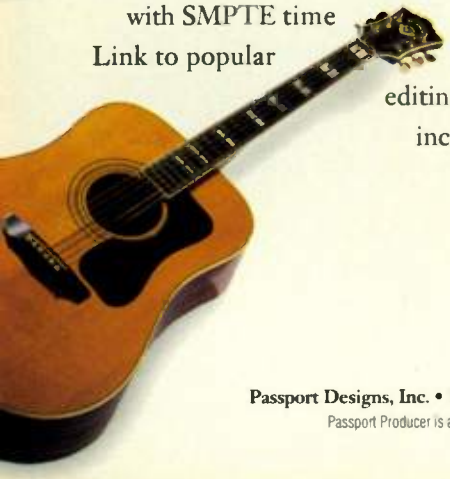


Musicians shouldn't have to waste valuable creative time working with cumbersome tools to integrate digital audio with MIDI sequencing. Passport Producer is software that seamlessly melds digital audio, MIDI sequences, QuickTime™ movies and other digital media—with ease and precision. Add digital audio to your favorite Macintosh MIDI sequencer including Master Tracks Pro 5,™ Trax,™ Performer,™ Vision,™ EZ Vision™ and Cubase.™ Producer is intuitive and easy to use so you can focus on creativity, not technology. Passport Producer locks MIDI and digital audio together with SMPTE time code. Link to popular audio editing tools including Alchemy,™ Sound Edit,™ Pro Tools™ and Sound Designer.™ With Passport Producer, you can expand beyond music into multimedia. MIDI, digital audio, digital video, animation and presentations can be integrated for easy, lightning-fast post-production. Spot sound effects, produce jingles or score a movie. Create music videos, demos and spectacular multimedia presentations on your desktop. If you want to create really hot musical productions, get your hands on Passport Producer...and set the world on fire. Available at fine music and computer stores worldwide. Call us for the dealer nearest you.



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S-VHS videocassette drive and records up to 40 minutes of audio per 120-minute tape. The cassette must be formatted to accept digital information. Formatting isn't a major operation and can be initiated during recording, but it's best done before recording to ensure consistency. During the formatting process, ADAT records fifteen seconds of leader, two minutes of data, and then time code (starting at -00:05) until the tape ends.

The lag time while the VHS drum mechanism wraps tape around the helical head may take a little getting used to. The operation is faster than your home video recorder, but you probably are accustomed to the quicker access of stationary-head reel-to-reel and/or cassette multitracks.

Alesis deals with this lag time by allowing the user to engage the tape head. This means the tape is in contact with the spinning helical head even when the tape is stopped. When a tape is engaged, it can go into Play or Record faster and can monitor during cue and review functions. When the Stop button is depressed once, the tape remains engaged.

Pressing the Stop button twice disengages the tape from the head to allow conventional rewind and fast-forward functions. When you're finished recording, it's a good idea to press Stop twice before rewinding. If you don't, your tape will contact the helical head throughout its entire rewind function; according to Alesis, this doesn't cause significant headwear, but it results in a slower rewind time.

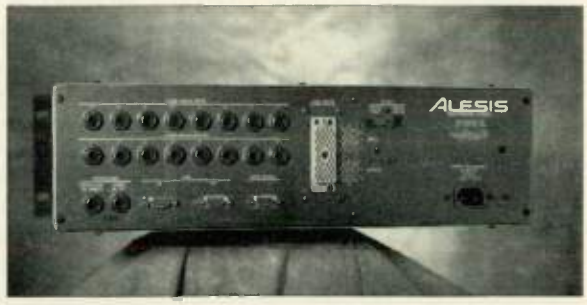


FIG. 1: There's no standard for wiring 56-pin ELCO connectors such as the one in the center of ADAT's rear panel, so you may have to wire your own cable or buy an adapter. The pin-out diagram to the ELCO's right shows the face of the female connector or the solder side of the male connector.

HOW IT WORKS

The basic concepts behind ADAT are straightforward. Analog signals from the -10 dBV and +4 dBu inputs are routed through a Crystal CS5336 Delta-Sigma 16-bit analog-to-digital converter (ADC) with 64 times oversampling. Each of the eight channels has its own ADC. The converted digital signals are shipped through an encoder that houses a memory buffer and data-interleaving function, and the signals then are sent to the tape heads. Data interleaving shuffles consecutive samples so they are mixed as far apart as possible. If samples are lost, chances are they will be non-consecutive, which makes error correction much easier.

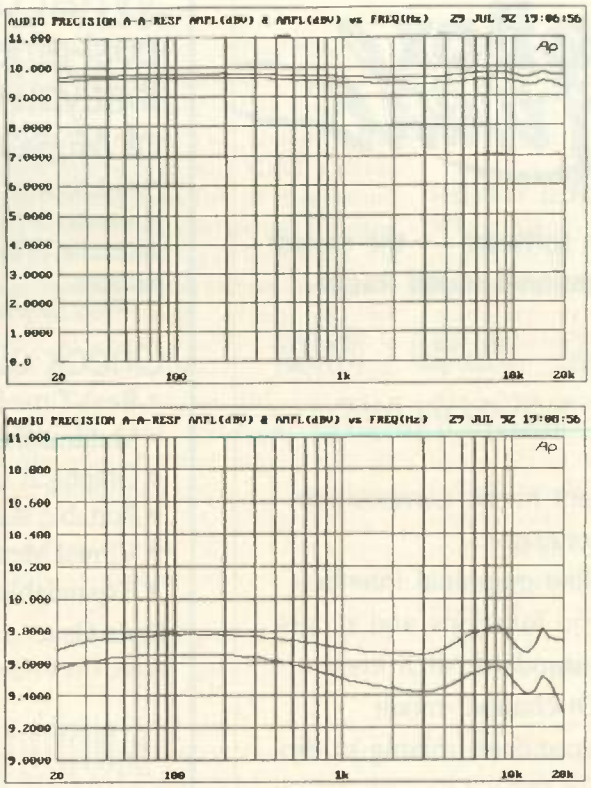


FIG. 2: This large-scale overview (a) shows ADAT's impressive, relatively flat frequency response. A close-up view (b) shows that our test units exceeded Alesis' 20 Hz to 20 kHz, ±0.5 dB spec by a healthy margin, with Deck 1 flat to a tolerance of ±0.1 dB and Deck 2 within ±0.2 dB.

analog (on a Tascam MS16 with dbx) were left up for comparison.

Preliminary tracking utilized the -10 dBV inputs and outputs, because at press time no preassembled +4 dBu ELCO-to-XLR connectors were available. Given the short turnaround necessary to get this review in the October issue, we didn't have time to make our own cable. Luckily, Pro Co Sound (tel. [616] 388-9675) had an extra connector/snake assembly ready to ship, preventing a studio-wide nervous breakdown.

Before receiving the ELCO cable, we were stuck running -10 dBV signals through our +4 dBu system. This situation didn't make for a pristine test environment. Signals were routed from our mixer's eight subgroup sends so our hotter system levels could be turned down to accomodate ADAT's -10 dBV inputs. Monitoring necessitated running ADAT's outputs into eight Countryman direct boxes and then (via microphone lines) into available mixer input modules.

But even encumbered with mixed operating levels and ridiculous cable runs, ADAT sounded absolutely clean. Except for a minute sharpness in the upper midrange frequencies, signals were reproduced like mirror images. Drum-machine tracks sounded as if they had never been laid to tape; visceral impact remained almost unchanged between monitoring from ADAT and listening directly to the drum machine from its headphone output. Acoustic guitars sounded crisp and distorted electric-guitar rampages were unbowed by the supposedly sterile digital medium. The clarity of vocals was astounding.

When the ELCO connector finally arrived, we cleaned our electronic house and routed ADAT more conventionally through our system. Because ADAT sounded great at -10 dBV, there was not a major increase in quality once the unit was running at +4

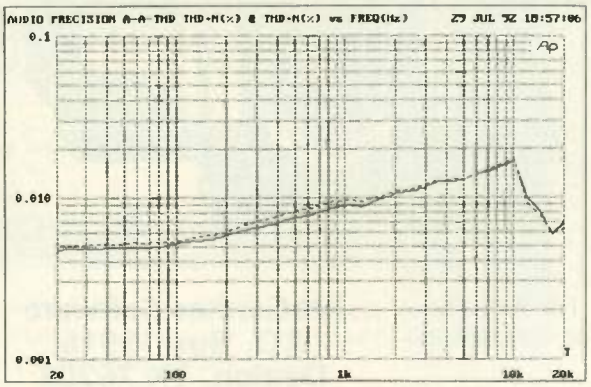
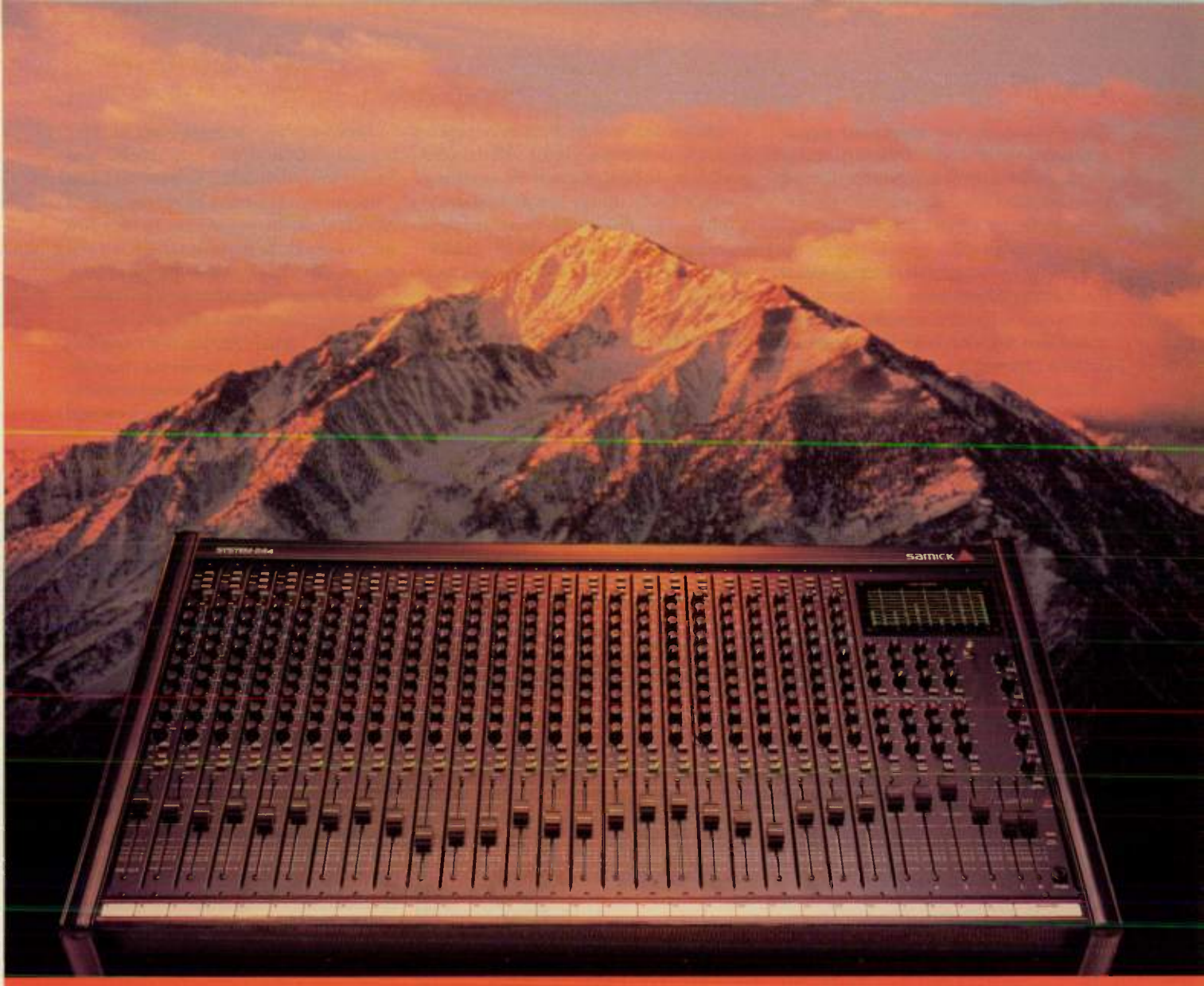


FIG. 3: At 1 kHz, one ADAT is almost right on the manufacturer's stated 0.009% Total Harmonic Distortion+Noise spec, testing at 0.00952%. The other ADAT is also extremely close, at 0.00958%. As expected, THD+N rises with frequency, but even at 10 kHz it is well below 0.02%.



Perfect For Any Environment

Admittedly, your particular PA environment probably wouldn't be this demanding. But even if it was, you'd find a Samick PA component that could handle the job.

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Samick Pro Audio
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samick

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Go ahead, boost the drums, pull back the bass, eliminate the brass section completely. You decide which musicians you want to offend. With the SC-155 Sound Canvas you're in complete control

The sliders on the SC-155 Sound Canvas let you fade out unwanted musical elements.

of your music. An array of sliders lets you manipulate both the level and panning of different parts in a composition, whether they originate from the SC-155 or another module. But that's just half the story.

(Or song, as the case may be.) This unit also gives you the power to compose up to sixteen-part arrangements with twenty-four voice polyphony and built-in effects. And GS Format makes it compatible with the huge variety of third-party Standard MIDI File sequences. There's even a "Minus One" feature that lets you listen to all but one part of a song. Which is great news if you're a musician. Provided, of course, you're not one who plays the accordion.

Roland®

Roland Corporation US, 7200 Dominion Circle, Los Angeles, CA 90040-3647 213 685-5141.

track 8. Score three for ADAT; the submix was clean.

SUSPICIOUS MINDS

Despite being thwarted in our attempts to defile the ADAT, several engineers persisted in voicing concerns.

Tape transport. The robustness of the tape transport was a consistent worry. Would the unit stand up to the punishment of professional use? After all, home studios are seldom used 40 to 60 hours a week or more, as project and commercial studios are.

Although video editing suites usually shuttle a recorder's transports harder than comparable audio applications—an MTV-style, quick-cut edit often is frame-by-frame, while an audio punch-in is measured in seconds—professional video decks often require overhauls every 1,000 hours. A project studio posting 40 hours a week could conceivably need the ADAT's transport repaired or replaced within six months. Fortunately, the machine's design should allow a qualified technician to swap drives quickly and easily.

Compatibility. Recording engineers discovered pretty quickly that DAT was no dream. Master tapes recorded on a Sony DAT deck in the studio sometimes didn't play back on the mastering facility's Panasonic deck. Because DAT manufacturers initiated error correction (and even head skew) slightly differently, compatibility is a major problem.

Obviously, ADAT is the domain of a single manufacturer. However, the stability of the formatting structure can have an impact on tapes played and/or recorded on different ADATs.

Fortunately, ADAT's S-VHS tape is 3 1/2 times wider than DAT, and its transport moves ten times faster. DAT's smaller size and slower tape speed crunches data, making it more susceptible to mechanical tracking error. ADAT's greater margin for tracking error also ensures data is read consistently between machines. In practice, we were able to swap tapes between two ADATs with no problems.

Head cleaning. Heads get dirty, and dirty heads can sabotage performance. Because they're spinning, helical heads typically encounter less tape gunk than stationary heads, but it's madness to assume they'll go through life unsoiled. At press time, there was no official recommendation from Alesis regarding cleaning instructions. We assume, since few manufacturers officially condone prancing around inside the machine, that cleaning options will be limited to commercial cassette cleaners, which might not do a great job.

GOOD VIBRATIONS

Assuming the tape heads and transport hold up, we can't find any reason not to love ADAT. Of course, only time will tell if the system remains dependable and engenders trust from professional engineers. For now, ADAT works great, sounds amazing, and is priced right. That's good enough for us. We're buying in.

(Many thanks to Michael Gore, B.A.S.E.; Gary Hall and Jeff Mock, Sonic Solutions; George Petersen, *Mix* magazine; Marcus Ryle, Fast Forward Designs; Buddy Saleman, Sound & Vision studios; and Charlie Wicks, Pro Co Sound.)

EM *associate editor* **Michael Molenda** *and partner* **Neal Brighton** *are independent producer/engineers and owners of Sound & Vision studios.*

Akai MX1000 MIDI Master Keyboard

By Steve Oppenheimer

Take control of your MIDI gear without tears.

An oft-repeated dogma states that if you want sophisticated products, you have to accept a steep learning curve. If you have ever programmed a many-featured MIDI controller or synth with a tiny numerical display, you understand the implications of this repressive medieval philosophy. Few sane humans enjoy memorizing the shapes of a few dozen velocity curves to avoid constantly referring to a manual. And trying to keep track of dozens of parameters in multiple zones, sent on sixteen MIDI channels via several MIDI Out ports, is enough to make less-dedicated electronic musicians want to pull the plug. We buy this stuff to make music, not suffer the

tortures of the Inquisition.

Fortunately, we don't have to suffer Torquemada-esque torture to make music. In the musical-instrument world, as in the computer industry, a host of manufacturers are heeding the call for improved user interfaces. Akai's MX1000 MIDI Master Keyboard is right in step with this enlightened philosophy, offering easy access to an extensive feature set.

Touch is critically important in a keyboard controller, so let's deal with that before delving into the features. The MX1000's velocity- and channel aftertouch-sensitive, 76-key, weighted action feels pretty good, although I've played deeper, more piano-like controller actions. It easily beats the so-called "weighted" actions found on 76-key controller/synths such as the Ensoniq SQ-2 or Roland D-70. If you're not a technique purist, you can play piano licks with few compromises, and if fast licks are your bag, the MX lets you tear 'em up.

THE SCREEN TEST

The doorway to the MX1000's functions is a generous 40-character by 8-line LCD display. Like Roland's A-80 (which the MX1000 superficially resembles), but unlike most MIDI keyboard controllers, the display offers graphic, as well as numeric feedback. You can watch the velocity curves change in real time as you adjust them, and the Main menu graphically displays note ranges via a keyboard icon and bar graphs. I wish all master keyboards had comparable displays.

In addition to the Program name and number and the Key Group note ranges, the Main menu graphically displays the MIDI Out port and MIDI channel assignments of all zones. ("Key Group" is Akai's term for a range of notes mapped to the keyboard, more commonly referred to as a "zone.") You're almost always in the Main menu when performing, especially on stage, and this arrangement gives you a valuable instant overview of the current Program. A separate, highly visible, 2-character LED display shows the current program number.

At the bottom of each screen is a menu bar that identifies the current functions of the six function keys. A set of four cursor buttons and a pair of data keys navigate among the parameters within the screens. When you hold them down, the scrolling speed increases. Akai remembered to add a panic button to the MX, but unfortunately it only sends All Note Off and Controller Reset commands. I've said it before, but it bears repeating: Panic buttons also should send individual Note Off 0 to 127 messages on all channels, because some instruments don't understand All Notes Off.

Overall, the MX offers one of the most accessible user interfaces on any keyboard controller around. It's no problem to zip around screens and tweak parameters. After the first few minutes, I never got lost.

PROGRAMS

A complete set of parameters comprises a Program, and 100 Programs are held in battery-backed RAM. Although they are numbered, you also can name the Programs, and as you navigate the MX1000's various windows, the current Program name is displayed at the top. When in the Main menu, the name shows up on the LCD in large letters. You'll appreciate that when you need to work quickly, especially onstage.

Programs can be called up directly via the two sets of ten front-panel buttons. In addition, a rear-panel jack admits a Program Up/Down footswitch that increments through Programs in numerical order when in Program mode. With two footswitches wired to a single TRS stereo plug (e.g., a normally closed double footswitch), you can use one switch to increment and one to decrement.

When performing live, many keyboard players prefer to step through predefined chains of Programs. Four separate 100-Program chains can be defined, edited, and named; most MIDI controllers only provide one. In Chain mode, the Program Up/Down footswitch steps through the currently active chain.

In addition to the Program Change messages sent with each Key Group, each MX1000 Program allows you to send four independent MIDI Program Changes on any channel through any combination of the four MIDI outs. This feature enables you to select programs on MIDI-controlled effects processors, patch bays, or any other MIDI devices.

All MX1000 Program and chain data can be saved as named sets and dumped or loaded via MIDI System Exclusive or an Akai BR-16 battery-backed RAM card ($99.95). A rear-panel Memory Protect switch keeps you from accidentally overwriting the onboard memory.

AKAI PM76 PIANO MODULE

Undoubtedly with the best intentions, Akai decided to offer an optional internal PCM sample-playback board for the MX1000 so you could play a quick gig or rehearsal with just the MX1000 and an amp. Unfortunately, the PM76 Piano Module is a guaranteed loser.

The PM76 is internally patched to the MX1000's MIDI Out D (which is still operational), and in Program mode it is addressed in the same fashion as external sound sources. In Piano mode, the module preempts all external devices and Slider 1 controls Volume. An external pot on the MX's rear panel controls the PM76's output level. Left and right audio outputs and a headphone output also appear on the rear.

The module offers ten preset sounds, which cannot be edited in any way except fine-tuning. It is not multitimbral, and it adds quite a bit of weight to the MX1000. But the twin killers are the outrageous price ($995) and the mediocre quality of the sounds.

The ten sounds include grand piano, upright piano, two electric pianos, a "Mellow" electric piano, honky-tonk piano, vibes, cembalo, pipe organ, and electric organ. The pipe organ is big and fat; it's clearly the best of the lot. The rest of the sounds range from decent (the electric pianos) to clearly unrealistic but usable for some purposes (the electric organ). Some sounds badly need parametric EQ. For example, the vibes' low end is far too boomy. The grand piano sounds like it was sampled in a highly reverberant chamber, but you could use it for a quick rehearsal or jam session.

The PM 76's sounds aren't downright awful, but at $995, the deal sure is.

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KEY GROUPS

You can define four completely independent, overlapping Key Groups (keyboard zones) for each Program, and the data from each Group can be routed to any combination of four independent MIDI Out ports. Some MIDI controllers give you more zones and layers than the MX1000, but if you use the MX's capabilities judiciously—especially in combination with a multi-port MIDI interface/patch bay—you'll have all the control and flexibility you're likely to need.

The Key Group screen (see **Fig. 1**) is laid out in table form, with the Groups from left to right and the parameters in a column. Each Key Group gets its own MIDI channel assignment; outgoing Program Change; Sustain Pedal on/off setting; and values for transposition (±50 semitones), Pitch Bend range, Mod Wheel depth, Pressure, and Pressure Offset. Maximum volume for each Key Group is set in a related Preset Volume window.

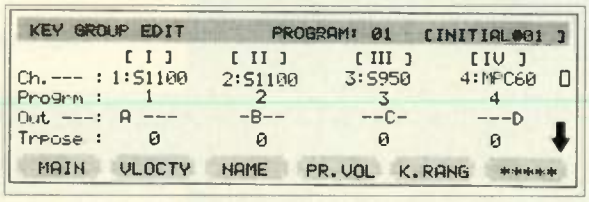

FIG. 1: The Key Group screen. The arrow at the right indicates you can scroll down for more parameters.

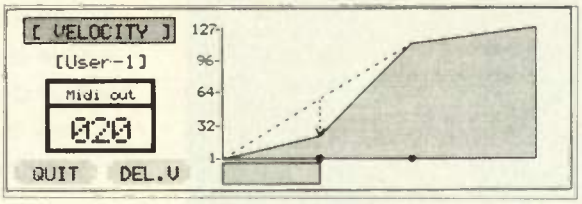

FIG. 2: In the Curve Edit screen, you can program custom Velocity curves with as many points as desired.

VELOCITY

Each Key Group has its own velocity curve. Akai provides six preset curves, which are fine for the majority of applications, but you also can program eight custom curves.

This is one of the controller's coolest features. While watching the graphic display in the Curve Edit screen (see **Fig. 2**), you select points (called "Power Points") along the curve. A little "nipple" at the bottom of the screen denotes the points' locations. The Data keys raise or lower the value at each Power Point, producing a custom curve. You can use an unlimited number of Power Points, so it's possible to create extremely complex curves.

A readout at the left side of the display continuously shows the outgoing Velocity values as you play, and a bar graph at the bottom of the screen reflects the same data. I relied heavily on this readout to gauge the effect of curve changes.

A Velocity Offset feature determines where the velocity curve kicks in. For instance, if you set the offset at +10 (the highest offset), using Velocity Curve 1, even a light attack gives you values in the 60 and up range. If you set the offset at -10, a comparable attack yields Velocity values around 40 because it takes more "pop" to get past the zero point and into the lower part of the curve. You also can program the highest and lowest Velocity values that can be sent by each Key Group.

Some sound modules or patches don't respond equally to Velocity messages triggered at the extreme ends of the keyboard, and sometimes you don't want a patch to respond the same at the top as it does in the middle. For instance, I have a Rhodes Chroma (analog synth) patch that, because of the way I programmed the filter, unavoidably loses level at the high notes. Anticipating such problems, Akai supplied a Velocity Key Follower feature (see **Fig. 3**), which lets you create a curve that scales velocity response separately for the top and bottom sections of the keyboard. As the curve's value gets further from zero, the affected range increases; at ±10, the Velocity Key Follow curve affects approximately $2\frac{1}{2}$ octaves. The friendly keyboard icon shows the curve changing in real time, and a numerical value facilitates precise adjustments. By increasing the velocity response at the top of the keyboard, I leveled my analog synth patch's overall Velocity response so it became more even across the keyboard.

CONTROLLING INTEREST

If you want to send a lot of controller

messages to multiple destinations, you'll like this keyboard. Unless you're a real nitpicker, you'll find only a few things missing. The most notable controller I miss is Poly Pressure (Aftertouch) instead of Channel Pressure, but only a few keyboards offer Poly. Besides, if you want more exotic MIDI controllers, the MX1000's merging MIDI In (discussed later) lets you add them.

The MX1000's modulation wheel is a unidirectional, dedicated controller. You can program the range for each Key Group, but not the type of MIDI Controller message. The spring-loaded pitch wheel has an excellent feel. The wheels are almost 2 1/2 inches in diameter, large enough to grab quickly yet use with relative precision. Like the mod wheel, the pitch bend wheel and Channel Pressure have range settings for each Key Group but are dedicated to their respective tasks. For each Key Group, you can program a Pressure offset that works the same way as the velocity curve offset discussed earlier.

In addition to the wheels, the MX1000's front panel includes four programmable sliders, below which are four numbered, programmable Control Switches with on/off LEDs. The sliders can send any MIDI Controller message—including switches such as soft or damper pedal—to any combination of Key Groups. You can even use the sliders as data-entry devices in case you don't like scrolling through parameter values with the Data keys. Continuous (CV, or "sweep") pedals attached to the rear-panel jacks have the same functions and controls as the sliders. Unfortunately, you have to use a Yamaha FC7 pedal or modify Roland-type pedals to fit Akai specs.

The data for each slider can be separately sent channel out any combination of the four MIDI Outs on any one extra MIDI . For example, I wanted to experiment with using a single slider to modulate the LFO rate on an E-mu Proteus/3 and at the same time sweep the LFO rate on a Lexicon LXP-5 chorus patch. I simply programmed the two devices, assigned the slider to send Mod Wheel messages to the Proteus' Key Group, and set the extra MIDI channel and port assignment to address the LXP-5.

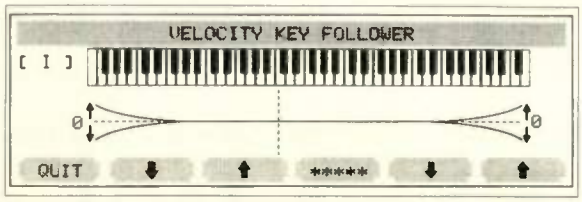

FIG. 3: The Velocity Key Follower screen lets you scale Velocity response for the top and bottom of the keyboard.

An important option sends global All Controller Reset messages every time you change Programs. If All Controller Reset is enabled, when you change MX Programs, all sliders and continuous footpedals are set at their default value, which is 127 for Volume and 0 for all other controller messages. This means you have to move a slider immediately after a Program change before its setting

takes effect. You can disable this in the System window, so that when you change MX1000 Programs, the sliders immediately send controller values based on their current position. By offering All Controller Reset enable/disable on the MX1000, Akai has avoided a widely criticized limitation of Roland's A-80 sliders.

Each of the four front-panel Control Switches can send a Program Change or any type of MIDI Control Change (on/off) message to any combination of MIDI Outs, independent of the Key Group. The four rear-panel footswitch jacks accept normally closed momentary switches and are functionally identical to the Control Switches. If you prefer, the switches can send a Control Change value of 127 (on) when pressed and a value of 0 (off) when released. Alternatively, a Control Switch can trigger MIDI Note On and Note Off messages for use with the Chords feature.

Of the MX's various Control Switch functions, the Chords feature is utterly unique. You can program up to ten 4-note chords, any one of which can be triggered from a particular Control Switch or remote footswitch. This obviously is a live-performance feature, as you could easily step-enter physically unplayable chords into a sequencer. I can't think of many uses for the Chord feature, but if you want to trigger a series of enormous spread chords that only King Kong could play, this should do the trick.

To help you keep track of your controller assignments, Akai provided a Slider and Control Switch Monitor feature. With this enabled, every time you move a slider, or hit a control switch or footswitch, a small monitor box pops up onscreen. For sliders and continuous pedals, the box shows the Key Groups affected, the controller message, the value, and the extra (fifth) outgoing MIDI channel. For switches, the pop-up box displays the MIDI channel, controller message, value or on/off status (for a switch message), and the Out port. If you find the controller monitors obtrusive, you can disable the feature, but I found it better to keep the feature active.

MERGING AND MONITORING

With some MIDI keyboards, the MIDI In port is just for SysEx loads. Indeed, you can use the MX1000's MIDI In to load data via SysEx, control the optional internal PM76 Piano Module (see sidebar), and direct data to the MIDI Thru port, but that's just the start. A MIDI merge feature, which can be enabled or disabled separately for each Key Group, allows you to use the MX to process and route data from an external controller or sequencer. Aside from sequence-playback applications, this

Product Summary

PRODUCT:
MX1000 MIDI Master Keyboard
PRICE:
$2,299
MANUFACTURER:
Akai Professional/IMC
1316 East Lancaster
Fort Worth, TX 76102
tel. (817) 336-5114

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

feature lets you apply the MX1000's considerable routing and processing power to an external MIDI controller (such as a strap-on keyboard, a keyboard with Poly Pressure, or a non-keyboard controller). The MX1000 is by no means the only MIDI master controller that offers this feature, but many don't, and they should.

If you don't have a computer with a MIDI monitor program, keeping track of incoming and outgoing MIDI data can be difficult. This is especially true when you're trying to program Velocity curves and route controllers. So Akai included data monitor screens on the LCD that show the six most recent incoming or outgoing MIDI messages in real time. The feature doesn't have memory, so you can't scroll back to see previous messages, but the monitor shows enough to check basic parameter changes.

CONCLUSIONS

The MX1000 has a lot of potential and a lot to like. I've already lavishly praised the user interface and controller features. The firmware is stable, and the system never crashed or caused anything else to crash. The instrument case is extremely solid and appears strong enough to take the stresses of regular performing. According to the spec sheet, the MX1000 weighs a reasonable 20.5 kg, or about 45 pounds. (The review unit also included the internal PM76 piano module, which added a surprising amount of weight.)

I often bewail the use of wall warts, so I want to give praise where it's due: The MX1000 boasts an internal AC power supply with a standard 3-conductor, IEC-type connector. The supply is on the opposite end from the optional internal sound module, so there's no problem with induced noise. Thanks, Akai, for avoiding 2-conductor AC connectors and the dreaded wall-wart plague.

The MX1000 doesn't give you every feature you can imagine. Some master keyboards give you more zones, a few throw in arpeggiators and MIDI delays, and at least one (from Elka) lets you write SysEx strings in hex. But you can always add a MIDI patch bay for more routing capacity. MIDI delays are not in great demand, and if you want to write SysEx, you're better off doing it on a computer. It would be nice to have Poly Pressure and a proper panic button, though. You'll have to try the touch for yourself; I could certainly live with it, but it's not amazing.

The manual is fairly easy to understand, it's in real English (!), and it's printed on recycled paper. I would have liked a few more technical details (e.g., about the merging MIDI In functions), but it didn't take long to figure things out.

The main thing that might inhibit MX1000 sales is its price: At $2,300, this is a very expensive master keyboard. You'd pay more for Elka's MK88 or the Roland A-80, but most of the others cost a lot less. I'm pretty demanding when it comes to keyboard controllers, but this one's well-designed, and quality has its price.

If you can deal with the price, and especially if you can find a good discount, try the MX1000. It strikes a solid blow against the medieval power-versus-ease-of-use dogma.

EM *managing editor* **Steve O.** *thinks he deserves a long vacation. He won't get one.*

Macromedia SoundEdit Pro

By Paul D. Lehrman

The Macintosh 8-bit audio standard turns pro. Or does it?

Long before Digidesign got into the act, Macintosh users had access to some pretty hip sound tools, thanks to the built-in 8-bit, 22-kHz sound chips that come with every Mac. To get sound into earlier Macs, which didn't have built-in audio inputs, the most popular tool is Farallon's MacRecorder. This little device incorporates an inexpensive, 8-bit A/D converter with a built-in microphone and a cable that hooks directly into the Macintosh's serial port. It also comes with a slick piece of software called *SoundEdit*.

SoundEdit is fast (it deals only with sounds in RAM), has one of the most intuitive user interfaces on the market, and boasts a host of simple but

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much defeats the whole purpose. Also, you can't use any of the effects on 16-bit files, although you can cut-and-paste and—if you don't mind the sputtering—mix.

Macromedia says they are waiting for Apple to standardize the way the *Sound Input Manager* system software handles 16-bit audio before they include any drivers for 16-bit hardware in the program. Apple apparently will incorporate a 16-bit *Sound Manager* into *QuickTime 2.0*, but no one's sure how long the wait will be.

There are a few weird bugs associated with high-fidelity files. When you preview a 44.1 or 48 kHz sound from disk, the pitch is wrong. It's not off by an octave, as you might expect, but by about a minor third. When you change either the sample rate or the resolution of any file, the loop points move. Apparently this is because the program assigns the loop points to sample numbers, not clock times, so if you change the number of samples in a file, the loop points shift. Not smart.

Surprisingly, for a mature program whose previous versions have been rock-solid, *SoundEdit Pro* is not stable. It crashes a lot when you're moving a loop point, adding silence to the end of a file, adding a new track, or just at random. (Again, Macromedia says this doesn't happen at their house.) There's a bug in the envelope function, so that if you set up a fade-out that's shorter than about one-quarter the length of the file, the fade doesn't happen.

CONCLUSIONS

SoundEdit Pro is not yet the product that will bring 16-bit audio to the Macintosh masses. For those working with 8-bit audio, it's great, but except for the mixing, the improvements in its features are incremental. Hard-disk recording is a plus, but in reality few people will be able to take advantage of it, mostly because the number of playback engines in multimedia programs that can handle hard-disk 8-bit playback is still small.

If you work with 16-bit audio and you own Sound Tools or Audiomedia, you're better off sticking with the *Sound Designer II* software that accompanied your board. *Sound Designer* may not work as quickly or elegantly as *SoundEdit Pro*, but it certainly does so more professionally and reliably. If you need a more flexible alternative that can work with 8-bit AIFF files for multimedia applications without giving up 16-bit recording and playback, *Alchemy* is the choice, if you can afford it.

In summary, while *SoundEdit Pro*'s new features are welcome, the basic utility of the program has changed little. It's still slick and as much fun as ever if you're working with 8-bit files, but anyone looking for a cheap, high-fidelity audio editing tool will not find it here yet.

Paul D. Lehrman, *an overworked and undercompensated composer, author, and teacher, is working on algorithms for glitch-free reality compression and liquid-asset expansion.*

Ramsa WR-S4416 Mixer

By Lori Bolender with Mike Cutter

Pro sound quality and features enter the low-price sound-reinforcement market.

Doing sound reinforcement isn't always the most glamorous work, but it sure puts you in touch with a lot of gear. At the San Francisco Hilton Hotel, we have the opportunity to work with sound-reinforcement mixers ranging from a 4-channel Shure M-267 to the high-end Soundcraft Europa. The Ramsa WR-S840 Series console is a particular favorite, and the mixer format we use most is sixteen channels, so we were excited to test-drive the new 16-channel Ramsa WR-S4416.

The Ramsa WR-S4400-series mixers include 12-, 16-, and 24-input models. They feature four subgroups, Left-Right mix (main) outputs, four auxiliary sends, and four auxiliary returns. The 16-channel mixer is surprisingly compact, considering its features. Weighing in under 50 pounds (despite the built-in power supply), it is easily set up by one person.

CHANNELS

The first things we checked were the 100 mm faders. They have a smooth

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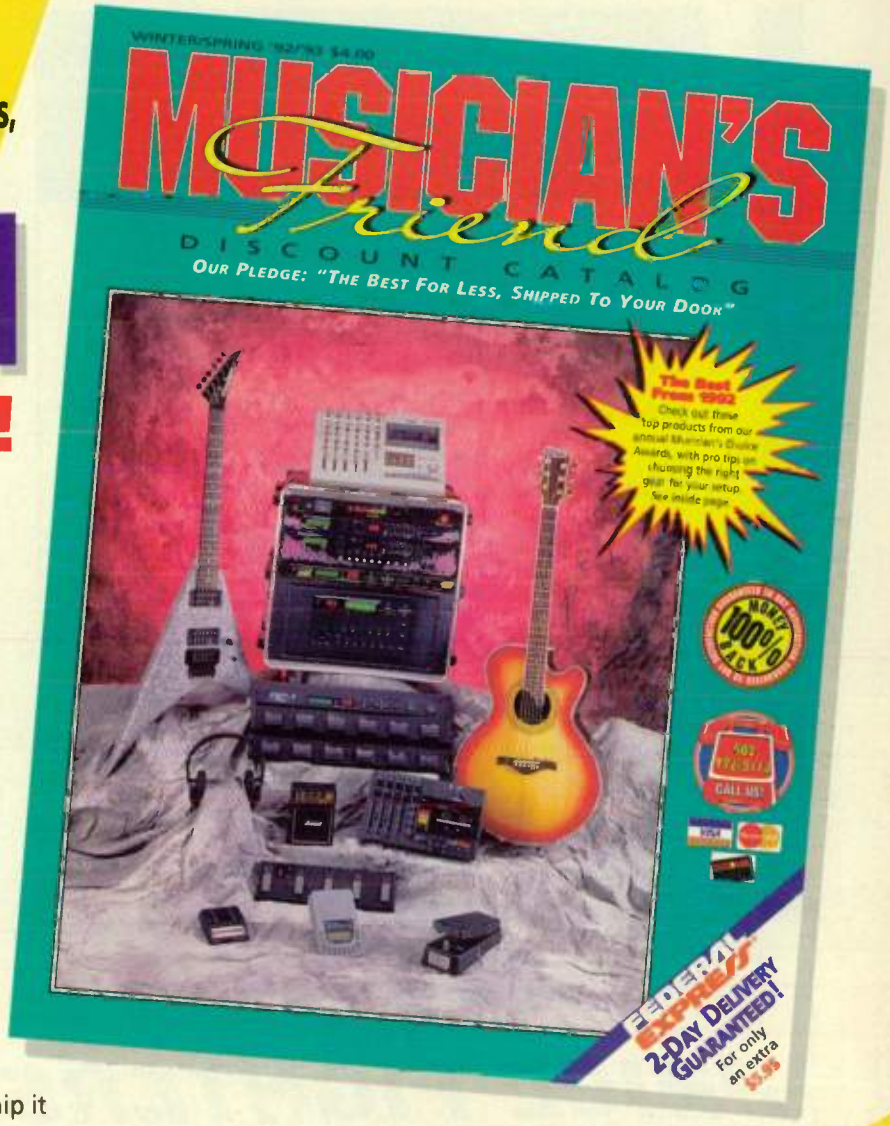

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● WR-S4416

and consistent feel that's reminiscent of the WRS-840 series.

The input section contains two switchable inputs. Input A is an electronically balanced XLR jack that can accept an input source ranging from -60 dB to +4 dB. Input B is an electronically balanced tip/ring/sleeve (TRS) jack that can accept input sources from -54 dB to +10 dB. We appreciated the flexibility of the A/B inputs, which greatly reduce the need for adapters when connecting effects processors and/or electronic musical instruments.

As is typical with compact boards, the channel insert is a single-point, unbalanced, TRS send/return. The majority of our equipment uses balanced XLRs, however, so we were forced into adapter hell. Obviously this board was designed for use with unbalanced signal processors.

Though we had no occasion to use it, each channel has a direct output that is assignable from the Aux 1 output (discussed later). With the myriad of effects processors used today, this is a very intelligent means of assigning channels to their own effects without burning up one of your auxiliary sends. Each channel also has its own 48-volt phantom power switch for the XLR input, a feature typically found only in much more expensive mixers.

The input gain control (trim) is a continuously variable rotary pot with a 64 dB range. The trim pot affects the A or B input, whichever is selected. We prefer the continuously variable pot over a stepped attenuator because "emergency" gain changes can be made subtly.

We had mixed feelings (no pun intended) about the 3-band equalizer section. The high-frequency band shelves at 12.5 kHz, which is useful for reducing sibilance or adding a bit of sizzle, depending on the application. The mid band is a sweepable peak/dip with a respectable range of 200 Hz to 6.3 kHz. The low band shelves at 70 Hz, which we found too low for applications such as reducing the proximity effect on vocals. For example, we needed to use the mid-range band to roll off the 200 to 300 Hz range on podium mics, which left the mids and high mids completely "exposed." A highpass filter or another band of EQ would have been useful. On the other hand, the 70 Hz low band is good for

adding low-end bump in music-reinforcement applications.

Channels are assigned to the subgroup section by pan-dependent odd/even assignment between groups 1 and 2, 3 and 4, and the Left/Right mix outputs. You can enable any combination of the three routings. Because the assignments are pan-dependent, routing channel 1 to subgroups 1 and 2 means that the channel signal goes to group 1 if the balance control is panned left, to group 2 if panned right, and to both if panned center.

The channel status meter section includes an On button, separate signal and peak LED indicators, and a pre-fader listen (PFL) button. An On/Off indicator light would be a nice addition, rather than the two-colored button; it's difficult to ascertain the channel status at a glance with the button.

Most other mixers of this type only have a peak/clip indicator (if anything); the WR-S4416's separate signal and peak LED indicators are great for setting input gains and quickly checking for signal without having to throw on the headphones and hit PFL.

AUX BUSES

The channels have four auxiliary sends. Aux 1 and Aux 2 are post-fader but are internally switchable to pre-fader via jumpers. Aux 3 and Aux 4 can be switched pre/post-fader as a pair.

The most innovative feature is the Aux 1 direct-output assign switch, which Ramsa calls "Aux Send Multiplier" (ASM). This switch allows you to use a channel's Aux 1 level pot to control the channel's direct output, bypassing the Aux 1 bus. This is useful for dedicating an effects processor to an individual channel—for instance, using a gated reverb on just the snare drum—without using up an entire auxiliary bus. The Aux 1 bus still is available to any channels not assigned to their direct output.

The four stereo auxiliary returns have single-point, unbalanced TRS jacks, with tip carrying the left channel and ring the right channel. The returns can be assigned to pairs of the four subgroups and/or to the Left-Right mix outputs in the same pan-dependent manner as channel/group assignments. For versatility's sake, it would be nice to be able to assign the aux returns to the auxiliary sends, too. That way, you could assign an effects return to a different send bus for use as a wet monitor send.

The four auxiliary send buses, the four subgroups, and the main mix buses all have PFL capability. We would have liked to see PFL on the returns in order to listen to just the wet signal return from an effects processor, but the signal can always be returned to an input channel if this is important.

SUBGROUPS

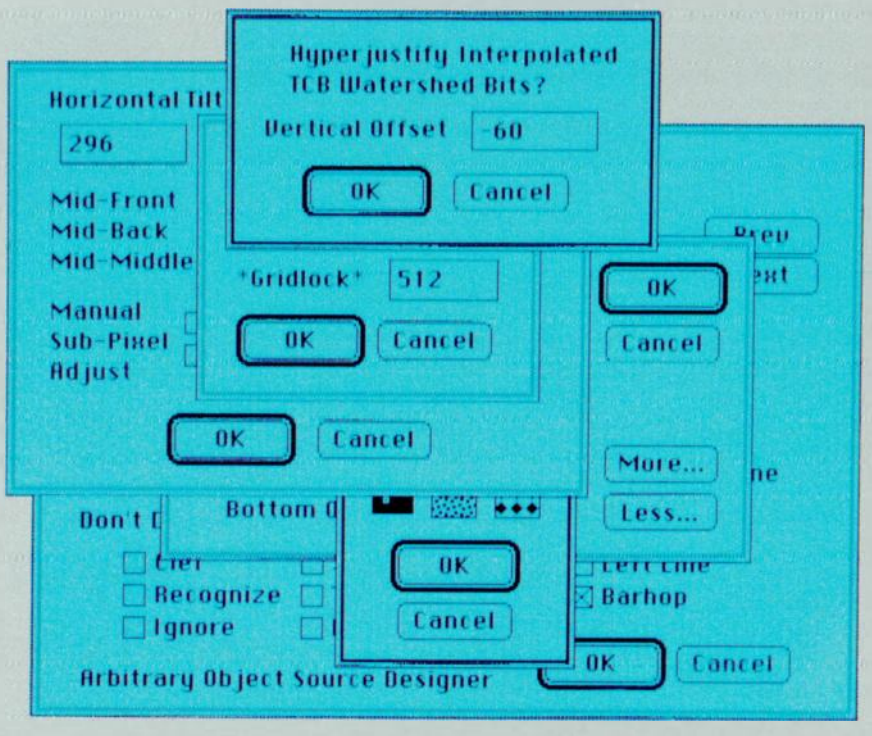
The four subgroups and the Left-Right mix buses all have an "On" button, which is great for muting the system without having to change fader settings or turn off individual mics.

The subgroups can be assigned and panned into the main mix outputs. The main mix buses have separate faders for independent control of the left and right outputs. We strongly prefer this to a stereo fader with a pan pot because we often drive our system in mono, using the left output for the main speakers and the right output for the subwoofers.

MONITORS

The monitor section derives its signal from the main mix outputs or the PFL. The PFL behaves as a Solo feature in the

Ramsa's WR-S4400 mixers are available in 12-, 16-, and 24-channel configurations.



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monitor section, overriding the mix output when any PFL is pressed.

There are separate level controls for the monitor output and headphone output, and a PFL level pot that affects both the monitor output and the headphone output. We were very impressed with the flexibility of the monitor section, especially the PFL level control, which saves the operator from having to turn down the headphone level whenever PFL is pressed.

OTHER GOODIES

The WR-S4400 mixers have a number of other nice features that make them an excellent value. First, the talkback section (yes, a talkback section!) was a pleasant surprise. When you're dealing with only sixteen channels, you don't want to burn up an input for a "God mic" (a mic for a director or producer whose voice seems to come from the heavens), or to talk to the musicians on stage.

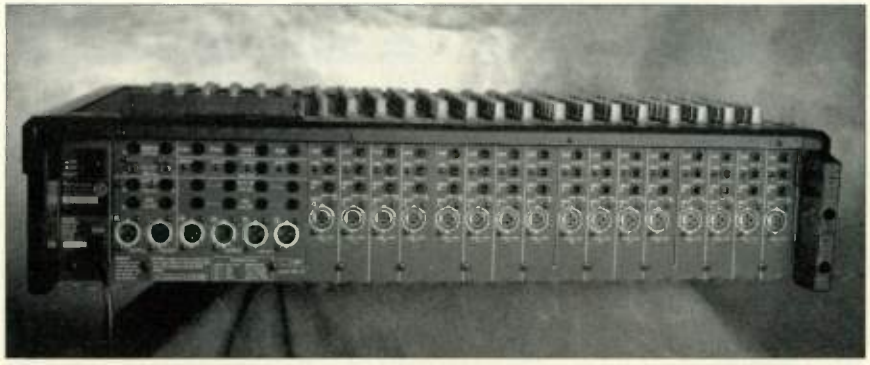
The talkback input is an unbalanced XLR on the face of the mixer and will accept any standard dynamic microphone. It can be assigned to all four subgroups as a whole, all four auxiliary sends as a whole, or the Left-Right mix outputs as a whole. The only drawback, which typically would not be an issue in sound reinforcement, was that the monitor output did not mute when talkback was engaged.

At the top of the output section is the sloped metering display incorporating six VU-response, 12-segment LED bar graphs. The first four bars are switchable between the subgroups and auxiliary sends. The last two are for the main mix outputs, but the right-mix bar graph automatically switches to a

Product Summary

PRODUCT:
WR-S4416 mixer
PRICE:
$2,395
MANUFACTURER:
Ramsa/Panasonic
6550 Katella Ave.
Cypress, CA 90630
tel. (714) 373-7277

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



Ramsa's WR-S4400-series mixers offer balanced XLR and unbalanced 1/4-inch inputs, TRS insert points, and direct outs on every channel.

PFL meter when any PFL button is pressed. We appreciated the slightly raised and sloped meters, which were easy to view when sitting at the mixer, thus eliminating the need for a cumbersome meter bridge.

The four subgroup outputs and the left-right mix outputs have electronically balanced XLR jacks; single-point, unbalanced, tip/ring/sleeve insert jacks; and unbalanced sub inputs that accept TRS or tip/sleeve plugs. The left-right mix buses also have RCA phono outputs for 2-track recording. The auxiliary sends and the monitor outputs all accept unbalanced TRS or tip/sleeve jacks. In general, the mixer has enough patching versatility for most applications.

CONCLUSIONS

We had two opportunities to use the mixer: at a series of business luncheons featuring keynote speakers with multiple video tape rolls, and at a series of entertainment evenings featuring gospel and gospel-rock performances. Both systems incorporated a flown Meyer sound system with subwoofers.

The business luncheons included a small lighting mixer that was set up next to the Ramsa. We were impressed with the solid grounding and the absence of interference from the lighting mixer and associated video monitors. We also needed to key our walkie-talkies right at the mixer, which induced absolutely no noise.

The mixer was quiet and clean, with no apparent crosstalk. Some appropriate "sound adjectives" would be "warm" and "transparent." Not surprisingly, the sound quality reminded us of the WRS-840 series mixers. The output section was flexible enough to drive a stereo pair of main speakers, subwoofers, and one set of delay speakers, while all the auxiliary sends were still available for video and audio recording feeds and monitor mixes.

For the money, the WR-S4416 offers an unmatched mix of quality and features. Bottom line: We *loved* it!

Lori Bolender *has been production manager at the San Francisco Hilton for four years. She previously did sound reinforcement with Pro Media for six years.* **Mike Cutter** *has been a sound engineer at the Hilton for three years and a recording engineer at OTR studios for seven years.*

Soundtrek The Jammer ProGenitor MusicSculptor

By Bob Lindstrom

The Jekyll and Hyde of algorithmic composition programs for PC-compatibles.

If computers are so smart, why don't they ever grab a synth and take a few choruses? They expect me to do everything on my own. I have to whack out the percussion tracks. I have to hammer down the keyboard parts. I have to pull the tunes and harmonies out of thin air. They can't even come up with one decent piece of counterpoint.

Two recently released programs for PC-compatibles prove that computers don't have to be dumb. Soundtrek's *The Jammer* and *MusicSculptor* from ProGenitor Software apply artificial intelligence and computer composition techniques to MIDI sequencing. Neither seems likely to transform your musical life, but they do demonstrate that computers don't have to be passive tape-transport clones.

THE JAMMER

It's a slow Sunday afternoon; nothing's happening. Suddenly, the creative juices start to flow. You leap to your synth, flick on the computer, and get ready to jam. But first you have to lay down a rhythm track, crank out a progression, and pile up a bass line. By the time you're prepared to play, the juices have dried up, and it's back to the Sunday funnies.

The Jammer is intended to rise to this occasion and immediately step out with changes, percussion parts, a bass line, and a comping rhythm part for those moments when you need a backup group. It isn't so important if they aren't the best sidemen in the world, they just have to be ready *now*.

Getting started with *The Jammer* is as straightforward as selecting one of over 100 musical styles and variations (Blueeasy, Easyrock, Hrokjazz, Funkrock, and other more cryptic 8-letter file names, as dictated by MS-DOS), punching in the number of measures you want in the first section, and hitting F7. The program automatically configures its instrument set, writes a chord progression, and creates backup parts.

If the results aren't to your liking, poke F7 and regenerate parts until you get the chords, bass, or percussion you want. And if you like the changes but hate the bass, *The Jammer* lets you leave the chords untouched and regenerate a new bass line, or vice versa.

When you have an accompaniment that works, *The Jammer* provides up to 232 additional tracks so you can sequence your own parts. Editing options are limited to some simple cutting and pasting, which is consistent with Soundtrek's commitment to fast execution at the expense of a complete set of features. You'll probably want to export your piece to another MIDI sequencer for polishing, but *The Jammer* will carry you far along the road to completion. And if innovation isn't an issue, the program's competent, if slightly bland, backups may get you to a fully realized score.

The Jammer's text-based user interface is designed to support rapid-fire progress through the program. Almost all

options are available in pull-down menus and are mouse-selectable, avoiding the numerical entry and guesswork that might stand between you and immediate results.

TRACKS AND MEASURES

Up to 256 tracks are available in the Tracks window (see Fig. 1). *The Jammer* reserves the first 25 for its own use, although you can commandeer them, too. In addition to a set of standard tape-transport controls, status lines at the bottom of the screen indicate the current style and mix (instrument setup), the number of measures, the current measure, and the time of day (a constant reminder that you have deadlines to meet, I guess). A menu bar provides access to the program's features.

Within the Track window are toggles to Solo, Mute, or Play each track. You can set the relative volume level of each track, change the relative Velocity values on each track (a good way to mix different parts on the same MIDI channel), transpose tracks, change the MIDI channel assignment, and read the number of clocks and bytes used by every track.

You'll spend most of your time using three main parameters for each track: Mode, Composer, and Style. The Mode parameter toggles between Comp, Erase, and Keep, allowing you to recompose, clear, or retain the selected track. The Composer parameter lets you choose between several instrumental techniques, including Bass, Rhythm (keyboard or guitar), and a variety of percussion (Kick Drum, Hi-Hat, Tom Tom, etc.). Selecting the Bass Composer for a track generates a single melodic line based on chordal notes. The Rhythm Composer pounds or arpeggiates chords, while the Kick Drum Composer slaps a punctuation from time to time. You needn't apply these Composers to the indicated instrument, which could lead to some interesting results.

The Style parameter summons a window in which you further refine the Composer setting. For example, the Style window for the Rhythm Composer lets you choose chordal or arpeggiated accompaniment; one-shot or repeated chords; and syncopated rhythms or rock-solid, beat-bound backups. The Hi-Hat Style window offers a range of options from constant, steady

hits to unpredictably staggered punctuation. The Style selections vary depending on the specified Composer, and *The Jammer* encourages you to experiment by mixing various options. This capability gives you a surprising degree of control over the complexity of the final result. All of the Composer and Style settings can be saved in a Style file for future use.

FIG. 1: *The Jammer*'s Track window provides controls and status information for the entire song as well as individual tracks.

The Progression track is the first of the 256 available tracks, and it determines the chords played by *The Jammer*. In this track's Style window, you select major or minor modes, time signature, chord types (jazz, pop, blues, breezy), chord progression types (monochordal, polychordal, or conventional I-IV-V), verse or refrain patterns, and the frequency of chord changes. As in all the Style windows, the options are simple and few but the interaction between multiple choices can get pretty complex.

The other major display in *The Jammer* is the Measures window. Here, chord names are displayed in their numbered measures. Besides letting you read the chord names while playing along, the Measures window allows you to edit or enter your own chord changes at any eighth-note position.

The menu bar provides a number of functions, including loading and saving Song and Style files, copying and deleting measures from the Song or individual tracks, and defining patch and drum-note assignments. You can select tempo, punch in and out of algorithmic composition and MIDI recording, and insert new measures into existing scores. Again, the limits are more numerous than the feature set, but they are all aimed at achieving ease of use over complex options.

JAMMED UP

My initial reaction to *The Jammer* was enthusiastic. Of all the "instant" music programs I've seen, *The Jammer* seemed best able to generate ear-pleasing, useful results in a number of utilitarian styles. The user interface is simple to understand and even simpler to use, and the interactive aspects of the program provide plenty of audible feedback.

As time passed, that first blush of enthusiasm faded a little. The program's bass lines started to sound a bit repetitive. The chord-clawing approach to keyboard accompaniments tended to be predictable. The percussion lines proved to be more reliable than imaginative. Everything embodied the blessing and the curse of conservative music-making.

Eventually, I realized I would rarely use *The Jammer* to unjam a creative block. I also realized that it serves a different purpose than *Band-In-A-Box*, to which it undoubtedly will be compared. Although *The Jammer* offers far more accurate control over chord placement and the complexity of each part, there are no data disks of ready-made song progressions, and generating short intros, breaks, and endings is not quite as direct. On the other hand, *BIAB* doesn't generate its own chord progressions.

While *Band-In-A-Box* makes it easy to practice playing existing tunes, *The Jam-*

Product Summary

PRODUCT:
The Jammer
PRICE:
$175
MANUFACTURER:
Soundtrek
3384 Hill Dr.
Duluth, GA 30136
tel. (404) 623-0879

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

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mer is a first-rate sketchpad that can hammer out some solid rhythmic foundations while you experiment your way into a chart-topping masterpiece. After the sketches are done, the serious musician probably will move to a more complete sequencer. I might use *The Jammer* to slap together some ideas or even drop its output unaltered into a noncritical music bed, but I wouldn't expect surprises or challenges. *The Jammer* is like a fellow musician whose chops aren't spectacular, but who's fun to be around, plays in tune, shows up on time, and doesn't drink all your beer.

MUSICSCULPTOR

On the other side of the planet is ProGenitor Software's *MusicSculptor*. ProGenitor makes some heady claims for this program, including the ability to "create entire compositions (not just accompaniments)" with its algorithmic and interactive composition tools.

This claim is true; *MusicSculptor* can create entire scores on its own. However, it takes a more indulgent audience than I've ever encountered to fully appreciate the generally "out" results that are likely to mark some of your initial efforts to use the program.

In fact, *MusicSculptor* is not a tool for the working mainstream musician. The program carries a copyright belonging to the University of North Texas and one of the two programmers is Phil Winsor, a UNT professor who has done considerable research in the field of algorithmic music composition. By and large, *MusicSculptor*'s output has considerable theoretical interest but little to charm the ear of the commercially gigging crowd.

After *The Jammer* had lulled my ears into middle-of-the-road euphoria, *MusicSculptor* came on like an audible cataclysm. The module that generates jazz-style scores spat out a mind-tweaking sequence of notes that recalled Zappa's *Jazz From Hell* album. The tunes were angular, the drum patterns were mechanical, and the harmonies were often dissonant and acerbic. The dissonant tunes and sudden brass outbursts from the New Age module are not the mellow music you might expect. In short, no matter what the manual or ads imply, chances are excellent that you won't be dropping any of *MusicSculptor*'s often quirky and surprising sounds directly into that music bed for the local used-car dealership.

After unsuccessfully struggling to discern any mainstream musical applications for *MusicSculptor*, I decided it was better to consider this as a piece of software that will help you explore the often untrodden and sometimes untreadable field of computer-music composition. In this context, *MusicSculptor* is an ingenious, intriguing, and sometimes captivating experimental tool for the musically adventurous.

FIG. 2: *MusicSculptor* provides the ability to copy and delete tracks, mute/play tracks, step-enter note data, and edit data in an event list.

WHAT IT IS

At its heart, *MusicSculptor* is a serious algorithmic composition program that generates its own pitches, controller messages, velocities, and so forth. It also can algorithmically alter MIDI data from any source. The program makes its decisions on a track-by-track basis using a number of techniques, including randomly selected values from a range, or weighted values from a statistical distribution.

▼

After *The Jammer* had lulled my ears into middle-of-the-road euphoria, *MusicSculptor* came on like an audible cataclysm.

Entire multitrack scores can be created in various musical styles by selecting autocompose modules from within *MusicSculptor*. Two modules—New Age and Minim—are provided with the program, while two additional modules—Jazzer and Serial—are available from ProGenitor for $49 each. Some of these modules generate scores of up to thirteen parts, each of which might use four or more synth voices, so you need some serious gear to hear everything.

When you select a module, *MusicSculptor* unloads itself, loads the module, executes the composition process, then reloads *MusicSculptor* with the generated MIDI data. The modules automatically generate all MIDI parameters of a score, including orchestration. ProGenitor notes that it is possible to program your own autocompose modules using any programming language and use them within *MusicSculptor*.

Without a lot of playing with the algorithmic muscle of *MusicSculptor*, your results are likely to have more cerebral than audible appeal. At first hearing, many of the program's creations are muddy and incomprehensible. In many cases, this can be fixed in the mix. It helps to use sample-based instruments with imitative sounds rather than synthesized textures. Start with the computer-controlled settings of the autocompose modules. Then spend some time fine-tuning the instrument settings and octave-transpositions of the individual parts.

When *MusicSculptor* needs a seed number to generate random values, it asks for one; no coy graphics, no mathematical dissertation. The onscreen "explanation" is vague and not very explanatory. If you *really* want to know, you can read Winsor's book, *Automated Music Composition* (UNT Press).

Graphic curves can be applied to MIDI continuous controller data by selecting one of the standard waveform patterns (sawtooth, linear, square), or by drawing your own. A curve librarian saves your algorithmic artwork.

MusicSculptor includes a simple MIDI sequencer with up to 60 tracks. The text-mode user interface lacks the convenience of a *Windows*-based sequencer, or even a polished text interface like

Cakewalk's. Unlike *The Jammer*, however, *MusicSculptor* provides the function and flexibility to bring full scores to completion without exporting to another sequencer. The program provides the ability to copy and delete tracks, mute/ play tracks, step-enter note data, and edit data in an event list (see Fig. 2). A virtual memory mode allows the playback of sequences that are too large to fit in RAM.

DRAWBACKS

The user interface is downright puzzling at times. Even though this is almost a compliment for algorithmic software (believe me, it can get *much* worse than this), the shifting patterns of menus and sometimes indecipherable names for functions make the learning curve long and steep.

Navigating through the user interface can be slow and cumbersome. Just muting a track requires that you click on the track to select it, then click on the mute button to call up a menu, and click on the menu to toggle between Play and Mute. Not only that, none of these operations can be performed while the sequencer is playing.

You probably think displaying a file directory when opening a file is standard procedure by now. Nope; when you try to load a file, *MusicSculptor* prompts you for the file name but doesn't tell you the names of the files you already have saved. If you don't have a good memory or a notepad full of file names, you're out of luck.

MusicSculptor's Standard MIDI File capabilities have a few serious bugs. My efforts to import Standard MIDI Files

Product Summary

PRODUCT:
MusicSculptor
PRICE:
$495
Introductory price $299
MANUFACTURER:
ProGenitor Software
PO Box 13916
Denton, TX 76203
tel. (817) 565-3185

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

inevitably resulted in rhythmic chaos as parts slowly pulled out of sync with each another. MIDI files exported from *MusicSculptor* (in both Type 0 and Type 1 formats) couldn't be imported to *MasterTracks Pro* or *Trax*. They either failed to load or crashed the system. Two tracks with identical note-on values would not play in sync with each other.

OUT

The Jammer and *MusicSculptor* almost could be called right-wing and left-wing music programs. *The Jammer* is conventional, conservative, and reliably dedicated to giving you more of the same. *MusicSculptor* is daring, full of promises, often impressively effective, and sometimes disappointing. In both cases, neither program performs quite as well as you hope it might. Gee, that sounds an awful lot like the current presidential election.

The Jammer and MusicSculptor could be called right-wing and left-wing music programs.

Both products come from relatively young companies and, as such, exhibit a certain lack of polish. The most notable example is in their documentation. In each case, the documentation contains a thorough rundown on the features of the product, but you'll spend a longer-than-normal amount of time trying to find information within their pages.

However, depending on your aesthetic orientation, you might find a welcome use for either of these products when you have a pressing need to get some MIDI data into a file. It's still true that if you want something done well, you have to do it yourself. But sometimes, if you just want something done, one of these programs can help accelerate the process.

Bob Lindstrom *is a composer/conductor and creative director of Dynamix, a computer-game publisher.*

Symetrix 425 Dynamics Processor

By Neal Brighton

The 425 is just what the dynamics doctor ordered.

Although multi-effects processors with reverb, delay, chorus, and other effects have been available for quite some time, compression, limiting, expanding, ducking, and gating traditionally have been handled by separate units. But these days, manufacturers are starting to combine these elements into products that make it a breeze to clean up less-than-perfect signals. One of the newest such units is the Symetrix 425 Dual Channel Compressor/Limiter/Expander.

THE UNIT

The Symetrix 425 provides two channels of powerful dynamics processing that would have cost an arm and a leg in years past. Each channel provides three dynamic processors in a serial configuration: The signal passes through a compressor, followed by a limiter and expander.

The 425 utilizes what Symetrix calls IDP (Integrated Dynamics Processing). A dynamics processor uses a VCA (voltage-controlled amplifier) to change the dynamic range of an audio signal. With IDP, Symetrix has integrated several dynamics processors so they share a single VCA. This reduces the amount of electronics required for each individual processor, making the product a lot less expensive to manufacture.

I was immediately impressed by the 425's ease of use. The unit has only three buttons: a bypass button on each channel and a button that links the two channels for stereo operation. But despite this simple interface, Symetrix didn't eliminate any important controls. With balanced XLR inputs and outputs in addition to unbalanced 1/4-inch inputs and outputs, connecting the unit to almost anything is a snap.

Like most multi-mode dynamics processors, the 425 has a sidechain input that enables the unit to function as a sibilance controller ("de-esser") or a ducker. Admittedly, there are better

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The Symetrix 425 provides two channels of dynamics processing, each of which has a compressor, followed by a limiter and expander.

duckers on the market, but the 425 can do the job in a pinch. For sibilance control, you need an external equalizer, but most home studios have some type of outboard equalization.

USING IT

The compression section has all the standard functions most engineers are used to: a compression ratio up to 10:1 with an adjustable release and threshold. The attack time is fixed at 200 ms. If you don't want the compressor to be active in the chain, simply turn the threshold control to Bypass. The limiter is permanently set with a 200 ms attack time and a ratio of 20:1, but it does have a variable threshold, which is all you need in a studio application.

I was quite surprised to find little bass coloration as I increased the compression ratio. Most units in this price range have a tremendous bump in the low end, but the 425 was clean and clear until I really started pushing it. I also appreciate the inclusion of an expander instead of a noise gate. In most multi-mode dynamic processors, I avoid using the gate because it's impossible to get a smooth sound. The expander on the 425 did a good job of eliminating headphone bleed, pops, coughs, etc. I also found it useful for cleaning up noises on lead guitar tracks.

Although I did not have the opportunity to use the 425 in a live situation, it certainly has all the right elements for this application. This unit would be perfect for live vocals. The expander would help reduce feedback problems, the compressor would deliver more punch to the audience, and the limiter would be perfect for vocalists who don't quite have their technique down.

The only weakness I found in the unit was the control pots. All of the pots are mounted on the PC board rather than the front panel. Consequently, the pots have a weak, floppy feel and may not hold up as well as the pots in the Symetrix 500 series gates and compressors. According to the company, this was a conscious design decision. Apparently, the inevitable physical shocks that all equipment endures on the road are distributed more evenly to the PC board, and the pots are less likely to break than if they were mounted to the front panel.

▼

I was immediately impressed by the 425's ease of use.

THE BOTTOM LINE

The Symetrix 425 is a great unit for the price. It offers a lot of dynamics processing for the dollar, and it is one of the cleanest-sounding units in its price range. The controls are simple to use but very effective. On top of all of this, its manual is one of the best and easiest to read that I've ever seen. All in all, it's a heck of a good buy.

Product Summary

PRODUCT:
Symetrix 425
Dual Channel
Compressor/Limiter/
Expander
PRICE:
$579
MANUFACTURER:
Symetrix
4211 24th Ave. West
Seattle WA, 98199
tel. (206) 282-2555

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

Dr. T's Interactor

By Robert Rich

Go interactive with this iconic, Mac-based music-programming language.

For over twenty years, Morton Subotnick has been composing music that stretches the boundaries of human-machine interaction. Many of his compositions require custom electronics, using software to track a performance while processing and augmenting the sounds of a live soloist. Dr. T's *Interactor* began its life as a tool developed for one of Subotnick's compositions. Its creator, Mark Coniglio of Interactive Music Systems, has since developed it into a unique graphic software environment optimized for building interactive performances.

Interactor joins a respectable list of music software designed to help composers stretch the limits of MIDI. The program resembles a high-level music-programming language, but it fills a niche left open by music languages such as Opcode's *MAX*, Frog Peak's *HMSL*, and Hip Software's *Hookup*. Like *MAX* and *Hookup*, it uses graphic icons to represent various musically related functions. By patching these icons together on your Macintosh screen, you can build custom MIDI applications and create some fairly complex performance setups.

Every creative tool reflects the influences of its designer, and *Interactor* is no exception. You hand over many creative decisions to the software, and its decisions color your sound. There's a great deal of flexibility built in, but not enough to be overwhelming. *Interactor* compromises between simplicity and versatility by giving you lots of programming muscle within well-defined parameters. It doesn't try to do everything; instead, it excels at real-time accompaniment and interactive MIDI performance.

OVERVIEW

Interactor follows a clear hierarchical structure. At the beginning of any

action, an Event must occur. *Interactor* only acts when it gets a stimulus, but stimuli can include more than just notes. You can program *Interactor* to respond to any MIDI message, to Macintosh key presses or mouse movements, to onscreen graphic controls, or to internal timing events.

To get *Interactor* to respond to an Event, you string together a number of Operators. *Interactor* supplies over 80 Operators, each of which performs a specific action when triggered by an Event. A collection of these Operators forms a Statement, which you read from left to right. Statements cannot branch or loop, but simply form a chain of actions.

To build complex actions you collect a number of different Statements together in a Scene. All the Statements in a Scene can operate at the same time. Typically, a Scene defines the musical behavior of *Interactor* at any moment. Scenes can jump to other Scenes automatically, thus changing the personality of the program. You also can call an entire Scene as a subroutine. A Scene Group is an ordered list of one or more Scenes. A Document can hold up to eight Scene Groups. While only one Scene in each Group is active at any time, all the Groups in a Document can be active at once.

You work with *Interactor* in one of two modes: Edit or Performance. *Interactor* opens its documents at the top of the *Interactor* hierarchy, in Edit Mode, showing you its Scene Group window. From there you can start editing a Scene by opening up the Scene Edit window, or you can enter Performance mode. In Performance mode, *Interactor* shows you its Controls window, which provides an assortment of interfaces including text fields, sliders, knobs, indicators, and pop-up menus. Of course you must configure these controls in Edit mode before you can do much with them in Performance mode.

DIVING IN

To create an *Interactor* Performance, you must navigate an assortment of windows in Edit mode. Most of the editing happens in the Scene Edit window (see Fig. 1), where you build strings of Operators and tell them how to behave. Other edit windows are called up when you need them by selecting them from the Mac's menu bar.

To start building a Statement in the Scene Edit window, you grab some Operators from the Operator Select window (see Fig. 2). The Operators come arranged in categories, but you can rearrange them as you wish.

Operators come in two main types—Conditional and Action. A Conditional Operator tests whether a certain range of events occurs. If the desired event occurs, it passes a "true" to the next Operator in the Statement; if not, it passes a "false." An Action Operator performs a task whenever it gets a "true" message and sends a "true" down the chain. If a "false" occurs anywhere in the chain, the Statement stops operating until the next event kicks it into action. Usually you want to start a Statement with a Conditional Operator so that only certain events make the Statement execute; if you don't, the Statement will try to execute once every timing cycle, which occurs 1,000 times per second.

If you want an Operator to execute only once, you can assign a flag telling

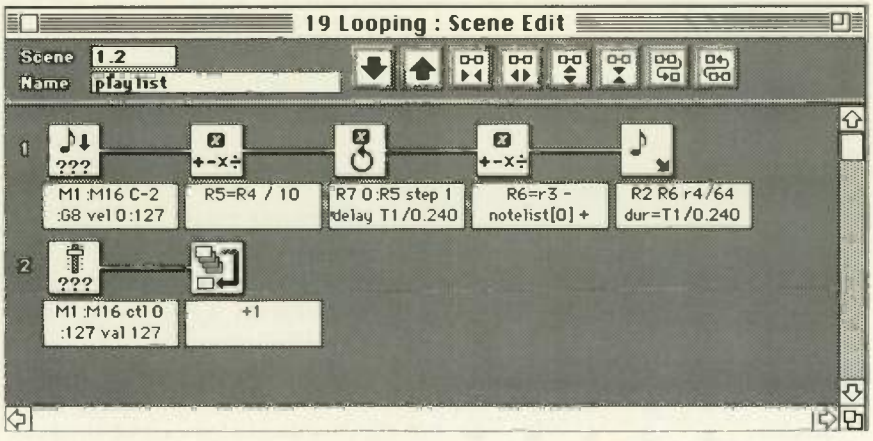


FIG. 1: *Interactor*'s Scene Edit window, showing a Scene with two Statements. Here you build strings of Operators and tell them all how to behave.

it to return "false" after its first execution. The next time around, the Statement will stop executing as soon as it hits that Operator. You also can assign a flag telling it to remain "true" after the first pass; the next time around, the Statement will skip that Operator and execute the next one in the chain. These flags are useful if you want *Interactor* to send setup commands to your MIDI rig at the start of a performance, or if you need to initialize some internal settings.

Interactor supplies too many Operators to list in this short review, but here's a summary. Conditional Operators include tests for any type of MIDI message, Mac input from mouse or keyboard, timing event, or movement of onscreen controls. Other Conditionals work within *Interactor*, testing for numerical relationships between variables or matches within lists of values. *Interactor* also provides some logic Operators, which let you build if-then-else statements. Action Operators can send all sorts of MIDI messages, including SysEx; play, record and modify sequences; interact with any of the eight Timebases used to keep tempo; read, store, and modify any of the variables; perform a range of operations with Lists; and write messages to the Controls window to let you know what's happening or provide instructions to a performer.

By double-clicking on an Operator, you gain access to one or more text fields that define the Operator's behavior. You can enter data into these fields via MIDI as well as from the Mac. Operator fields can hold both constants and variables. A constant can be a number, a symbol (C3 instead of 60), or a simple mathematical expression (C2+12 instead of 60). *Interactor* provides some built-in symbols, such as note names, but you can define other substitutions in the Symbols window if you want. (If you're a programmer, think of the Symbols window as a way to define global variables. In fact, *Interactor* always uses global variables, which contributes to its excellent speed performance.)

Interactor refers to its variables as Registers, and provides 112 of them. The program reserves the first four Registers, R1 to R4, to catch the essential parts of an incoming MIDI message. For example, if the message is a Note On, these Registers will store the message header, channel, note number, and velocity. You can create expressions with Registers (e.g., R4+7-R9), but these expressions can't get very complex.

LISTS AND TRACKS

The Lists window gives you access to one of *Interactor's* more powerful features. Lists hold strings of generic values that *Interactor* can apply as gestures, note values, mathematical constants, or whatever else you like. You can display and edit List values graphically, numerically, as MIDI note names, or in hexidecimal (see Fig. 3). You can type values in by hand, draw them with the mouse, or record notes or gestures directly into a List by playing a MIDI controller. Once you have entered these values, you can use them for anything. For example, you might grab numbers randomly from a List to generate Velocity messages while reading the same List backward and forward to generate pitches. You could also examine a List for values that match incoming MIDI notes, using those values to locate a performer's place in a score while playing an accompaniment from a sequence.

Interactor's Tracks window lists all the Tracks currently in the Document. *Interactor* imports, records, and exports Standard MIDI Files and holds up to 256 sequencer tracks in memory. One Interactor Track can hold sixteen channels of MIDI data, assignable to either the modem or printer port on the Mac. *Interactor* cannot yet speak directly to multiple-output MIDI interfaces such as Opcode's Studio 4 and 5 or Mark of the Unicorn's MIDI Time Piece I and II, but it can use Apple's *Patch Bay* and *MIDI Manager* programs to assign

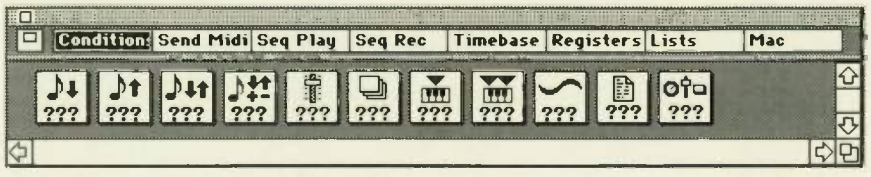


FIG. 2: The Operator Select window, showing a choice of Conditional Operators. The Operators come arranged in categories, but you can rearrange them as you wish.

outputs to these interfaces.

Interactor provides eight Sequence Players. Each can play one sequence at a time from the 256 available. All Sequence Players can run simultaneously using up to eight different Timebases. Timebases have a resolution of 480 ticks per quarter note and can change tempos independently. Unfortunately, the current release of *Interactor* does not allow you to sync any of its clocks to an external source like MTC or SMPTE; however, future releases might include this feature.

This program offers a variety of ways to modify sequence playback beyond changing tempos. You could, for example, scale the note Velocities of a Track with a continuous controller while the Track plays, or use a List to generate note transpositions. You can use such tools to conduct and mix a live performance, or to build applications resembling Dr. T's *M* or *Jam Factory*, which perform random and cyclic modifications on prerecorded material.

To get the most out of an interactive application, you need good performance controls. *Interactor* lets you configure your own user interface in the Controls window (the same window you see in Performance mode). You can assemble an array of sliders, dials, toggle and momentary buttons, pop-up menus, text fields, and status indicators, most of which can respond to incoming messages and send messages of their own.

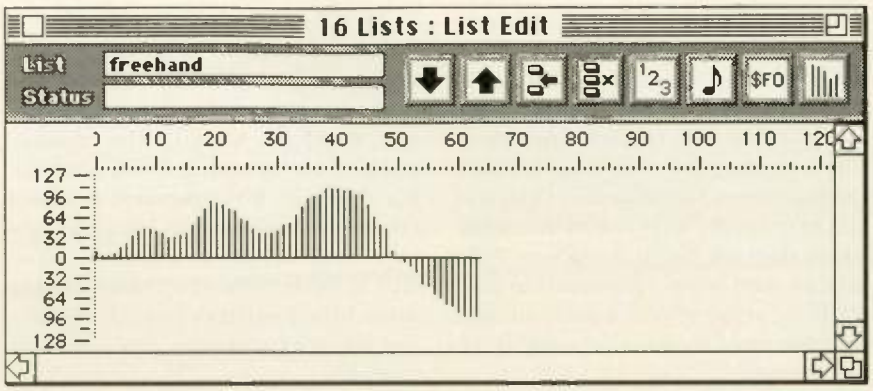


FIG. 3: In the List Edit window, you can display and edit List values graphically, numerically, as MIDI note names, or in hexidecimal. Lists hold strings of generic values that *Interactor* can apply as gestures, note values, mathematical constants, etc.

The default window provides message fields that tell you the status of Sequence Players, active Scenes, and all eight Timebases. Double-clicking on a control opens a window that lets you define the control's type (slider, field, etc.), what it responds to, what it sends, its range, and the font it uses for its display. These controls are flexible enough to let you build a SysEx editor with knobs and sliders, conduct an orchestra of Sequence Players, instruct a performer with running commentary, or do any number of strange things to the parameters of an *Interactor* Scene.

IMPRESSIONS

Interactor succeeds in providing a flexible and intuitive programming environment. It bears the marks of an elegant tool, developed by people who use it. Like any language, however, *Interactor* has a fairly steep learning curve. This program won't do much for you right out of the box. Luckily, the manual is very good (despite having lots of typos), with almost 100 pages of tutorials. Working through these tutorials is the best way to learn *Interactor*. In fact, the tutorials contain some information you won't find elsewhere in the manual.

Naturally, *Interactor* has a few weak spots. The fact that it only works with integers puts limits upon its mathematical abilities. For example, you can't use a trigonometric equation to generate wobbly, periodic, pitch-bend curves. You can do this sort of thing fairly easily in *MAX* or *HMSL*. (You could use *Interactor*'s Lists to compensate somewhat for this weakness by drawing a complex curve in the List, then scaling it as needed for output.) Furthermore, each Operator has only one input and one output, preventing you from branching or combining Statements. Because the chain of events only moves from left to right, you can't build feedback loops or other dangerous but interesting chaotic structures. Although these features sound a bit esoteric, their addition might make *Interactor* as well-suited for algorithmic music as it is for interactive accompaniment.

Among the more mundane improvements, *Interactor* could benefit from the ability to synchronize its Timebases to MIDI Clocks or MTC. Also, *Interactor* responds slowly to the Mac keyboard during performance. This slight time delay makes it difficult to trigger events or sequences from the Mac; instead, you should trigger them via MIDI. In most other respects, *Interactor* is lightning-fast. Author Mark Coniglio says he's trying to improve *Interactor*'s response to Mac events, and he's also adding MTC compatibility, so hopefully both of these complaints will be moot by the time you read this review.

When I first saw *Interactor*, I thought the simplicity of its left-to-right linear patching structure would prove limiting compared to *MAX*'s flexibility. In fact, this structure lends itself to efficient and relatively trouble-free programming. If you want to modify the playback of a sequence, perform pattern-recognition or random permutations of musical phrases, record and control loops and arpeggios in real-time, or

Product Summary

PRODUCT:
Interactor MIDI programming language
PRICE:
$279
$249 for registered users of Dr. T's programs
REQUIREMENTS:
Mac Plus or better with System 6.0.3 or later; System 7.0-compatible (but not 7.0-savvy); 1 MB RAM; hard drive
MANUFACTURER:
Dr. T's Music Software
124 Crescent Rd., Suite 3
Needham, MA 02194
tel. (617) 455-1454

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

otherwise employ your Mac as a performance companion, you won't find a better tool than *Interactor*. Furthermore, because of *Interactor*'s programmability, the boundaries between what it can and can't do are by no means fixed; a lot depends on your facility with its patching language.

The more I work with *Interactor*, the more I like it. It's an elegant and easy-to-use live-performance programming language. Rather than trying to do everything imaginable, it tackles a well-defined range of tasks in an integrated and intuitive environment. The designers of *Interactor* did their best to make editing as simple as possible without sacrificing depth or flexibility. It continues to surprise me with its almost clairvoyant, musically useful features. *Interactor* is a refreshing piece of software.

Robert Rich *plays electronic music. He wants you to unplug your TV, question authority, fight censorship, love someone, stop consuming junk, and make glorious noise.*

Yamaha DTS70 Drum Triggering System

By Larry "the O" Oppenheimer

Acoustic percussion takes another step into the MIDI world.

Even though the drum preceded the keyboard by thousands of years, development of sophisticated percussion controllers has lagged far behind that of keyboard controllers. After Bob Moog's percussion controller, there wasn't much to report until Simmons introduced their pads and accompanying brain-dead synthesizer.

In the last few years, things have improved. A few systems, especially the KAT drumKAT, perform great triggering and processing feats. But most of the available products still miss the point: Drummers want to trigger synthesizers and samplers from their drums and pads, and they need the same level of system control offered by master keyboard controllers.

Yamaha, who makes drums, synthesizers, and trigger pads, seems a likely candidate to understand this need, and the DTS70 is the company's first attempt to respond. In two rackspaces, the DTS70 packages twelve trigger inputs with processing; twelve fast, analog trigger outputs; and a MIDI input that can be merged with the two discrete MIDI outputs. Its MIDI capabilities go well beyond basic "one trigger-one note" functions and provide master-controller functions such as transmitting multiple program changes for a single received program change. Unlike other systems, the DTS70 works with whatever kind of pad, pad-controller, or trigger you prefer.

PHYSICAL LAYOUT

Physically, the DTS70 is uncomplicated. The rear panel has two rows of trigger input and output jacks, with a 3-position Level-Select switch over each input. Above the MIDI In, Out 1 and 2, and Thru jacks are three 1/4-inch jacks for footswitch control of program change, increment and decrement, and bypass. A 3-wire, non-detachable (sigh) power cord completes the back.

The front panel is highlighted by an 80-character LCD and a 2-character LED program-number display. A typical button selection is underneath: data increment/decrement, cursor control, Page Up/Down, Mode Select, Edit Compare, and power. A MIDI In connector (which disables the one on the back) and a MIDI Out (a split of MIDI Out 1) are conveniently placed on the front panel. It's pretty straightforward.

SETUP

Connecting triggers and MIDI sound modules to the DTS70 is too obvious to describe, so I'll start with parameter setup. The Level Select switches serve as a first line of defense in accommodating the wide range of levels received from the variety of acceptable inputs (pads and different drums).

Triggering from drums is much trickier than from pads, because drum acoustics are complex. False triggering is the highest hurdle to overcome, and the DTS70 has three parameters to deal with it. Self Rejection is the time period the DTS70 waits after the initial strike before recognizing another strike. Although this parameter is

primarily intended to eliminate accidental bounces, it also is usable as an effect, as it can extend to 400 milliseconds. Other Rejection is adjusted to keep an input from being triggered when a nearby drum is struck. The wild melee of vibration that occurs at a drum hit can make it difficult to get an accurate level reading; the Wait setting determines how long the DTS70 waits after the initial strike before trying to read the level of the input. The Gain parameter allows you to fine-tune input levels in software.

Optimal setup of these parameters can be a chore. Typically it requires a lot of experimentation with values and observation of the interactive effects. Yamaha provides several aids to reduce the "futz quotient." The Autoset function lets the user choose from one of five input types (pad, snare, high tom, low tom, and bass drum); the machine then requests that the pad or drum be struck three times. The DTS70 sets the trigger parameters to its best guess at optimal values; you can then adjust them manually, as needed.

In the Trigger Learn mode (which must be enabled for the Autoset function to work), striking any pad or drum connected to the DTS70 immediately selects it for editing. The input level is displayed as a percentage of the full range, along with the current switch and software-gain settings. It's a handy little time-saver. I tend to tune my drums low and leave them fairly ringy, but the Autoset function gave me reasonable starting points every time.

TRIGGER PLACEMENT

Trigger placement and processing are not exact sciences, so reviewing a product like the DTS70 demands consideration of several possible trigger-placement methods to evaluate the effectiveness of the processing. I had spotty luck mounting the triggers directly on the drum heads, as Yamaha suggests, because firm mounting required damping the head more than I found musically desirable.

This problem is not a concern if you are using acoustic drums merely for triggering in the studio and not acoustically, but I used them in live performance for both purposes. Shell-mounting gave better results, although I still had to spend a good bit of time moving the triggers and massaging the trigger-processing parameters before I got something consistently usable. The effort I had to expend was not due to any shortcoming of the DTS70; it's simply the nature of the beast. Perhaps future systems will have even more sophisticated detection software.

MIDI CAPABILITIES

The twelve analog trigger outputs are for triggering older, pre-MIDI equipment, or samplers and drum modules that accept analog triggers. Unfortunately, because they don't go through any of the digital circuitry, the Bypass function has no effect on them. In fact, there is no way to disable these outputs, either collectively or individually, which is most unfortunate if you only want to trigger from your drums at certain points in a performance.

However, it is likely that more people will make use of the DTS70's substantial MIDI capabilities anyway. As if to make up for the lack of trigger-out bypass, a software bypass offers the ability to disable all MIDI output, a functional duplication of the Bypass footswitch jack.

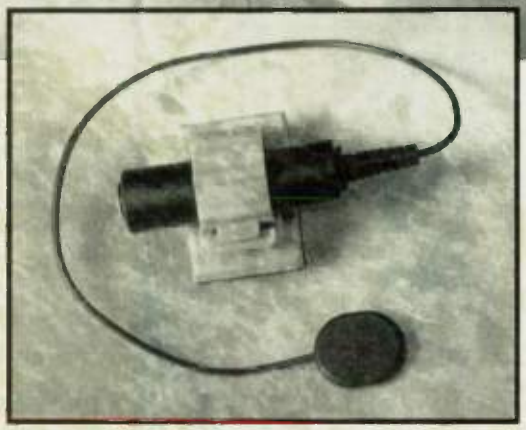
The DTS70's two MIDI Outs carry discrete datastreams, giving it 32-channel operation. For each input, the DTS70 lets you set the MIDI note that will be sent (displayed by note number as well as name), the channel and port over which it is to be transmitted, and the gate time (length) of the note sent for each trigger. The maximum gate time of five seconds should be fine for virtually all applications, with the exception of very long samples or synthesized sounds. I usually like to set up one or two pads for long sounds and would love to have a longer gate time,

Product Summary

PRODUCT:
DTS70 Drum Triggering System
PRICE:
$945
MANUFACTURER:
Yamaha Corp.
6600 Orangethorpe Ave.
Buena Park, CA 90620
tel. (714) 522-9011

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

Yamaha's DTS70 drum trigger system offers advanced MIDI master-controller functions and provides twelve trigger inputs with processing, twelve analog trigger outputs, and a MIDI input that can be merged with the two discrete MIDI outputs.



PETER DIGGS

The DTS70 can be used with Yamaha's optional DT-10 triggers (above), or with whatever kind of pad, pad-controller, or trigger you prefer.

but for most applications, five seconds is plenty. (If you want to use longer samples, you can set your sampler so the entire sound triggers from one Note On. With a synthesizer, you can use the sustain pedal.)

The MIDI Learn function simplifies mapping of inputs to MIDI outputs by enabling the DTS70 to "listen" to the MIDI In and set the note and channel to match an incoming MIDI note. Thus, assigning an input to a drum machine sound is as simple as striking the drum or pad and then pressing the button on the drum machine for the desired sound. (This assumes that the drum machine sends note messages when you play its buttons.)

Three parameters deal with velocity. One sets upper and lower thresholds for the input range. Any incoming trigger with a level within this range (e.g., more than 20% and less than 90% of full range) will generate a note. The second parameter sets the available range of outgoing note velocities, and the third selects one of seven velocity curves. I found these parameters to be useful selections, with a value that worked well for every kind of sound I tried to trigger. Another nice touch is the display of velocity value output for each strike.

Multimode allows each input to generate more than one output note. When set to Stack, every strike on that input produces up to four simultaneous notes, each with its own note number, channel, and port. Chords or component synthesis (where a composite sound is created from several component sounds) are created this way. The Xfade setting sets a velocity crossfade of two to four notes each, again, with separate parameters. The Alt setting steps through the four notes as a minisequence, each strike sounding the next note. A Multi Parameter Copy function lets you set up all the parameters for one note and copy the entire parameter set to the other three notes. The machine can automatically set up a velocity crossfade for any combination of the four notes.

Multimode is one of the master controller functions that sets the DTS70 apart from a simple trigger-to-MIDI box. I could have used more than four steps in the Alt setting, but with twelve inputs, I can accomplish what I need by using another input for more notes. I obtained a nice velocity layering effect (as opposed to a velocity crossfade) by making a stack of two sounds and setting the low threshold of input range to about 65%. When I struck the drum softly, I got one sound; when I hit it hard, I got both.

If twelve inputs are not enough for you, or you want to add continuous controllers, the DTS70 can merge

● **DTS70**

MIDI In with the internally generated data and spit the combination out either port.

It would be nice to have one or two jacks that accept continuous controllers or footswitches and convert them to MIDI, but perhaps Yamaha doesn't think drummers need them. I disagree: I like to control effects parameters such as wet/dry mix, delay regeneration, and reverb time from footpedals or sliders, and I sometimes need volume-pedal control for fades. The merge function at least makes it possible to do this as long as you have another unit to do the controller-to-MIDI conversion. Because there is a MIDI In and trigger outputs on the rear panel, it also would have been useful for the DTS70 to work as a MIDI-to-trigger converter, but I suppose you can't have everything.

PERFORMANCES

Another excellent system control feature is the DTS70's ability to generate up to 32 separate program changes—one for each channel on each port—each time you select a Performance (complete trigger and MIDI setup for all twelve inputs).

There are 48 Performance memories, and four ways to select them: from the front panel; via footswitches or pads plugged into the Increment/Decrement jacks; the Special Function Pads feature, which turns inputs 10 to 12 into Bypass, Increment, and Decrement triggers; or an incoming MIDI Program Change. Incoming Program Changes can be mapped arbitrarily to Performances, and Performances can be linked into up to 32 Chains of 32 steps each. In Chain Play mode, increment/decrement functions step through the Chain.

CONCLUSIONS

All in all, the DTS70 is filled with useful features and performs as advertised. Even if you already have an Octapad or similar pad-controller, the Yamaha system's processing power makes it a good supplement.

Like any advanced piece of gear, it takes time to get the DTS70 programmed, in addition to the time spent getting the triggers placed well. But it certainly is time well-spent, allowing drummers to bring to their electronic instruments the sophistication they richly deserve. ●

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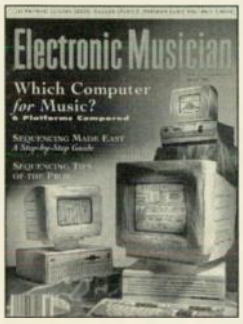

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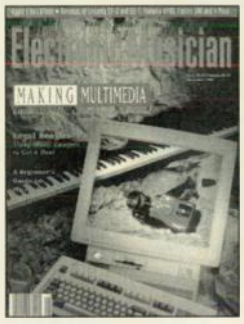

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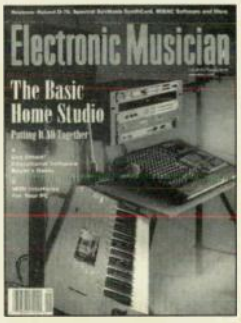

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PRO FILE

Vocal Compression

Irreverence and Intimacy à la INXS

By Michael Molenda

"It sounds horrible!" exclaimed **EM** art director Andrew Faulkner, reacting to the brutally compressed vocal on "Heaven Sent," the premiere single from INXS' *Welcome From Wherever You Are* album. "Michael Hutchence has such a great voice," Faulkner continued. "Why would they mess him up?"

Faulkner's reaction was rather funny, considering his personal artistic vision routinely butchers stock images into arcane collages. Manipulation of known quantities into unique permutations is the fearless tradition of the creative arts. Picasso embraced this, as did Chuck Berry. And in today's pop music genre, bloated and fat with marketing niches and gelded playlists, it never hurts to shake things up a bit.

"We tried to break as many rules as possible," confessed producer Mark Opitz, who directed the mayhem of *Welcome From Wherever You Are*. "It was essential that the album possess a certain organic character—I call it 'true grit'—and passion took precedence over sonic quality. After all, we didn't make this record for other engineers and producers."

On "Heaven Sent," Hutchence's tortured vocal sets the tone for the album's gritty swagger. Opitz toured with INXS for a year, preparing and motivating the band to cut tracks with the relentless fury inherent in their live shows.

To ensure an explosive performance, Hutchence was recorded live with the entire band in the control room (minus the drummer, who was shuffled off to a proper studio room for isolation purposes), listening to huge monitor speakers at tremendous volumes. The vocal on the record is the first take. ("We weren't concerned about other instruments bleeding into the vocal mic," Opitz admitted.)

Hutchence's voice was recorded with a Beyer M88 microphone, then routed through the onboard compressor on a SSL Series G console. The vocal's gnarled timbre was produced by setting the compression ratio at 20 to 1, with a fast attack and release. Further sonic damage was added by recording the voice with *telephone EQ*: Midrange frequencies were boosted drastically, and bass tones were rolled off.

"Believe it or not, I would have preferred the vocal with even harsher EQ and buried even deeper in the mix than what ended up on the record," stated Opitz. (*Welcome From Wherever You Are* was mixed by Bob Clearmountain.)

Ballads were treated more conventionally, and the silky resonance that bathes Hutchence's crooning on "Beautiful Girl" illustrates the versatility of compression.

Hutchence sang the sparse ode to a runaway waif through a Neumann U87 microphone (sans pop shield) routed into a Summit Audio TLA100 compressor. Because the TLA100 is basically an in/out device that reduces gain by 2 or 3 dB, the compression effect is very subtle. Placing Hutchence in a "dead" vocal booth and having him sing close to the mic produced an intimate quality that sounds as if the singer is whispering into one's ear.

"Sonically, we really tried to evoke 1960s 'album rock' productions that offered continuous listening experiences," said Opitz. "The last thing we wanted was an album with two huge hits and a bunch of other songs tossed in."

INXS (vocalist Michael Hutchence at center)

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