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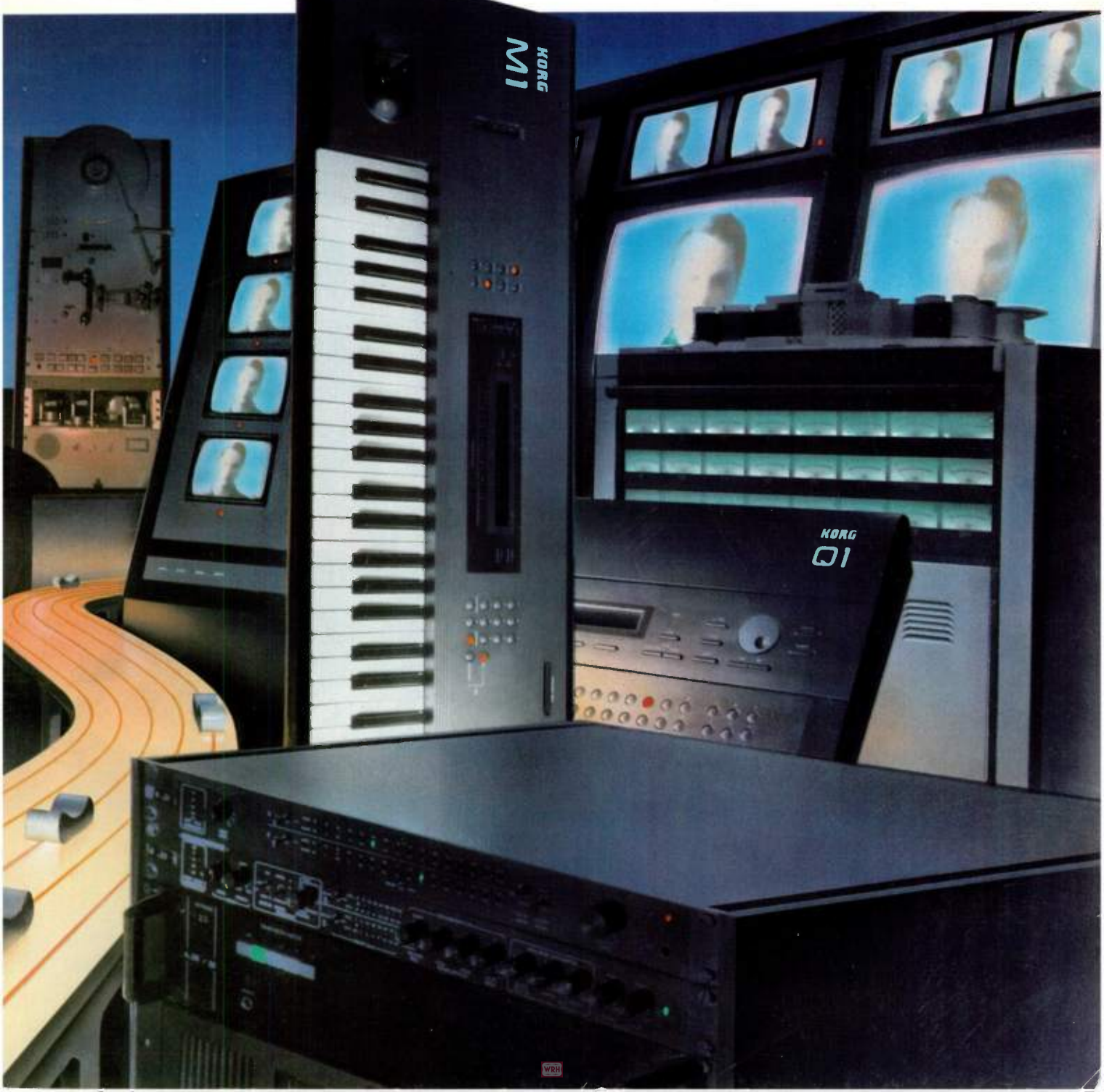

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VOL. 4, NO.6 JUNE 1988

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A MIX PUBLICATION

## DEPARTMENTS



## COVER

This issue looks at how to translate music from your imagination into something tangible—whether via analog tape, digital sequencer or a combination of both techniques. Our cover symbolizes the breadth of today's technology, as well as the multiple facets of today's hybrid studio. Equipment courtesy of Bananas-at-Large, San Rafael, CA and Computerland, Oakland, CA. Photograph by David Bishop.

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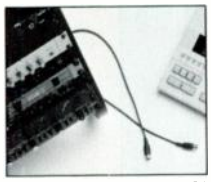

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### DO-IT-YOURSELF



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### REVIEWS

# Editor's Note

Every now and then it happens: you buy a piece of gear that's a lemon, or does strange things, or contains bugs. In fact, we get a reasonable amount of letters from readers who are unhappy with a product for one reason or another. Usually these letters take the form of a diatribe against the manufacturer, and end with a plea for help ("you have a lot of influence in the industry, solve my problem").

Although our goal here is to put out a magazine, I must admit that I often get in touch with these readers to find out a bit more about the problem, and to see if I can indeed help. What I generally find, though, is that many times these unhappy customers have failed to take advantage of the avenues available to redress their grievances. Usually my first question is, "have you talked to the manufacturer?", and you'd be astonished how many times the answer is "no." The music industry is a small industry, and companies need to have good word-of-mouth support. They are very sensitive to the fact that unhappy customers create serious damage to a company's credibility, and often a call to a customer service person is all it takes to clear things up. Call, don't write, as you'll seldom provide enough information in a letter for the company to properly diagnose your problem; you'll probably need to answer questions about other elements in your system, the revision level of the gear in question, and so on.

Remember, too, that the people at the other end of the phone (or mail) are generally proud of their work and have feelings, too. Coming on in a hostile manner won't encourage them to be cooperative, especially if the problem ends up being due to operator error. Patience and understanding will get you the desired results much faster than yelling and threatening.

I'm also amazed at how many people fail to send in warranty cards for equipment they've bought. Warranty cards provide a very important function—should any major bugs be discovered, you'll be on the company's mailing list and will often be notified of these problems. Also, many companies offer free updates, but only to registered owners. A warranty card is like an insurance policy, and all it costs is a stamp and a couple minutes of your time.

But what happens when the customer support people are nasty, the company is fraudulent, and there's nowhere to turn? Call your Better Business Bureau and ask for advice. Mail-order operations in particular operate under very strict federal guidelines, and if those guidelines have been violated, you may be able to initiate a suit to recover your losses (or maybe even start a class-action suit to put the company out of business so it won't take advantage of others). Also, be sure to write us if you have any problems with particular companies. Due to the magazine's long lead time, most fraudulent operators would be long gone by the time any notice could appear in print, but every now and then we have an opportunity to catch some of these people and put pressure on them.

One final note: *always* contact the manufacturer first before sending your complaints to us. We're *deluged* with all kinds of mail here; while we happily read every letter that comes in (your feedback is invaluable), answering requests to intervene with a company on someone's behalf has to take a much lower priority than getting copy and artwork ready for next month's issue. We'll help when we can, but EM is definitely the court of last resort.


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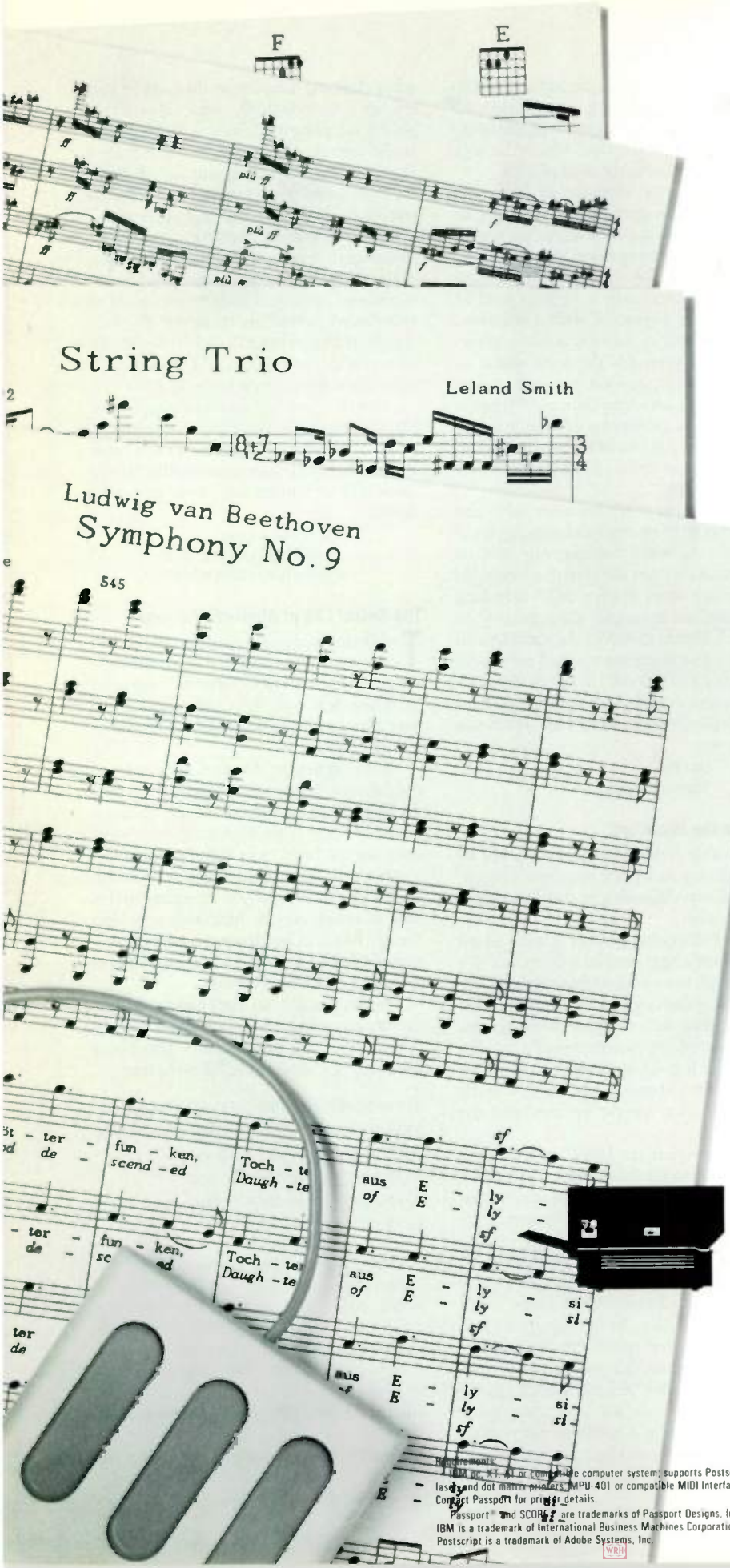


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### Sequencers are Instruments Too

I am writing this letter for three reasons. I agree with your response to Bob Walker's letter *(March '88; the letter essentially said that programming "feel" into a composition is no substitute for instrumental virtuosity—Ed.)* and would like to ask him a question. Bob, if you do not sit around dreaming up riffs, then where do you get them? Copy from your favorite artists? Riff-of-the-month club? The point is not whether you can play the riff on an electronic keyboard (synthesizer) or an electronic keyboard (computer). I work as a 40-hour-a-week lab technician for a local university and also attend school full-time working for my M.S. in biology. I will start working on a PhD program this fall. This does not leave me much time to "shut up and play." I have very little time for practice of any type, but when I have time, then I can compose something on the computer far faster than I can practice something over and over on an instrument. Then I can go back and learn my part later. Also, my first instrument is an acoustic guitar and I haven't the funding yet to get it "electronified." I only started playing a synthesizer about two years ago and my chops aren't up to non-quantization yet. But I practice when I can. So please keep in mind, Mr. Walker, that the feel comes from the heart and the head, not the instrument.

The second part of this letter is to let Robert Carlberg know that I am in complete agreement with his column in the same issue concerning the dearth of progressive rock music. It is hard to accept that the music he describes is gone for good (except on well-worn tape) but it appears as if this is so. I know of people who say they were influenced by this progressive rock but then to hear them play, I can't help but wonder how they were influenced by it. This music has the feeling and the soul that comes from practice and sheer talent (ode to Mr. Walker). You do not come across complex harmonies, time signature and key modulations in the Top 40 or Top 100 for that matter. I am sure there is some music of this style out there; record companies, please take a *real good* listen. Also, perhaps if you artists send your works to Mr. Carlberg with an address and how much you charge for your recordings, I will support you with a buy.

The third and final reason for this letter is to compliment the entire staff of EM for maintaining a magazine with high standards, and to encourage you to keep up the good work.

Michael S. Taylor
Missouri

### More Comments on Sequenced "Feel"

I'm an enthusiastic beginning home recordist and am writing with regard to Bob Walker's letter to the editor. His point about "feel" —i.e., how getting feeling into music is far more than just a technical trick—is well-taken. I would, however, like to comment on Bob's apparent fear that certain tricks with sequencers (shifting track tempos, etc.) will be used by some sequencer-based musicians as a substitute for the "feel" which, he says, comes only from experienced playing.

Experience is important, I agree, but there's more than one way to get it. There are composers without great live playing experience who are creating finely honed, sequencer-based music with a lot of care and enthusiasm. If the results justify it, then it's valid for the composer to practice with a sequencer rather than with an instrument (although sequencers are getting to the point where we might call them instruments in their own right). As Ray Hoh's letter (January '88) pointed out, it takes incredible patience, but "feel" can indeed be achieved without great playing chops (perhaps you do need great software chops, though!).

I sense some reservation on Bob's part toward this relatively new (and growing) breed of sequencing-based musician. Any style has its potential excesses, but I feel that we should try to be tolerant of all approaches to making music, and share insights along the way. In that spirit, thanks to Bob for the warning (and to EM for disseminating so much useful stuff in general). Bob is correct in saying that practice is necessary for feel—but there are a lot of tools (sequencers included) with which you can practice.

Jim Butler
Massachusetts

### More on the MusiCard

Here's a tip of the hat to all of you at EM for producing such a fine magazine. The articles are always interesting, and receiving each issue is a treat.

Thanks for running Carter Scholz's review on the Music Magic *MusiCard* (December '87). Music Magic has a product that displays creativity, conceptual elegance, and the possibility of tremendous future improvement. Being a happy user of the system myself since last June, I was beginning to wonder if anyone else out there had one. I hope that your article encourages more people to investigate the MusiCard.

In my opinion, the MusiCard represents an approach to synthesis that is superior to most pre-packaged synths in its price range. Since music synthesis is an inherently complex task, almost anyone with any kind of computer background would probably consider the usual practice of equipping a synth with a couple of data-entry buttons and a 12-character LCD to be a near-defiance of ergonomics, or perhaps reason. While Music Magic's final product has its flaws, I hope the rest of the industry realizes that significant benefits accrue to the user of a synth that is designed to work as a computer peripheral.

If the cats at Music Magic are reading this, I have a few suggestions: (1) produce a method of chaining samples, so they will be long enough to be melodically useful; (2) better yet, get the sampling module out, price it aggressively, include plenty of RAM, and make it simple for us to import existing sample libraries from other popular machines; (3) write some software utilities that will map the sound libraries of prevalent synths (e.g., the DX series) onto their nearest wavetable approximations; (4) provide a utility for printing out summaries (in several levels of details) of an instrument definition (printing all those screens is a bit awkward); and (5) beef up the technical documentation (the MusiCard is tailor-made for software hackers).

One final word—I am organizing a Music Magic users group. We will exchange advice, patches, programs, etc. There will be a newsletter (called MMUGshots) and a BBS. Anyone interested in joining may write to me for details.

Daniel Mocsany
2532 Highland Ave. #20
Cincinnati, Ohio 45219

### The Secret Life of Alternate Tunings

Thanks for the corrections, suggestions, and comments I have received with regards to my article back in the October '87 issue titled "Alternate Scales on the Commodore 64." I have a few comments and some modifications for the program.

With regards to Wendy Carlos' letter in the February '88 issue, I apologize for getting the Alpha scale incorrect—I simply misinterpreted the liner notes. Fortunately, the errors were not too large. Note that the data statements for the Beta scale in Figure 2 are also in error. I urge anyone who is interested in this field to check out the harmonic scale that Wendy listed in her letter. I stumbled into something like it during some experiments with fractionally even tuning.

Wendy pointed out that I had not labeled the notes using the standard convention of the prime being note 0. This is not difficult to fix. Update the following lines:

```
340 PRINT:PRINT "NOTES ";V(1),V(2)-1,V(3)-1
390 IF N>48 AND N<58 THEN N=N-47:GOTO 460
400 IF N=48 THEN N=11:GOTO 460
410 IF N=43 THEN N=12:GOTO 460
420 IF N=45 THEN N=13:GOTO 460
430 IF N=95 THEN N=1:GOTO 460
```

These are all minor changes, so use the Commodore screen editor. List the lines on the screen, make the adjustments (often just one digit), then press RETURN while the cursor is still on that line. The note numbers are now 0 through 12, with the back-arrow key at the top left of the keyboard corresponding to note 0. The keys 1 through 9 correspond to notes 1 through 9; the 0 key is note 10 with the two keys to the right of 0 being 11 and 12. On the screen display, a -1 means that a note is off.

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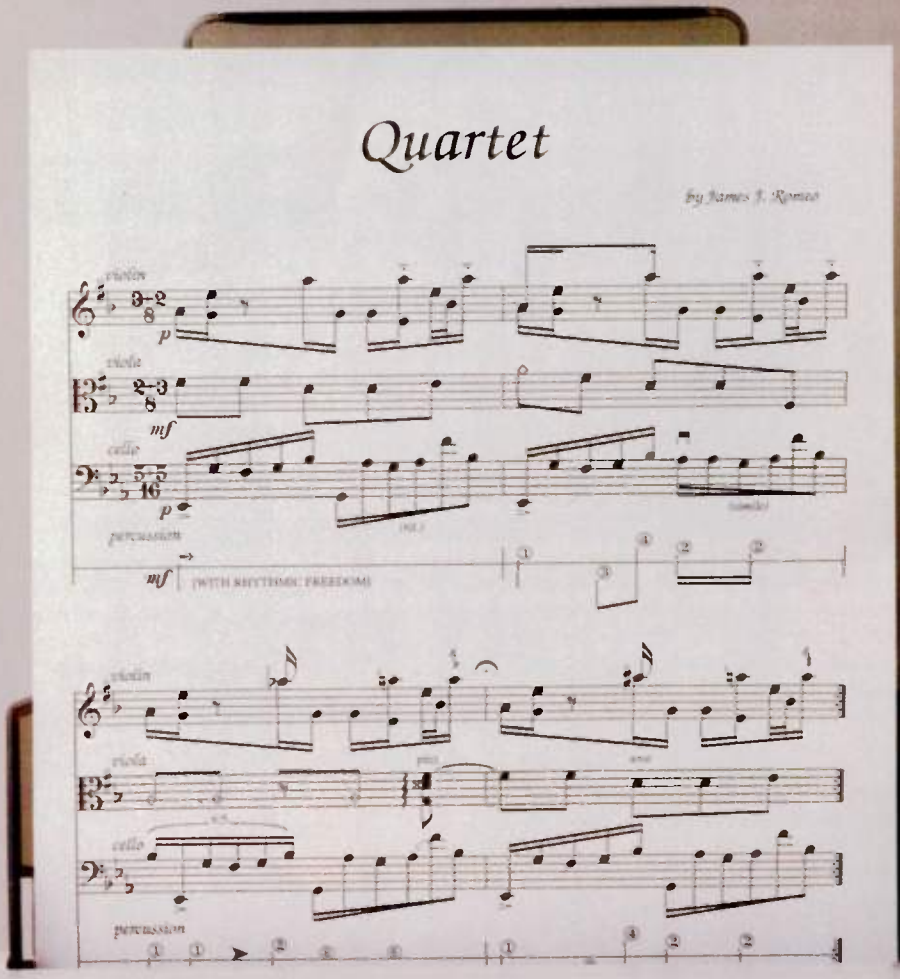


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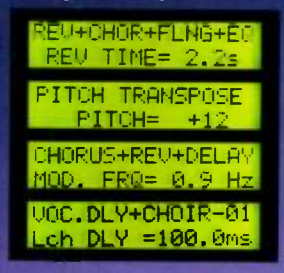


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Thanks also to Craig Paul for working out the Yamaha DX7II series cents/ratio equations. I wrote the article back in December 1986, just before the veritable explosion of instruments with alternate tuning capabilities. I still use my Commodore to try out new scales before programming them into an instrument, though.

By the way, the bio with the article was way off, made so by my recent travels and moves. I now live near Annapolis, MD, having been appointed to the faculty of a college here (i.e., found a real job) at which all the students dress the same. I can be reached on Compuserve at 75066,164.

Walter Daniel
Maryland

### Update to an Update

I'd like to thank Bill Berends and the other **EM** readers who appreciated my article on the IVL Pitchrider 7000 Mark II. It's nice to know my comments were helpful to fellow musicians.

One complaint I voiced in the article was that there was no simple way to interface Roland-type guitar synths and the Pitchrider. This is no longer true. Eric Ambrosino (28 Clover St., Windsor, CT 06095) has designed a "missing link" that accepts a Roland-compatible guitar and has both Roland and Pitchrider outputs in case you want to run the 7000 and a GR-300 or 700 simultaneously. The box also has straight guitar output and the sweetest hexaphonic fuzz I've ever used. Eric has interfaces for Roland-to-Kaman/Ovation/Takamine MIDI guitar setups as well.

On the down side, although DOD has in fact marketed the MIDI pedal (PDS3500) that I mentioned in my article, and it does have a jack for a continuous controller, it does not have a MIDI merge function. This means the Pitchrider and the DOD pedal cannot work together on a synth without another $150 or so spent on a merger. Oh, well, maybe DOD has a PDS3500 mod in its future. (Please?)

James E. Betts
Wisconsin

### Sequencer Problems and Solutions

When we turn to your magazine for a product review, as we have for the past two years, we expect an honest discussion of both the pros and cons of the product in question. With products that are unfamiliar to us, your reviews can make the difference between getting a piece of gear that works well for us or wasting our time and money. However, when a review sounds more like a press release than a critical analysis, we begin to wonder. This was the case with Geary Yelton's article about Opcode's Midimac Sequencer 2.5 (November '87).

We have owned this software for six months. At first, we were impressed with the look and feel of this powerful program. But after the first of many "System Error" messages appeared on our Mac, we became more and more disillusioned. To be sure, Opcode provided immediate support for us: suggestions concerning our recording techniques, and updated versions of the software at no charge. Sequencer 2.5 can do many wonderful things. Geary dutifully lists each feature clearly and succinctly, but it is hard for us to imagine anyone who has really used this sequencer a lot and not come upon several instances of bombing or freeze-up. We suppose that the intricate copy protection has rendered this otherwise useful sequencer delicate.

After months of frustration, we purchased another sequencer, and the problems we had with Sequencer 2.5 disappeared. The test of good software is invisibility to the user; with Sequencer 2.5 we were spending more time wondering what went wrong than on the music we were trying to create.

Charles Caldorola
New York

*Charles—We sent Opcode a copy of your letter for comment; here's what Chris Halaby, Opcode's president, had to say:*

*"I was sorry to read your letter regarding system errors while using our Sequencer version 2.5. We are upset any time we lose an Opcode customer. When that loss results from problems with our products, then it is all the more troubling.*

*"Regarding Geary Yelton's review, we can only assume that there was no personal bias and that the review was fair and up to the standards of* Electronic Musician. *The two of you may have been working with different versions of our sequencer, different versions of the Macintosh, or even with different versions of Apple's* System *and* Finder *software. In any case, I have found that* Electronic Musician, *through its reviews, does a fine job of walking the delicate line between fairness and guidance of its readers.*

*"It is true that we encountered some problems with version 2.5. Yelton, however, notes in his review that he was using version 2.53, an update that had fixed several of the bugs you may have encountered. Version 2.6 appeared shortly thereafter, which is compatible with the Mac II and MultiFinder. We have been shipping this version since October '87 and our technical support staff has heard of no serious bugs.*

*"I should also note that all of the major sequencers written for the Mac have at some point had releases that suffered from major bugs. I point this out only to impress upon you the fact that all software companies encounter problems with major upgrades, and most of us respond to the best of our abilities with updates and technical support. We're always sorry if those efforts fail to keep our users happy. We would hope, however, that you would find fault with a version of our program which we have already superseded, and not with* Electronic Musician."

*To Mr. Halaby's comments, I would like to add that I once experienced consistent system error problems with another make of sequencer. Once I changed to a different System and Finder, for whatever reason the system error problems stopped* completely. *Despite the user-friendly character of the Macintosh, it is indeed a complex computer; some desk accessories will crash otherwise robust programs, and some software is incompatible with particular versions of the System. The important point is that you now have a sequencer that works for you, but an equally important point is that the sequencer that didn't work for you works just fine for Geary—and Geary is not all that easy to please. Ah, the mysteries of MIDI . . . .*

### Help!!

I really enjoy your magazine, so much that I just re-subscribed for two years. I'm sure I'm not the only one who feels a little lost in this incredibly expanding world of musical technology. At the same time I feel it's where I belong.

I started to learn organ at age seven and was playing Top 40 and rock and roll in my teens and 20s. I found out, like most, that it's a tough way to make steady money, so I didn't pursue it as a career. I got a Mac Plus a year ago and recently acquired a D-50, MT-32, TX81Z, Midiverb II, and *Performer* 2.2; I mix down to an MT44D/ RM602 multi-track cassette recorder.

Now I've gone back to school to take courses on recording, producing and synthesis. I would appreciate any information I can get my hands on involving any of the above—particularly editor/librarians for my gear and more importantly, about schools specializing in high-tech audio applications.

I would highly appreciate any input you have and keep up the good work!

Mark D. Thornton
California

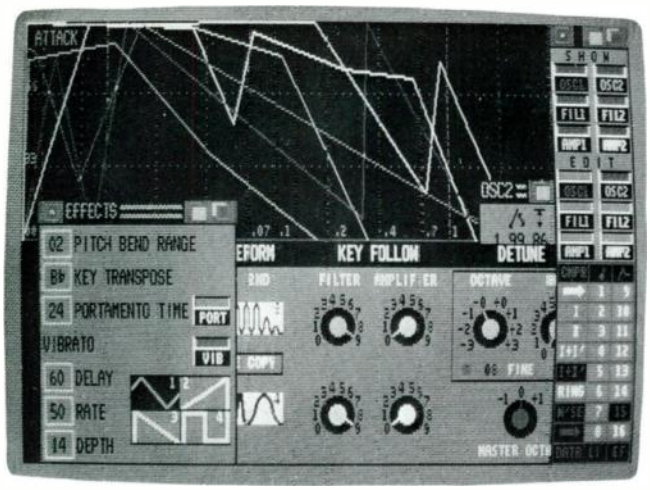
*Mark—Welcome aboard! A resource which you might find valuable is the* 1988 Mix Annual Directory *(available from Mix Bookshelf for $25), as it lists educational institutions as well as manufacturers and studios. Regarding your other questions on where to learn more, Mix Bookshelf is also an excellent source for all types of technical books on music and audio. For information on editor/librarians, keep reading* EM*—we review a fair amount of software. Also, many manufacturers offer semi-functional demo programs to give you a flavor of the software before you buy; when you write manufacturers for information, be sure to ask whether they have demo programs available.*

### Additions and Corrections

In the section on IBM computers in the April '88 issue, please note that Music Quest also makes an MPU-401 compatible MIDI interface, and that the *Vision II* editors from Turtle Beach Software cost $495, not $349. Finally, the phone number for 12 Tone Systems is 617/924-7937.

**EM**

# what's new




**Diemer C-ZAR Amiga CZ Editor**

## Accessories

**Sound Accelerator** ($995) is a high-speed digital signal processing card for the Apple Macintosh II and SE that plays back—with CD quality—sounds that have been loaded into the Macintosh via Digidesign's *Sound Designer* or *Softsynth* programs. Sound Accelerator allows most of the synthesis and sound processing functions of these two programs to be performed in real time. Digital equalization, mixing and merging can occur while the sound is playing, and three-dimensional FFT frequency analyses can be called up instantly on the screen.

**Digidesign Inc.**
1360 Willow Road, Suite 101
Menlo Park, CA 94025
☎ 415 / 327-8811

## Editors

**C-Zar** ($195) is an editor/librarian for the Commodore Amiga and the Casio line of CZ synthesizers. It comes with over 200 instrument sounds and effects, and provides mouse-control of volume, filter and pitch envelopes, waveforms, bend, detune, vibrato and other parameters. C-Zar allows loading from the CZ's memory or RAM cartridges and uses the Amiga's graphics abilities to present its controls in a format reminiscent of an airplane cockpit. The envelopes are color-coded and drawn with millisecond detail in an eight-color, 1024 × 200 pixel raster. They can all be displayed at once. Programmed in assembly language for speed, the program lets the CZ immediately play the changes you make. Other features include a sequencer, envelope copier, eight programmable tone mixes, MIDI on/off, no copy protection, and a 70-page manual.

**Diemer Development**
12814 Landale St.
Studio City, CA 91604
☎ 818 / 762-0804

The **MVP-DS8** ($119.95) is a MIDI voice patch editor for the Korg DS-8 synthesizer that runs in the Microsoft Windows environment of the IBM PC and compatibles. It edits eight voices (including graphic envelope editing), two voice banks, a combination (performance) and a master library at once, using a Macintosh-style mouse. Requirements are: Microsoft Windows 1.0 or 2.0, a Roland MPU-401-compatible MIDI interface, a graphics adapter (CGA, EGA, VGA or Hercules) and a mouse. It will also support the IBM Music Feature.

**Playroom Software**
7308-C East Independence Blvd., Suite 310
Charlotte, NC 28212
☎ 704 / 536-3093

## Patch Bays

Designed to streamline the process of making MIDI connections, the Korg **KMP-68 MIDI Patch Bay** has six MIDI In and eight MIDI Thru ports. Two Thru and two In connectors are located on the unit's front panel for quick access, with the remaining connectors on the rear. Each Thru port has a six-position rotary switch connecting it directly to any of the MIDI inputs.

**Korg USA Inc.**
89 Frost Street
Westbury, NY 11590
☎ 516 /333-9100

The PM-148, the first entry in Pro Co Sound's **Patchmaster** series of audio patch bays, provides 48 unbalanced, ¼-inch phone jacks on the front panel, with 48 similar jacks on the rear of this single-space, rack-mount unit. The rear panel jacks allow the use of prefabricated cable assemblies for quick assembly and/or reconfiguration. An internal "Selecta-patch" feature permits users to design a custom patch system by setting internal switches for full-normaled, half-normaled, paralleled or open operation.

**Pro Co Sound, Inc.**
135 E. Kalamazoo Avenue
Kalamazoo, MI 49007
☎ 616 / 388-9675

**Pro Co Patchmaster Patch Bay**

## Patches

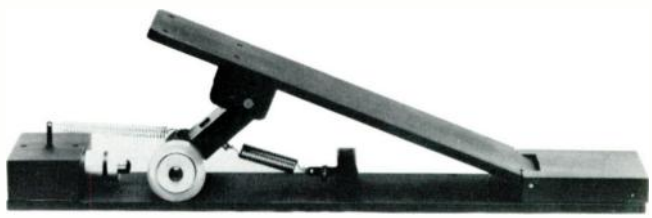
The **D-50 Top Forty ROM** ($80) contains 64 voices programmed by Bo Tomlyn for the Roland D-50 synthesizers. Version #1 is designed to be used with the D-50 and optional EV-5 foot pedal or the D-50 controlled by a MIDI master keyboard, so the external device controls such parameters as timbre, balance and volume; Version #2 works with the D-50 without external control, or with the D-550, using the *Tone Balance* control to control the tone parameters. Voices include acoustic and electric pianos, stringed and wind instruments, synth solos and an A-440 for tuning.

**Key Clique Inc.**
3960 Laurel Canyon Blvd.
Suite 374
Studio City, CA 91604
☎ 818 / 905-9136

## Percussion

The **Shark** electronic drum pedal ($289) is the result of four years of changes to the original design by inventor Arndt Anderson for Terry Bozzio. The pedal features a dynamically sensitive, piezoelectric triggering system that is said to eliminate false and double triggering. Its output is an omnidirectional voltage pulse for triggering electronic sounds from a variety of sources.

**Imagine Group**
751 South Kellogg, Suite A
Goleta, CA 93117
☎ 805 / 683-1183



**Shark Electronic Drum Pedal**

# AFTERTOUCH

OFFICIAL NEWS FROM THE YAMAHA USERS GROUP

# Build a better sequence.

THE QX3 DIGITAL SEQUENCE RECORDER is Yamaha's newest tool for MIDI sequencing. It offers many of the features of the QX1, along with several noticeable improvements.

To begin with, the QX3 has 16 tracks instead of 8, as well as a built-in 3.5" disk drive. It receives and records all types of MIDI information, including aftertouch and System Exclusive data. And it works with MIDI Song Position Pointer, to allow sync with external clock or tape clock.

With 512K of internal memory, the QX3 almost completely eliminates the delays associated with disk access. And its new panel features make all operations easier and quicker.

There's a 40 x 2 LCD with variable contrast control, a numeric keypad, and keys for Note Value, Note Name and Track Select. There's an Editing Dial for setting tempo and moving through measures or events. Plus, there are two function keys that can be programmed as "key macros." So with one touch, you can execute the operations you use most—up to 128 keystrokes each.

The QX3 records in Real Time and Step Time. But you can also record using Punch-In, either manually or automatically, beginning anywhere—even in the middle of a measure. And this function can be used with the Auto-Locate feature.

It all adds up to a sequencer that combines the professional features of the QX1 with the ease of operation and flexibility of the QX5. And at a suggested list price of $1595.00, it adds up rather well.

# Hot Tips

**Some voicing tips for the DX7 & DX711D/FD.**

1. To get a faster "attack" on string sounds, input a higher number for Rate 1 of the Carrier operators in the algorithm you're using.
2. To add a longer fade-away upon key release, input a lower number for Rate 4 of the Carrier operators in your algorithm.
3. To create "string pad" sounds, use the side-by-side algorithm stacks (numbers 1, 2, 14, 15, etc.). Try using a fixed frequency for one of the Carriers—this makes for good string chorusing.

*YAMAHA QX3 DIGITAL SEQUENCE RECORDER.*

# Questions

**Is there a way to save the memory of the MEP4 MIDI Event Processor to tape or disk?**

The MEP4 has no cassette interface. But you can use its Bulk Dump function to save its memory to disk via MIDI. All you need is a unit that stores MIDI System Exclusive data, like a MDF1 MIDI Data Filer, or a DX711FD (which has a built-in disk drive). The basic operation is described on pages 42–43 of the MEP4 owner manual. Simply make the MIDI connection from the MEP4 to the storage unit—instead of to another MEP4, as described in the manual.

**I have a DX100 and I'm having trouble with the saxophone voice in ROM. How do I get it to work?**

You're probably referring to the ROM voice called SAX BC. The "BC" stands for "breath controller," and that means the voice has been set up to operate with that controller. If you want to use this voice without a breath controller, go into FUNCTION mode and set the EG BIAS for the BREATH CONTROLLER to OFF. Every internal voice in the DX100 with "BC" as part of its name is preset for the breath controller, and can be changed in this way.

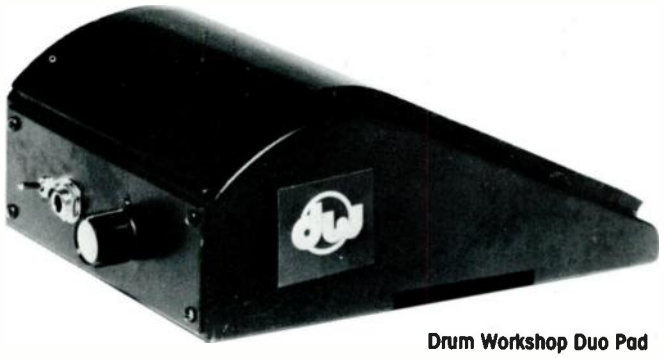
AFTERTOUCH is a monthly newsletter filled with the latest on Yamaha products. Get a year's subscription free by writing to: AFTERTOUCH, P.O. Box 7938, Northridge, CA 91327-7938.

YAMAHA

Yamaha Music Corporation, USA, Digital Musical Instrument Division, P.O. Box 6600, Buena Park, CA 90622.

The **Duo Pad** from Drum Workshop is a compact electronic drum pad capable of dynamically triggering two separate sounds. According to the manufacturer, the pad eliminates "hot spots" and crosstalk by utilizing Force Sensing Resistor (FSR) technology; thus multiple drum triggers can be placed next to or even on top of one another, while maintaining trigger integrity. The Duo Pad features dual ¼-inch output jacks, sensitivity control, universal multi-clamp adapter, and will trigger most non-MIDI drum controllers and trigger-to-MIDI converters.

**Drum Workshop**
2697 Lavery Court, #16
Newbury Park, CA 91320
☎ 805 / 499-6863



**Drum Workshop Duo Pad**

## Samples

**Miller/Blake Digital Samples** announces the addition of 21 new sample disks to their 175-plus sample library for the Sequential Prophet-2000 and Oberheim DPX-1. These latest releases include ten sax samples as well as new synth and percussion disks, priced at $8.95/disk (256K samples) or $12.95/disk (512K samples). A free catalog is available; a 45-minute demo cassette and fully useable sample disk cost $6.50.

**Miller Blake Digital Samples**
2801 18th Avenue
Sacramento, CA 95820
☎ 916 / 452-7685

## Samplers

The **Emax SE (Synthesis Enhanced) Digital Sampling System** (keyboard, $3,295; rack-mount, $3,095) and HD System with a 20M internal hard disk (keyboard, $4,295; rack-mount, $4,095) feature the Spectrum Synthesis process that allows the musician to work with harmonic building blocks (Spectra) consisting of 24 harmonics, each with its own level and pitch. Time-varying timbres can be produced in either of two ways. The user can select up to 24 of the 99 preset Spectra (or define them manually) and crossfade between them at any of 24 Time Slice locations. Alternately, one can specify amplitude and pitch contours for each harmonic. Each Emax SE voice in a Spectrum can consist of two synthesized timbres, two samples, or one of each. Other new Emax features include three digital signal processing functions: digital sample rate conversion for memory management, digital pitch conversion for flexibility and accuracy in keyboard mapping, and transform multiplication, a computation performed on two digital sounds to produce an entirely new sound. Preset Stack Mode stacks four presets to create one rich tone.

**E-mu Systems, Inc.**
1600 Green Hills Road
Scotts Valley, CA 95066
☎ 408 / 438-1921

## Sequencers

Roland's **MC-500 MkII MicroComposer** ($1,795) is a significantly upgraded version of their MC-500 stand-alone sequencer. When used with the Turbo-500 sequencing package, the MC-500 MkII can record up to eight tracks, each able to accommodate 16 MIDI data parts over 16 MIDI channels, allowing the recording of up to 128 different parts. Internal memory capacity is 100,000 events, with additional storage via the unit's built-in, 3.5-inch floppy drive. Other features include: two independent MIDI outputs for controlling 32 channels of MIDI; a track muting function; Song Position Pointer; precise "Microscope" control over details such as note strength, pitch bend and aftertouch; and an external edit function allowing the use of an external keyboard or MIDI controller to edit velocity, step time, or gate time. Turbo-500 is included with the MC-500 Mk II, and will be available optionally for the MC-500 and MC-300 sequencers.

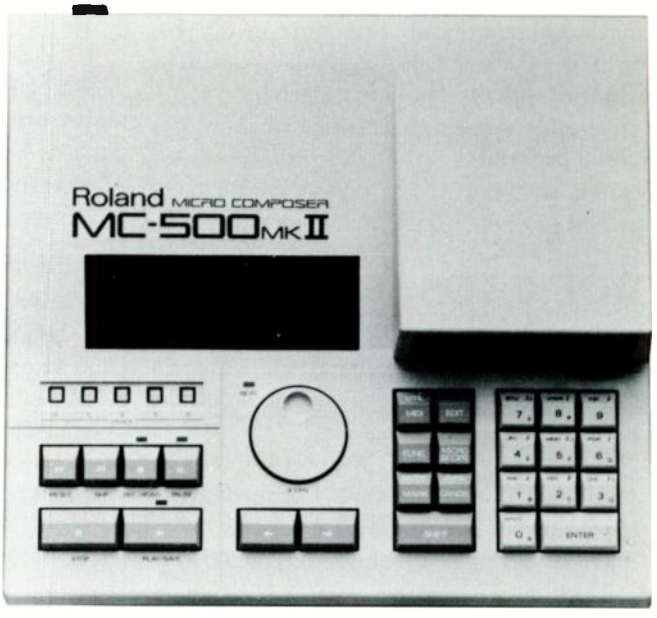
**RolandCorp US**
7200 Dominion Circle
Los Angeles, CA 90040
☎ 213 / 685-5141

The **Concepts: One** (version 1.70) sequencing system ($495) for IBM PC/XTs, ATs, 386 machines and most compatibles provides 32-track sequencing with each track capable of recording and playing back 16 MIDI channels simultaneously. Features include: System Exclusive message editing/storage/retrieval; real-time muting; three quantization modes; three sync modes, with or without Song Pointer; and extensive editing capacity with Mix, Unmix, Split, Copy, Cut/Paste, Insert/Delete, Transpose, Quantize, Shift and Looping functions. Minimum system requirements are 640K RAM and two floppy drives (hard disk recommended.)

**MIDI Concepts, Inc.**
7657 Winnetka Ave., Suite 327
Canoga Park, CA 91306
☎ 818 / 342-0409

## Software

**DMP7 PRO** ($395) is an interactive, intelligent mixing assistance program for use with the Yamaha DMP7 automated mixing board and the Macintosh. It displays a "front panel" with the status of, and controls for all DMP7 parameters, and offers functions not found in the DMP7, including automation assistance, solo and muting functions, channel naming, disk storage of settings, filtering or adjusting of MIDI sequences, visual or audible scene comparisons, and the ability to cut, copy and paste either scene or automation data. The software




**Roland MC-500 MkII Microcomposer**

# GET ON TRACK!

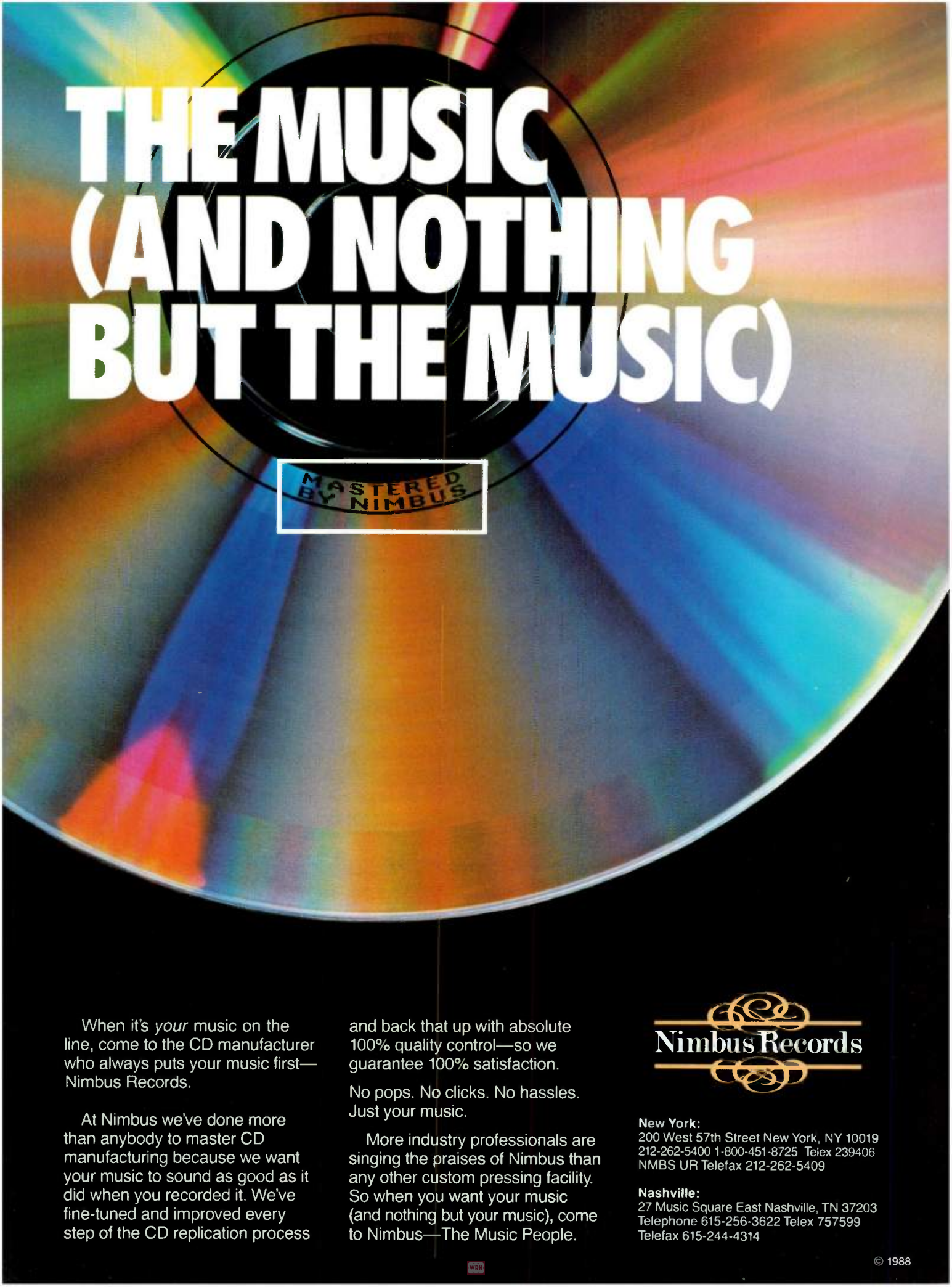
Whether you're recording original music scores, layering up sound effects, or synchronizing to video or film for audio-post sweetening, you need a tape recorder that's built especially for your new and exciting business. The MX-70 is the perfect multitrack for the synthesizer oriented studio tied together with MIDI.

The "70's" three-way design gives you 7.5, 15 and 30 ips in a 1" 16-track, a 1" 8-track, or a 1" 8-track prewired for 16. (An optional ½" 8-track is also available.) Noiseless, gapless, punch-ins and punch-outs provide quiet, inaudible inserts into pre-recorded program material. The MX-70's wide dynamic range makes for quiet, clean recordings. In fact, you'll find the "70" at 30 ips is so quiet that noise reduction just isn't necessary. And to complete this perfect package, you can add an optional autolocator to the standard full function remote for complete session control.

So if synthesizers with MIDI, or SMPTE with film and video, is part of your business, check the specs and don't settle for less than the MX-70. Call your nearest Otari dealer for **"Technology You Can Trust".**

Otari Corporation, 2 Davis Drive, Belmont, CA 94002,
415/592-8311, Telex 9103764890

OTARI®




When it's *your* music on the line, come to the CD manufacturer who always puts your music first—Nimbus Records.

At Nimbus we've done more than anybody to master CD manufacturing because we want your music to sound as good as it did when you recorded it. We've fine-tuned and improved every step of the CD replication process and back that up with absolute 100% quality control—so we guarantee 100% satisfaction.

No pops. No clicks. No hassles. Just your music.

More industry professionals are singing the praises of Nimbus than any other custom pressing facility. So when you want your music (and nothing but your music), come to Nimbus—The Music People.

Nimbus Records

**New York:**
200 West 57th Street New York, NY 10019
212-262-5400 1-800-451-8725 Telex 239406
NMBS UR Telefax 212-262-5409

**Nashville:**
27 Music Square East Nashville, TN 37203
Telephone 615-256-3622 Telex 757599
Telefax 615-244-4314

allows parameters to be grouped and controlled together, either in a linear way, or to preserve the mutual balance of the various levels. It memorizes front panel and automation settings and saves them to disk, allowing fast access and large storage capabilities. DMP7 PRO can store its data to any MIDI sequencer, allowing the operation of fader or other moves in sync with the original sequence. DMP7 PRO runs on the Mac Plus, SE and II and can run simultaneously with any MultiFinder-compatible sequencer.

**Digital Music Services**
23010 Lake Forest Drive
Suite D334
Laguna Hills, CA 92653
☎ 714 / 951-1159

## Software

**Clicktracks** ($349.95) from Passport Designs is a Macintosh program that simplifies scoring music to "hits" on video or film. Clicktracks can be used alone when scoring for orchestra or live conducting, or in conjunction with a MIDI sequencer and MIDI instruments. The user enters video or film hits, expressed as SMPTE time or frame numbers, and selects an initial tempo for the piece. The program then provides tools for laying out cues, searching tempos and creating tempo maps by inserting meter, beat and tempo changes. The software's "hitlist," for example, displays the exact *musical* location of all entered hits, musical notation of the nearest beat and beat subdivisions, and how far from the hit those locations are, in frames. Clicktracks requires a Macintosh 512e, Plus, SE or Mac II and is Multifinder-compatible.

**Passport Designs, Inc.**
625 Miramontes Street
Half Moon Bay, CA 94019
☎ 415 / 726-0280

## Tape Recorders

The **Revox C270** series from Studer Revox America is a new line of professional tape recorders available in 2-, 4- and 8-track versions. All models in the line feature three tape speeds, variable pitch control (-33% to +50%), true autolocator—with return-to-zero and search to cue, LED real time (hours/minutes/seconds) tape counter, 10½-inch reel capacity and built-in splicing block. The C274 ¼-inch 4-track and C278 ½-inch 8-track also offer bar graph metering and a parallel remote port for use with optional Studer remote controllers. Other options include an internal time code generator and SMPTE center-track time code electronics for the 2-track version.

**Studer Revox America**
1425 Elm Hill Pike
Nashville, TN 37210
☎ 615 / 254-5651

**Revox C278**

## Tuners

The **DT-1 Pro** from Korg brings digital tuning to any rack system. The unit automatically determines the pitch of up to four sound sources within a seven-octave range from C1 (32.7 Hz) to B7 (3951.07 Hz) and displays the note name and degree of sharpness or flatness. Fast or slow response modes make the DT-1 Pro suitable for both wind and string instruments, as well as acoustic or electronic keyboards. Other features include a large LED tuning display, four rear panel inputs/outputs (for checking the tuning on a multiple keyboard setup without having to repatch), a built-in four-in/one-out mixer that allows the unit to act as a basic mixer, front panel bass/guitar input jack and an internal reference generator that creates tones over a four-octave range from C2 (65.41 Hz) to B5 (987.77 Hz).

**Korg USA, Inc.**
89 Frost Street
Westbury, NY 11590
☎ 516 / 333-9100

## User Groups

**MUSIG**, the MIDI user group, meets the first Tuesday of each month from 6:30 to 8:30 p.m. at Martin Audio-Video in New York City. Meetings typically begin with a question/answer and discussion period, followed by a guest speaker demonstrating some aspect of music synthesis. All are welcome. For more information, contact Charlie Miller at ☎ 212 / 246-7438.

**Martin Audio-Video Corp.**
423 West 55th Street
New York, NY 10019

## Calendar

As part of its **Summer Arts '88** workshops, the California State University is offering a two-week workshop (graduate and undergraduate credits available) devoted to alternative MIDI controllers. Going from July 3 until July 16, the session will be a hands-on studio experience dedicated to composition, performance and production. Guest artist Craig Anderton will concentrate on MIDI guitar controllers; MIDI wind controllers will be covered by guest artist Tim Tully. The sessions will be given on the scenic Humboldt campus in Northern California, and will take advantage of the school's location in the beautiful redwood forest, as well as its outstanding arts facilities, to provide an exceptional opportunity for intensive study and dialogue. A session on electronic music in film and video will take place the following two weeks.

**David Bradfield**
400 Golden Shore
Long Beach, CA 90802
☎ 213 / 390-5768

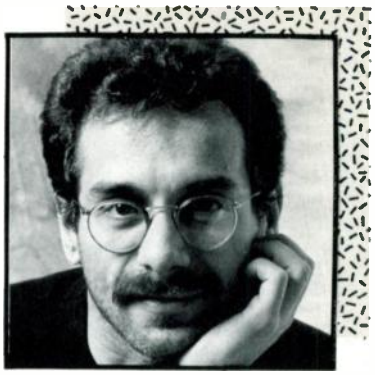
King Crimson guitarist **Robert Fripp** will conduct a six-day residential seminar for guitarists during September 1988 in the Los Angeles area. Known as Guitar Craft, the course will focus on the fundamentals of playing plectrum (pick) guitar. Further information can be obtained by sending a SASE to Guitar Craft.

**Guitar Craft**
PO Box 5306
North Hollywood, CA
91616-5306
☎ 818 / 786-8729

*All prices are suggested retail prices, as supplied by the manufacturers. All prices and specifications are subject to change without notice. Inclusion of product information and manufacturers in this magazine does not necessarily constitute a recommendation by* Electronic Musician *magazine or its staff; we suggest that all mail order purchases be COD. Contact manufacturers for further information.*

# What do these people have in common?

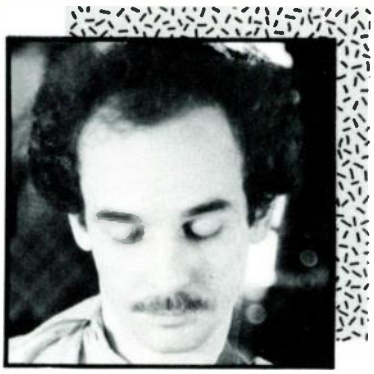
**Wayne Horvitz...**
Pianist/composer
Elektra recording artist



**Mark Styles...**
Composer/keyboardist
"Solestas" CD on Periodic Music

**Steve Coleman...**Saxophonist
Touring with Sting,
Pangaea recording artist

**Jimmy Hotz...**Producer
B.B. King, Leon Russell,
Mick Fleetwood

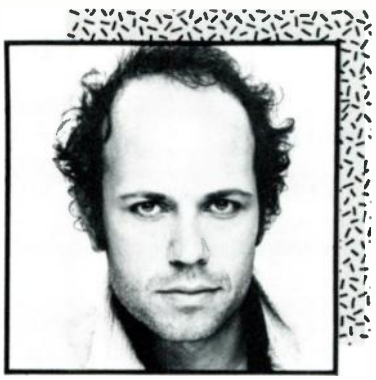


**Randy Roos...**Acclaimed guitar
synthesist/composer
"Mistral" LP

**John Coty...**Songwriter
B-52's, Shake Society,
The Foundation

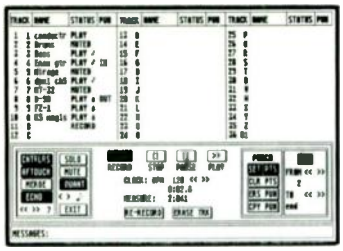
**Elliott Sharp...**N.Y. "downtown"
composer/improvisor
SST and Dossier recording artist

**Tom Schuman...**Keyboardist
Spyro Gyra

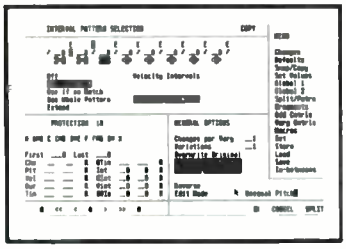


**Jan Hammer**
"What can we say?"

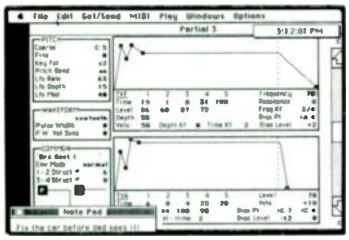
**Dave Holland...**Master bassist
ECM recording artist, composer,
teacher



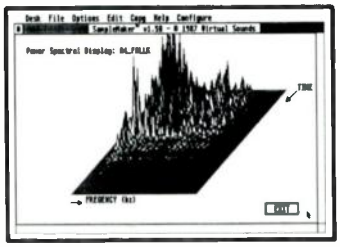
Keyboard Controlled Sequencer V1.6



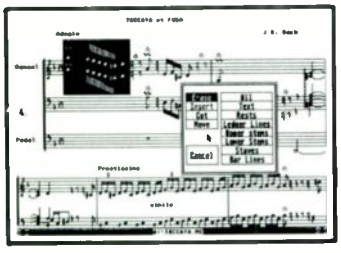
Level II, Interval Pattern Selection



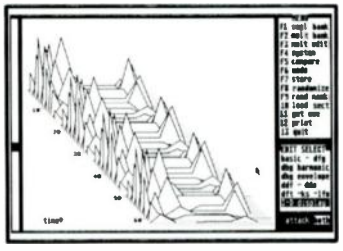
Macintosh MT-32 editor/librarian



Samplemaker



The Copyist II V1.5



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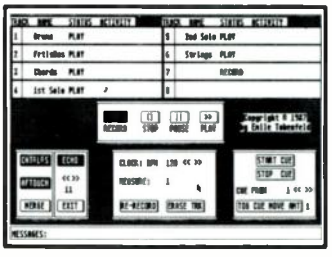
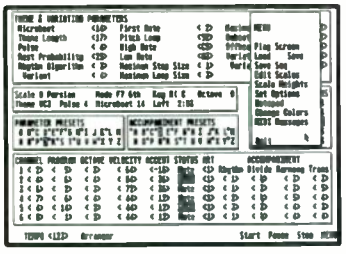
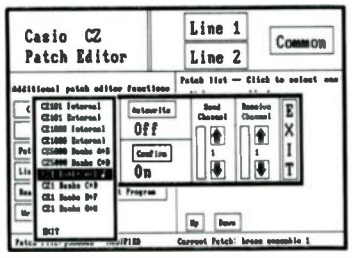


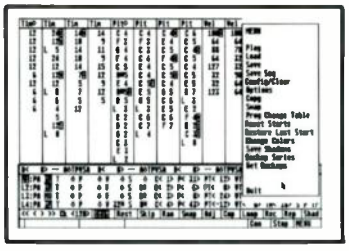
MIDI Recording Studio



Tunesmith




IBM CZ-Editor



Fingers

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*"Operation Help" is dedicated to helping musicians help each other. If you need technical assistance, a schematic for an old piece of gear, or just want to connect with people having similar interests, send your name, address, phone number (optional) and nature of your request to: Operation Help,* Electronic Musician, *6400 Hollis St. #12, Emeryville, CA 94608. If we print your letter, we'll include your name and address so that our helpful readers can contact you. There is no charge for this service, but we cannot guarantee that all requests will be published.*

**Plush Model 4000G:** I am trying to restore a Plush model 4000G amplifier, and need a schematic. I have not been able to locate any information on either the amp or the company; your help would be greatly appreciated. Paul E. Vickberg, 14361 Afton Blvd. So., Afton, MN 55001 ☎ 612/436-7598.

**Electro-Harmonix Electric Mistress:** I am seeking info on why my Electro-Harmonix Electric Mistress Flanger causes about a 30% volume loss whether it's switched in or out. I love this flanger but can't live with the volume loss. Is this problem typical for these units? Any suggestions? I have a Univibe schematic to trade for advice. Thanks. Kevin Ruddell, 92-0 Sherman St., Toledo, OH 43608.

**Yamaha MDF1/DX7 Owners:** I am interested in exchanging MDF1 disks, consisting of uncopyrighted or public domain DX7 patch data, with anyone who also uses this as a storage device for DX7 sounds. If interested contact: Rodney Reeves, Rt. 5, Box 119, New Albany, MS 38652.

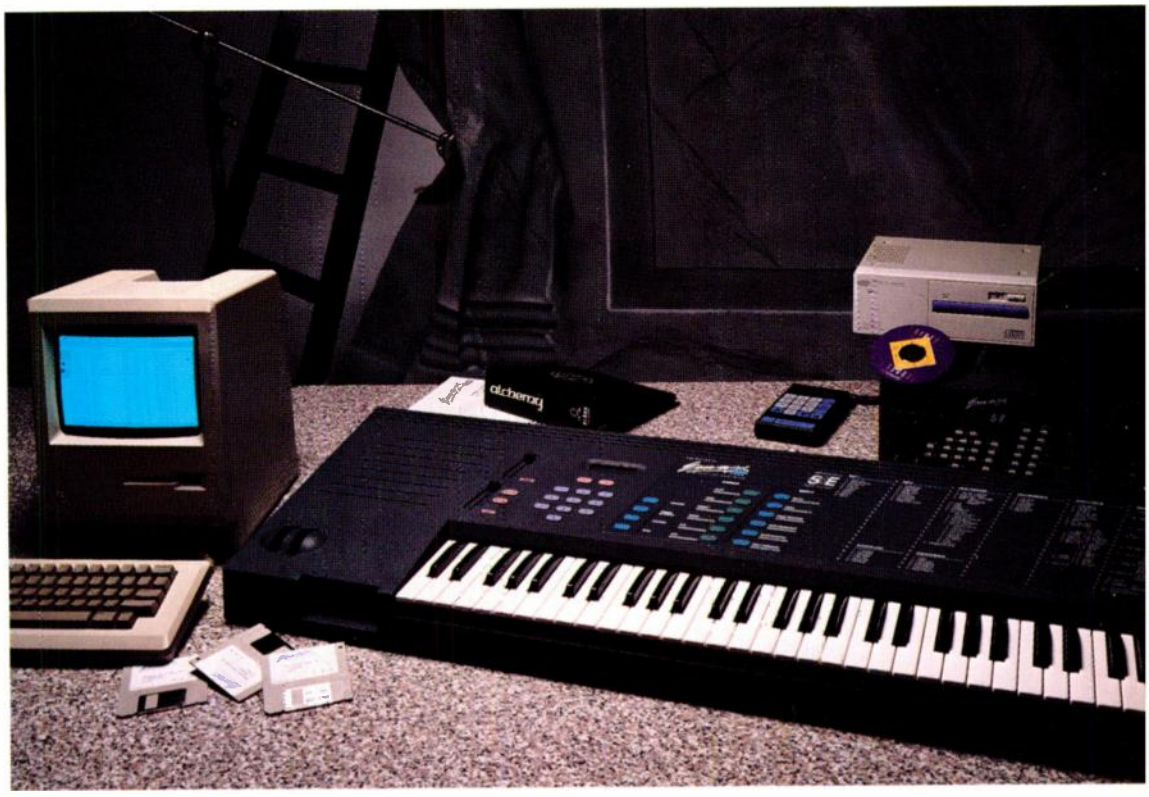
**Acoustic 150:** I need a schematic diagram for an Acoustic 150 guitar amplifier that was built around 1970. Does anyone out there have a schematic, or know where I might find it? Thanks! Dan Stuart, 1091 W. Grandview, Roseville, MN 55113.

**Casio M-501 MIDI Guitar Contoller:** Movement of the volume control on my Casio M-501 controller defeats/overrides the relative volume setup (20% to 90%) for 2 to 4 note poly sounds in performance mode on my Yamaha TX81Z. How do I lower the level from the controller, maintaining the relative volumes during live performance for volume swells? When I initiate a Program Change message from the controller the relative levels boot up correctly, but are at full volume. Greg Burgoon, 140 Bennington Rd., Akron, OH 44313

**Clavioline:** I have a keyboard called a Clavioline. Some of my friends said why not restore it—so I said sure, why not, it still works. I wrote to France where the guy who built it was supposed to be, but the letter was returned saying no forwarding address. Does anyone know were to get info on this unit or possibly parts? If you're not familiar with this instrument you might have to remember back to 1960 when Del Shannon made a song called "Runaway." Some of my friends thought that the backup instrument was a Solovox, but the special effects side sounded more like this guy to me. Contact: Rod Baxter, 4710 34th Ave. NE, Seattle, WA 98105.

**Electro-Harmonix Mini-Synthesizer:** I am looking for schematics for the Electro Harmonix Mini Synthesizer (model 0410, with echo and pitch ribbon); mine has begun to show signs of old age. Alternatively, is there a qualified EH repair technician out there somewhere? Mike Metlay, PO Box 81175, Pittsburgh, PA 15217-0675 **EM**

# Emax SE. The creativity of synthesis. The realism of sampling. The power of intelligent design.




The Synthesis Enhanced Emax SE.™ An instrument that combines the realism of sampling with the creative flexibility of advanced digital synthesis. An instrument that invites you to explore a new realm of sonic possibilities.

The Emax SE starts with all the features that have made the Emax the most powerful sampler in its class. Superb sound. Versatile processing and editing functions. And a sound library renowned for its size and quality. Then it adds **Spectrum Interpolation Digital Synthesis,**™ a unique form of additive synthesis that takes advantage of the Emax's computing power and flexible voice architecture to give you the sound creation capabilities of sampled wave synthesizers. Without confining you to a limited selection of factory supplied waves or sampled attacks.

Using Spectrum Synthesis, you can quickly and intuitively create your own library of dynamic wave timbres. Once synthesized, a timbre can be combined with a sampled attack or another timbre to create a voice which you can further shape with the Emax SE's complement of analog and digital processors. The results are sounds of extraordinary richness and complexity. Sounds that you can *only* create with the sampling and synthesis power of the Emax SE.

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Ask your E-mu Systems dealer for a demonstration of the new Emax SE and hear the power of intelligent design at work.

E-mu Systems, Inc. Applied Magic for the Arts. 1600 Green Hills Road, Scotts Valley, CA 95066. (408) 438-1921.



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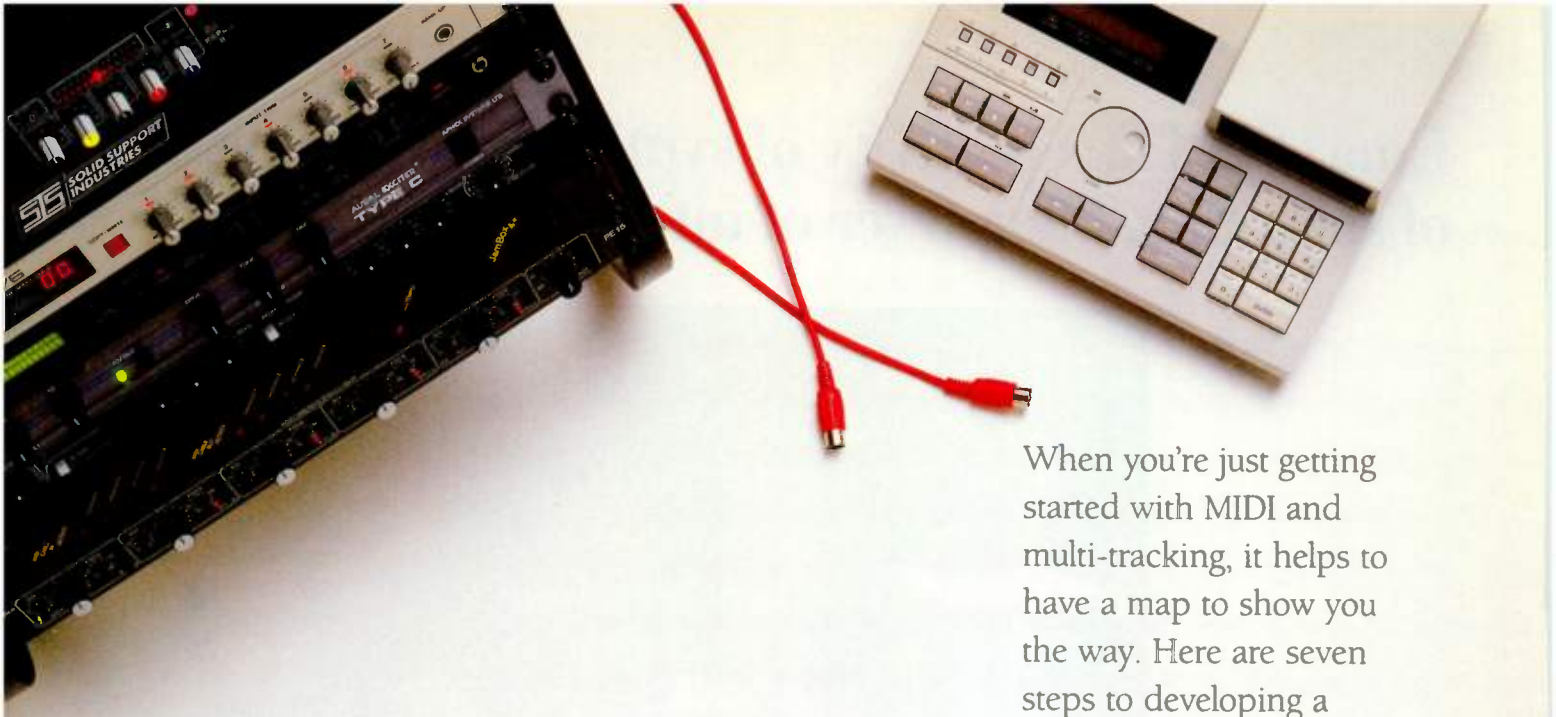



When you're just getting started with MIDI and multi-tracking, it helps to have a map to show you the way. Here are seven steps to developing a MIDI/multi-track studio of your own.

## Mapping Your Way Through

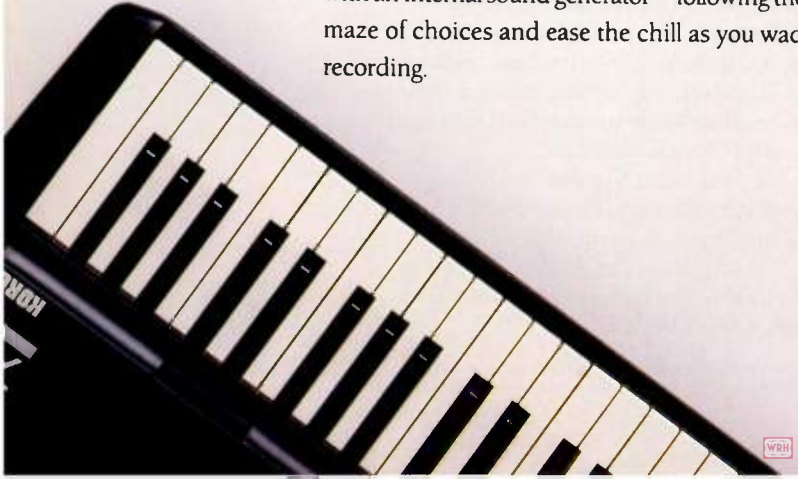
# MIDI MULTI-TRACKING

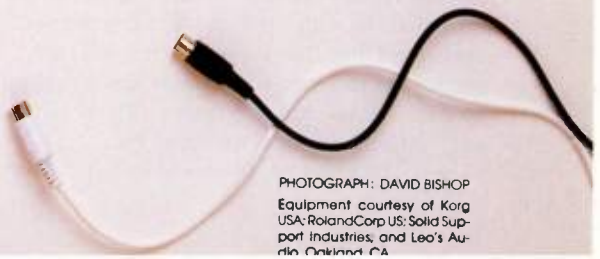
**One of the joys of being a musician is** listening to your own music play back. This joy can be even greater now that electronic musicians can synthesize virtually any sound, and create—even in a small, bedroom studio—intricate and varied orchestrations.

**But for the beginner,** this potential poses some problems. Not every potential MIDI musician has the technical wizardry of a Robert Moog or the financial base of a Chick Corea. As a result, some inevitable questions arise from the maze of options clamoring out of the ads in your favorite music magazine. How do you connect equipment in the most efficient manner? How do you know which equipment to buy with your available funds? In what *order* do you buy it to make sure you can expand the system's capabilities in the future?

**Clearly, a person in this situation needs** a logical, step-by-step approach to connecting the components of a MIDI recording studio, as well as suggestions for developing a systematic approach to expanding the system's capabilities. If you are designing your first MIDI studio—even if it's just one synthesizer and a tape deck, or only one computer with an internal sound generator—following the steps below can organize the confusing maze of choices and ease the chill as you wade for the first time into the sea of MIDI recording.

BY JOHN J. VOLANSKI





PHOTOGRAPH: DAVID BISHOP
Equipment courtesy of Korg USA; RolandCorp US; Solid Support Industries; and Leo's Audio, Oakland, CA

## PHASE ONE

This is where most people start. This system (see **Fig. 1**) offers no overdub (multi-track) capability or computerization: everything you record goes to tape from the synthesizer in one pass, and in real time. In this configuration, the tape deck can be any standard stereo cassette deck, reel-to-reel deck or even a stereo VCR. Beta or VHS Hi-fi are excellent in this capacity.

**Even if it's just one synthesizer and a tape deck, or only one computer with an internal sound generator, these steps can ease the chill as you wade for the first time into the sea of MIDI recording.**

If your synthesizer does not have a stereo output capability, you can simulate one by inserting a stereo effects unit, such as a reverb or delay, between the synthesizer and the tape deck. This arrangement will give your synth a quasi-stereophonic sound and also get you started on the road to using signal processing to enhance the sounds of your instruments. If you don't have a stereo chorus unit, a simple Y-cord will at least get you into both stereo channels.

## PHASE TWO

With the addition of a multi-track cassette or reel-to-reel tape deck—in the case of **Fig. 2**, a 4-track—you now have the capability to do overdubs. That is, you can record one performance, a bass line for instance, then change the patch on your synth and record another, such as the piano, and so on. You will finally mix all the tracks on your multi-track down to a 2-track (stereo) deck. This will be the master tape from which you make all your dubs.

To get the most out of the multi-track, you can "bounce" tracks by using Y-chords to simulate the function of a mixing board in the following way. Assuming the multi-track deck has output level controls for

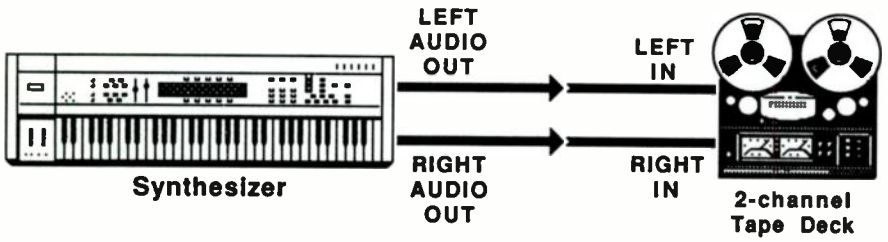



**FIG. 1: While overdubbing is not possible, this setup will let you get your musical ideas down on tape.**

each channel, record four instruments on your multi-track deck. Then mix those to a 2-track deck and record this mixed-down stereo version *back* onto one track of the multi-track. Now three tracks of the multi-track are freed up, and you can record new performances on these tracks. After the four tracks are filled, you can do a final mixdown to the 2-track. Lo and behold, you now have a stereo master.

This process can be repeated a few times, but soon reaches a point of diminishing returns. Even with Dolby, dbx, noise gates, or other noise reducing circuitry, tape hiss and machine noise will reach unacceptable levels after two or three iterations.

## PHASE THREE

The addition of an audio mixer (**Fig. 3**) greatly increases the ease and flexibility of recording. During mixdown, the mixer can control the relative volume of each track on your multi-track. It can also control panning (the placement of a track in the stereo image, anywhere from full left to full right), routing to effects units and equalization.

In this configuration, you can record onto tracks one, two and three, and then submix those to track four. Then put sounds on tracks one and two, and mix them to three. Put a lead line on track one and a counterpoint on track two and you have seven tracks. To put even more performances on your four tracks, you can play a live part as you bounce your tracks, so you would have 12 total "tracks." Of course, you have to be completely satisfied with the mix on these bounces before you proceed, because the original performances will be erased.

We could submix the whole song onto the 2-track so it could be retained as the master recording, or we could record that submix back onto the multi-track deck if additional tracks were required.

The problem with mixers is that they never seem to have enough channels. As you expand your system, you'll find yourself outgrowing your mixer's capabilities. This makes it wise to purchase the mixer with the greatest number of inputs you can afford. As you start adding microphones, a drum machine (which should send each of its instruments through one mixer channel, instead of just using its mono or stereo outs), MIDI voice modules (which have as many as eight outputs, each needing a mixer channel), and various outboard effects, you'll be glad you have the additional inputs.

## PHASE FOUR

In phase four we add a drum machine. A drum machine (**Fig. 4**) gives you the important ability to lay down a solid rhythm track over which all the other parts of your composition can go. Even if you own a sampler that you can load with good drum samples, adding a drum machine to your setup will free the sampler for playing non-drum lines when you record drums and another track simultaneously. Alternately, you can MIDI the two together so each drum machine note triggers the sampler or synth, creating "layered" drum sounds. If your drum machine does not have a

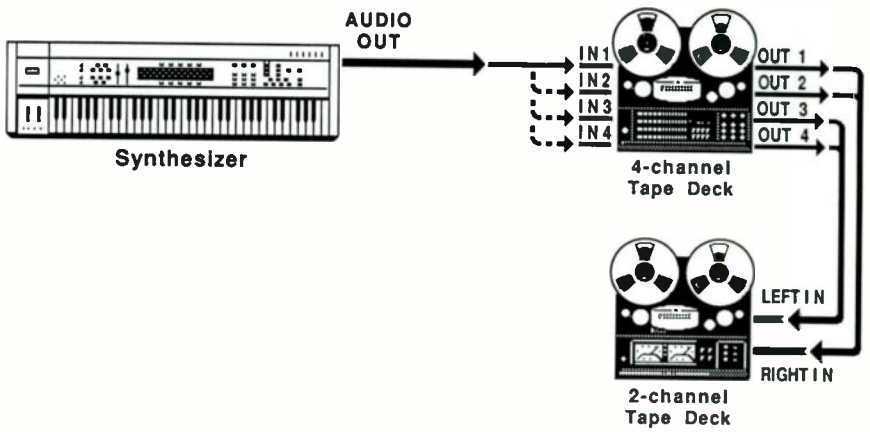



**FIG. 2: Adding a multi-channel tape deck allows for overdubs and experiments in orchestration.**

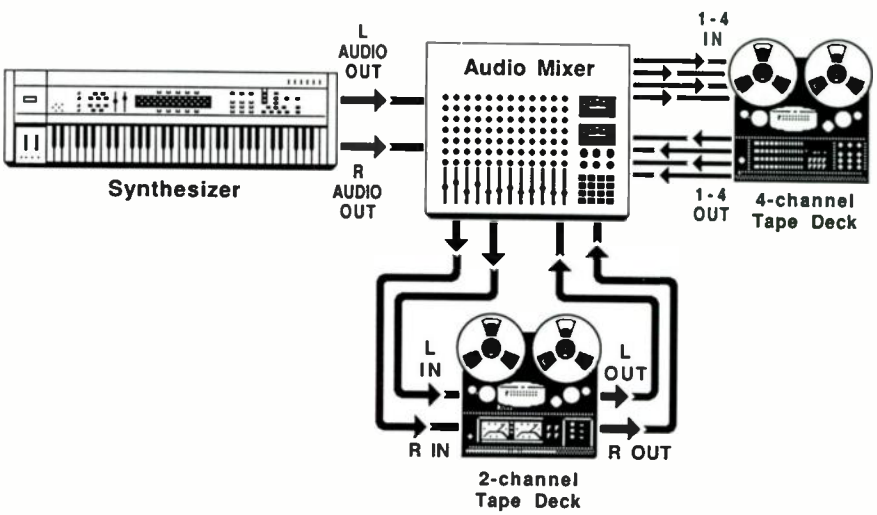



**FIG. 3: A mixer can not only adjust levels, but route signals as well.**

sync-to-tape feature (see the sidebar), no matter how hard you try, the two machines will never play exactly in sync, due to various physical or mechanical factors. This means you will need to lay your drum tracks onto one track of the multi-track deck first.

After you've programmed the drum pattern(s) for your song into your drum machine, you can start the drum sequence and play another part—bass, piano, lead or whatever—on synth along with it while recording both the drums and synthesizer on *one track* of the multi-track. It is the wise musician who arranges the multi-track recording process in the most efficient manner, and tracks are always at a premium.

## PHASE FIVE

With the addition of a MIDI sequencer (Fig. 5), you have essentially added another multi-track recorder—but one that records the digital data produced by a synthesizer or drum machine instead of an audio signal. The sequencer has several advantages over the multi-track tape machine. It has no tape noise, you can edit the musical score, often right down to the note level, and you can play back the sequence you record with any synthesizer voices you choose.

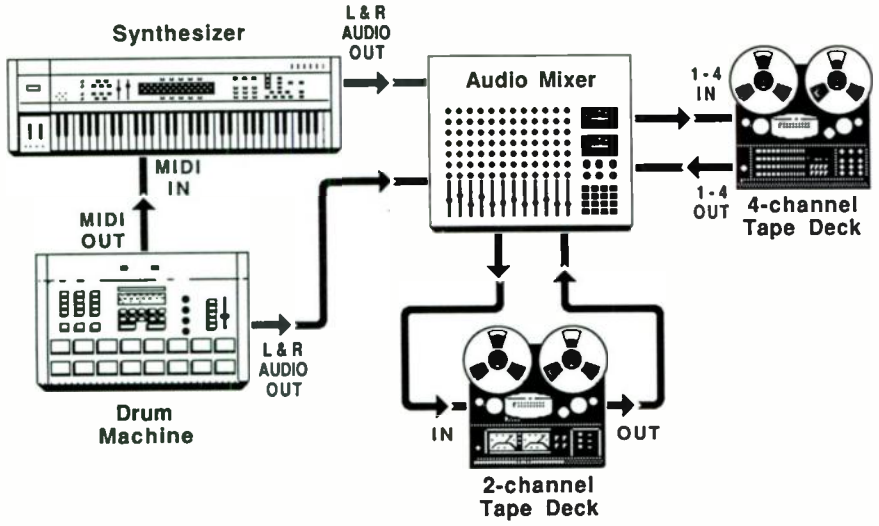



**FIG. 4: Drum machines provide a steady beat, and can lay the foundation for most pop and dance-oriented music.**

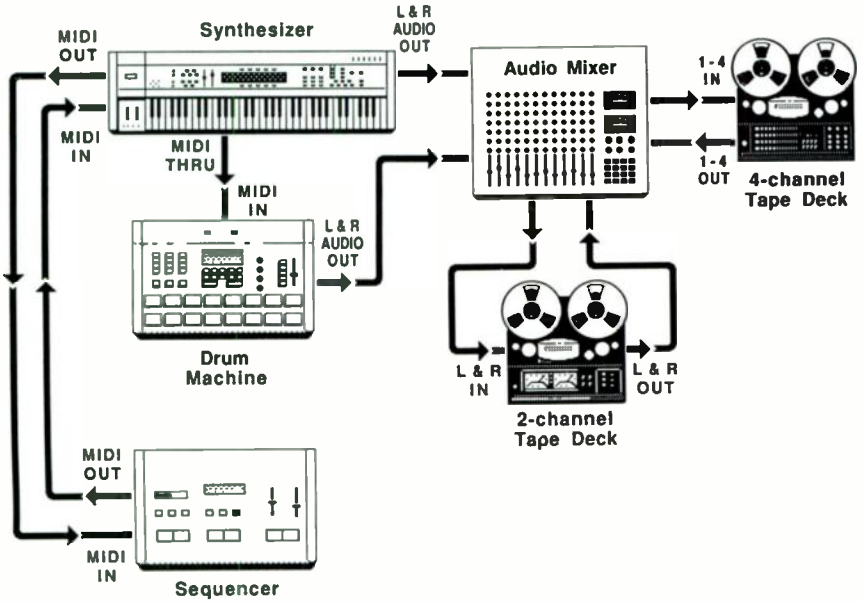



**FIG. 5: A MIDI sequencer allows for a detailed level of editing that is not possible with tape recorders.**

You can record into most sequencers in either real time or in "step" mode: indicating one note at a time. The step mode is especially handy for recording a passage that's too fast or too complex for you to play. The drum machine, sequencer and tape deck can be locked together in various ways, assuring perfect synchronization among those units as you record music onto the multi-track or sequencer.

A possible difficulty with sequencers can arise if you plan to do intricate orchestrations using many voices: you will need a separately addressable MIDI voice for each part you have programmed into the sequencer. Phase six addresses this problem.

## PHASE SIX

Using a "module" type of synth or sampler increases your recording versatility, especially if you're using a sequencer (Fig. 6). These units consist of the sound-generating electronics of a synth or sampler without a keyboard or other controller attached; they take less space and usually cost less. Save your multi-track for vocals, acoustic instruments, or additional overdubs and record all your MIDI instruments—synths, samplers and drum machines—digitally on the sequencer.

For instance, a multi-timbral expander module such as the Yamaha TX802 can give you eight solo instruments, each addressable on a separate MIDI channel and assignable to a separate audio out. You could record a bass, a piano part consisting of four-note chords, a two-note string part and a monophonic lead line each into an individual sequencer track, assign each track its own MIDI channel, and have the sequencer play all of them *at once*. You can then play another part on the synthesizer. The powerful advantage here is that all of these voices and the drum sequence can be recorded directly to the multi-track deck (or to the mastering 2-track deck) in one pass, avoiding the noise build-up that happens during multiple overdubs on the analog tape deck.

## PHASE SEVEN

In phase seven (see Fig. 7), if none of the equipment has provided it yet, we add a MIDI-to-tape sync signal converter such as the Yamaha YMC10. The YMC10 converts MIDI synchronization signals into an FSK tape signal that will synchronize the MIDI drum machine and sequencer to the tape tracks. This adds the ability to

*—continued on page 43*

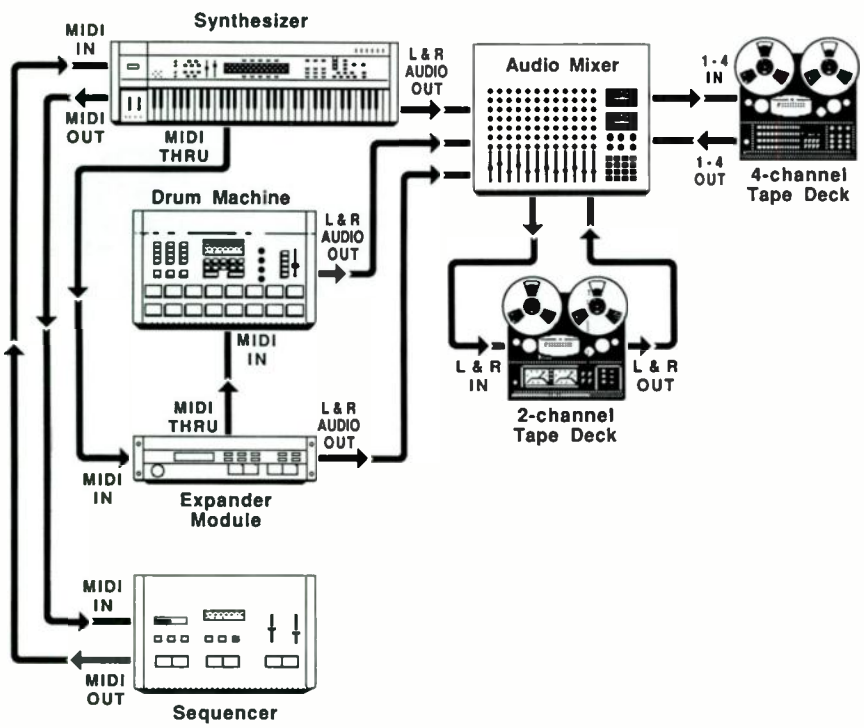



**FIG. 6: With sequencer-based systems, expander modules let you play back more sounds in real time, which can then be recorded on tape.**

## Synchronization

Linking tape decks, MIDI sequencers, synthesizers, samplers and/or drum machines so that they play in sync is an important concern to the musician/recordist. Here are some points to remember.

*Drum machines*, if they are even moderately sophisticated, will both generate and respond to some sort of sync signal, such as the commonly used FSK (Frequency-Shift Keying). The drum machine will produce this signal as it plays the pattern (or "song," or whatever that model calls it) you've programmed into it. Record this tone onto a track of your multi-track, and the drum machine can be set so it plays the same pattern while you play back the tape—in perfect sync, regardless of power fluctuations, tape stretching, mechanical inaccuracies or any of the other sync-destroying real-world elements.

Aside from freeing up tape tracks normally filled with drum sounds, one of the most important benefits of doing this is to enable you to mix the drums "live" to 2-track, and avoid altogether printing them to multi-track. The resultant first-generation drums on 2-track will sound a good deal better than would a second-generation mix.

The combination of a sequencer and a MIDI In port on your drum machine gives you a couple more options. Some drum machines will play their pre-programmed patterns in sync with the *MIDI clock* signal a sequencer sends. Alternately, you can program your composition's drum part into your *sequencer*, either in real time or in step mode, depending on what the sequencer accepts—just as you would for a synthesizer part—and have your drum box respond to that, in perfect sync, of course. To do this, you need to find the MIDI note number of each of your drum machine's instruments, then enter them into the sequencer according to the pattern you desire. You can even do this from your synth keyboard, then send those MIDI notes to the drum box over the MIDI channel to which it's assigned.

***—Tim Tully***

If you've become adrift in a sea of cable clutter, risked hanging yourself on errant patch cords, or watched your tape deck smash to the floor as you tripped over its leads . . . read on.

# AUDIO ASPIRIN FOR STUDIO HEADACHE #1

BY DEAN HEINBUCH

Quick! What piece of studio gear prevents headaches and backaches, saves wear and tear on knee joints, and reduces the need to crawl around, over, and under your rig? Experienced professional and homegrown studio owners most often answer that, used as directed, the humble patch bay provides relief from the pain of interconnecting mixer, effects, and synth.

If you're new to multi-track recording you might not be familiar with just what a patch bay is, or what it does. Even those who've used them might not *fully* appreciate how much easier and faster patch bays make multi-track recording. Since the logical setting up of a patch bay is seldom discussed in books or magazines, I'd like to offer some tips that have worked for me, as well as some ideas on individualizing a setup and finding what works best for you. You live performance types might want to stick around, too: some of the principles of a happy and healthy studio enviroment apply just as well to multi-synth/multi-effects *stage* setups.

Be forewarned that this handy piece of "audio aspirin" is habit-forming. Once you've used one, you could be addicted for life.

## WHAT'S A PATCH BAY?

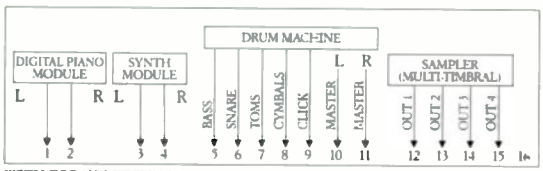
Like the old-style phone system that required the operator to "patch" your call manually by inserting the appropriate connector into a jack, the patch bay is the heart of a network of *audio* patch points that enable your various effects, synths

ILLUSTRATION BY ANDREW SHACHAT

# FOR THE ELECTRONIC MUSICIAN WHO HAS EVERYTHING: THE WAY TO CONTROL IT.


ACTUAL DIMENSIONS: 19"W x 9 11/16"D x 7"H

Actually, it's not even necessary that you have everything. Even if you have just a stereo keyboard, a sampler and a drum machine with separate voice outputs, you've already exhausted the capabilities of a conventional eight-channel mixer. And that's the reason behind the new M-160 and M-240 Line Mixers from Roland: modern electronic equipment demands modern mixers.




WITH TODAY'S TECHNOLOGY, IT'S EASY TO FILL 16 CHANNELS WITH ONLY A FEW PIECES OF EQUIPMENT.

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and tape tracks to connect to each other.

The most common patch bay configuration is a single space (1U) rack-mount unit with between 32 and 40 RCA or ¼-inch phone jacks. Variations on this theme are designed to meet each individual's wants and needs at least halfway: some patch bays include jacks only on the front panel, and require you to solder any leads to the rear of these jacks. While inexpensive, this approach requires a good deal more work every time you change your setup, and is not too practical for people with questionable soldering skills or highly changeable setups. To avoid these problems, many patch bays include jacks on both front and back panels. For studios with a mixture of both RCA and mono ¼-inch phone jacks, patch bays are available with ¼-inch jacks on the rear and RCA jacks on the front, or vice versa.

Some people prefer not to use patch bays with RCA or mono ¼-inch jacks since they're unbalanced and can result in hums and buzzes polluting your sonic environment. These people prefer *stereo* ¼-inch jacks that can be wired in a balanced configuration. However, my patch setup now consists of three patch bays and 160 patch points, exclusively of the RCA variety; at least in my case, unbalanced line operation has not been a problem, probably because I keep my cable runs as short as possible. For those of you who prefer balanced connectors but use tape machines or effects with unbalanced ones, some manufacturers configure their patch bays so both balanced and unbalanced connections coexist on the same bay.

Finally, if you need lots of patch points but are short of rack space, a patch bay equipped with *bantam* jacks might be just what the doctor ordered. These tiny jacks look like ¼-inch phone jacks but are considerably smaller, allowing for up to 112 patch points per 1U rack space.

## ORGANIZING A PATCH BAY

First, consider how many patch points (hence patch bays) you'll need. This depends on the number of inputs and outputs your mixer has, and how many of them you want connected to the patch bay. (Note that more and more mixers put most of their patch points on *top*, instead of on the back. This greater accessibility eliminates the need for patch bays in many situations, and saves rack space.) Further, the more effects devices, recorders and instruments you have, the more patch points you'll need.

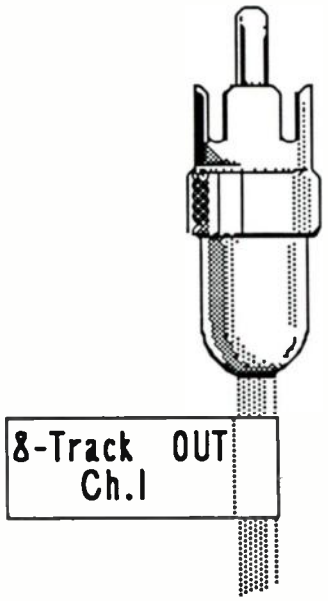


**FIG 2: Fold strips of tape around each end of each cable, and mark the tape with the appropriate signal connection.**

After adding up all your connections, decide if you're willing to pay for the convenience of having the input/output of each effect and every mixer input/output available on your patch bay. Some compromises may be in order (aren't there always?), but don't skimp too much. Remember, the object of having a patch bay in the first place is to reduce the amount of time spent crawling around, under, and over that multi-track, multi-synth, multi-MIDI, multi-computer, multi-payment recording rig for which you've given up all semblence of a normal social life.

Second, figure out how many patch cables you'll need; you need one cable for every input and every output you'll be bringing up to the patch bay. Don't forget to account for the *jumper cables* needed to route signals on the front of the patch bay; these should be no less than one foot and no more than two feet long. Count on needing about one-third to one-half as many patch cords as your patch bay has patch points. If you're not using a *normaled* patch bay (see sidebar), you'll also need a healthy supply of very short cables (about six inches) so you can connect your normals from the front.

## PLANNING YOUR APPLICATIONS

Before you plug in a connector or solder a wire, plan the layout of your patch bay on paper (use the diagram in **Fig. 1** as a guide; the diagram is for three, 32-point, non-normaled patch bays). Group your connections in a logical manner so they're easier to find. In the case of **Fig. 1**, where the mixer direct outs are grouped directly under the tape ins of the 8-track recorder, it's easy to bypass the submaster section's bus outputs and feed the tape machine from each channel's direct out. This bypasses an additional gain stage and results in a cleaner signal —there's no need to use the bus outputs until you have to do a submix. Likewise, the bus inputs of the main mixer are grouped directly over the line outs of external line mixers. Also, notice all the effect inputs and outputs are grouped together for ready access and easy, in-series connection. Keep your diagram on file so you can plan and record any future updates and changes. If you ever have to move your studio to another location, you will have a ready

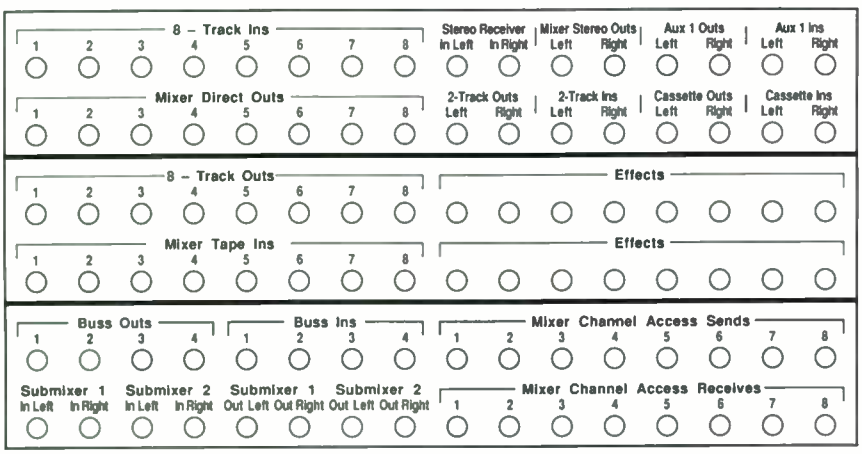


**FIG. 1: Three, 32-point, non-normaled patch bays. Use this as a planning guide.**

record of the signal flow you're accustomed to using.

Next comes the most tedious part of the whole job: labeling each cable that will be connected to the patch bay's rear panel. Cut three-inch strips of half-inch masking tape, two for each cable (don't cut more than a few at once). Fold the strips around each end of each cable, a couple of inches behind the connector, as shown in **Fig. 2**. Mark the label with the appropriate signal connection (e.g., "8-Tk Out, Chan 1"). This step is a lot of work, but you'll be glad you did it the first time something goes wrong and you have to trace down a single connection through dozens of others.

After labeling, connect your cables to the jacks on the patch bay's rear panel. Number each patch point or set of patch points on the back and front of the bay.

After making all the rear panel connections, label the patch bay. There are three ways this is commonly done. Some people crudely scratch the names of input-output points on the patch bay with a pencil and subsequently go blind trying to make out the writing in a darkened studio. Another method is to use a long strip of masking tape to label each row of connections. This is a definite improvement until you want to relabel something: it's inefficient to tear off the whole strip of tape to re-mark one or two connections (not to mention the gob of yucky glue stuck to the patch bay along with tape pieces that won't come off without a belt sander). The third way is my own patented "neat freak" method, which uses something called *signal labels* (normally used by libraries for who knows what obscure purpose). At any rate, go to your nearest office supply store and ask for Dennison PRES-a-ply signal labels. These ⅞-inch mini-labels are the perfect size for patch bay labels. For denser bays, they can be trimmed down, and they even come in several colors for those into color coding.

There's still one more thing to do: verify the proper signal flow. After all, you don't want to find out you've got track seven of your tape deck normaled to the tape in of mixer channel eight in the middle of a hot session. Avoid humiliation! Take the time to check each connection point by point.

## IS IT WORTH IT?

Sure, you could buy one of those snazzy, budget digital reverbs for the cost of a patch bay and cables. But a patch bay will give you something that even the most sophisticated reverb can't: painless access to all your equipment. While it won't add to your arsenal of effects, it *will* give you faster access to the sounds you do have—almost as fast as routing signals exclusively with switches—and provide the beneficial side effect of easy visualization of your signal flow. **Fig. 3** demonstrates a patch that's pretty typical of mixing tape and several virtual tracks to stereo.

Since I use a lot of virtual (sequencer) tracks, I have to supplement my only full-featured mixer with a couple of line mixers, which greatly complicates matters. For mixdown (**Fig. 3**), the tape machine outputs are repatched to a line mixer. I can use the simpler line mixer for tape outs since I print my equalization and effects (except the aural exciter) to multi-track tape, and therefore don't need most of the main mixer's extra fea-

tures. This leaves the main mixer free to EQ my drum machines, MIDI Bass and Mirage sampler, and use its greater flexibility in routing effects for my virtual tracks. I use a second line mixer for my analog and digital synths since their onboard filters and operators can provide basic equalization functions.

In a complex patch such as this, any mistakes in audio connections are easily tracked down by following the signal flow on the patch bay front panel. I'll even go so far as to say that a well-organized patch bay just might encourage you to attempt more sophisticated patches and produce a more polished sound.

## WHAT'S OUT THERE?

There is a *tremendous* variety of "audio aspirin" out there from which to choose. First up is the Ross R-16 patch bay. Although it's kind of clunky-looking and takes up two rack spaces instead of the usual one, at $100 list, the price is right. The jacks are ¼-inch balanced phone, front and back, and it comes front panel-normaled and may be modified to be rear panel-normaled by the reversal of internal circuit cards.

The Fostex entry is the 3010 ($90), a rack-mountable patch bay with 16 RCA-type normaled pairs for a total of 32 points.

Tascam offers considerably more variety with its PB-32 series patch bays. All five models are 32-point patch bays consisting of 16 normaled pairs. The Tascam units are the PB-32P, with ¼-inch phone jacks front and rear ($140); the PB-32R, with RCA jacks front and rear ($125); the PB-32H, ¼-inch front, RCA rear ($135); the PB-32W, 12 ¼-inch jacks front and rear, 20 RCA jacks front and rear ($130); and the PB-32B, with 32 ¼-inch, tip-ring-sleeve phone jacks front and rear ($175). Tascam also offers the PB-64, consisting of 64 RCA connectors which are *not* normaled, but connect directly to the rear panel ($120). The normaling can be defeated on both the Fostex and the Tascam units.

Gaines Audio offers what it calls "the affordable quality alternative." If you need a patch bay that can be wired to accommodate both balanced and unbalanced lines, the Gaines Model BN-16 should fit

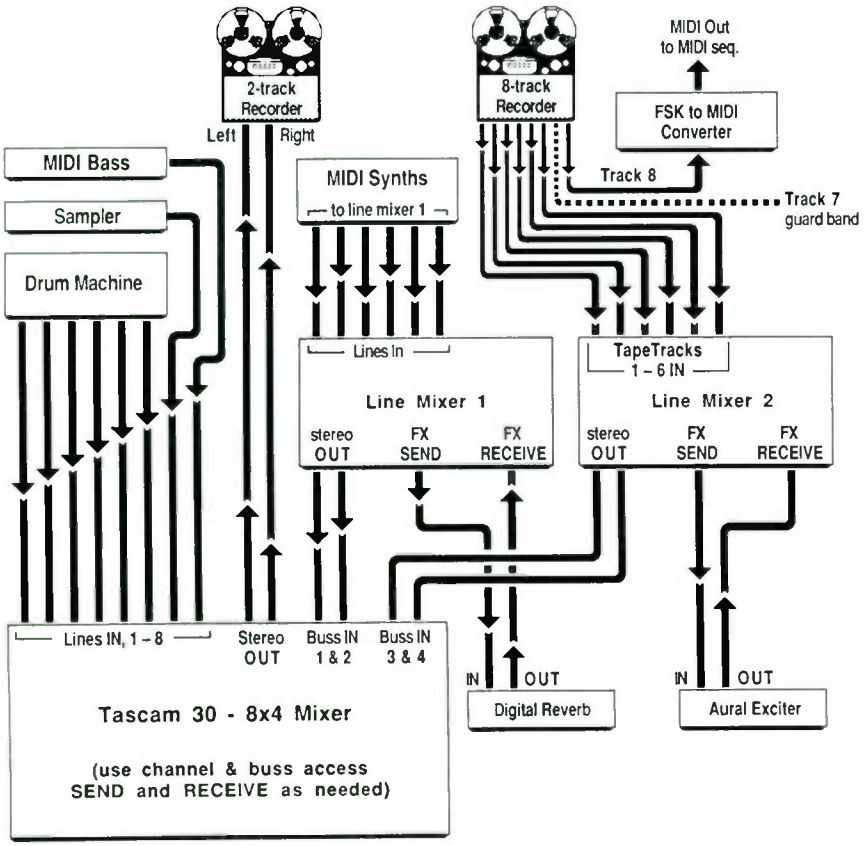


**FIG. 3: A typical patch for mixing tape and several virtual tracks to stereo.**

the bill. It has jacks on the front but requires you to solder the cable to the rear panel yourself. The standard BN-16 is supplied with all its top row jacks normaled to the bottom row. If you want to remove a normal from the signal path during installation, you simply cut the trace on the back of the circuit board with a razor blade. If you need to restore the normal later on, a drop of solder on the trace will restore it. At $85 for a 32-jack patch bay, and $125 for one with 48 jacks, it's certainly affordable. Gaines Audio also offers a patch bay with ¼-inch Switchcraft phone jacks on both front and rear for solderless installation. Another model, the PB-64, can be used as an unbalanced patch bay without modification, or balanced and unbalanced lines may be intermixed as needed. You may, as an option, specify RCA, BNC, or any connector that mounts in a ⅜-inch hole for installation on the rear panel. The cost of the PB-64 is $145. All the Gaines patch bays are available direct from Gaines Audio and are even cheaper when bought in quantities of two or more.

Furman Sound offers versions of Le Patch PB-40, a 40-point patch bay available fully assembled with ¼-inch phone jacks front and rear ($155); ¼-inch front, RCA rear ($145); and RCA front and rear ($145). If you want a custom "mix and match" combination, there is an additional $20 charge. Normaling is easily defeated by cutting a jumper on an internal circuit board. Several other customizations, most of which require some soldering, are also possible. These include third-circuit switching for specialized applications by means of isolated switches on each of the jacks, and the installation of multiples. Instructions for these modifications are included with the unit.

If you decide that smaller is better, Studio Sonics offers the Switchcraft Tini Telefone Patch System, assembled, for $318. Because of the small size of its jacks, a standard 1U, 19-inch rack holds a 96-point patch bay—a very cost-effective unit.

For state of the art, try the Akai Digital Matrix Patch Bay System ($2,499.95). The DP3200 is a 32 × 32 programmable patch bay with 64 programmable memories. Accessories include the PG1000 Universal Controller ($1,199.95)—with patch patterns switchable by MIDI, audio trigger, SMPTE, or a computer—and the MZ1000 monitor ($899). These are a little out of *my* price range, but the way things are going, within a couple of years somebody like Alesis will be making one for $19.95.

## TAKING THE CURE

If you've read this far, it probably means you have SRPS (studio-related pain syndrome) compounded by "console-crawlitis" and "patch confusion." If so, it's not too late to do what hundreds of **EM** readers have already done: take the cure. Pop a patch bay in your rack. You'll be glad you did. **EM**

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*In addition to composing and recording,* ***Dean Heinbuch*** *enjoys reading, watching old movies, playing flag football all year 'round, intersteller space travel and eating pizza or chili for breakfast. He has the dubious distinction of being the only electronic musician in his small home town in the deep South.*

## Normal and Not Normal

There are two types of normalized patch bays. In a *full normaled* patch bay, the top row of jacks is connected ("normaled") to the bottom row of jacks internally. A signal appearing at any of the upper jacks goes automatically to the jack below it, and vice versa. A patch cord inserted into either jack *on the front of the bay* will break the normal connection and re-route the signal.

In a half-normaled patch bay (also called normaled down), the internal connection allows the top row's signal to continue to flow to the bottom row, even when a patch cord is inserted into the front *top* jack. If you need to break the connection to the bottom row you must insert a connector into the *bottom* jack. So, if the top row of a patch bay carried a tape machine's output, and the bottom row was connected to a mixer's tape inputs, a patch cord inserted into one of the top row jacks would allow you to route the tape deck's signal to a spare input channel—for separate signal processing, for example—without interrupting the normal flow to the mixer input. This type of normaling provides you, in effect, with a built-in "Y" cable. Similarly, some patch bays, like the Furman Le Patch, can be fitted with "mults" (multiple paralleled jacks) that split one signal into several.

On a patch bay that is *not* normaled, the connectors on the front panel connect directly to the rear panel (as with a double female coupling connector). On a system of this type, all input or output cables brought up to the rear panel must be routed and re-routed by means of short patch cables ("jumper cables") inserted into the front jacks.

—*DH*

## List of Manufacturers

**Fostex Corporation of America**
15431 Blackburn Ave.
Norwalk, CA 90650
☎ 213 / 921-1112

**TEAC Corporation of America**
7733 Telegraph Road,
Montebello, CA 90640
☎ 213 / 726-0303

**Gaines Audio**
1237 E. Main St.
Rochester, NY 14609
☎ 716 / 266-0780

**Furman Sound Inc.**
30 Rich Street
Greenbrae, CA 94904
☎ 415 / 927-1225

**Ross Systems**
PO Box 2344
Ft. Worth, TX 76113-2344

**(Akai Digital Patch Bay)**
**International Music Company**
1316 E. Lancaster St.
PO Box 2344
Fort Worth, TX 76133
☎ 817 / 870-1271

(Switchcraft Tini
Telefone Patch System)
**Studio Sonics**
☎ 312 / 843-7400

(Dennison PRES-a-ply
signal labels)
**The Highsmith Co. Inc.**
W5527 Highway 106
PO Box 800
Fort Atkinson, WI 53538-0800
☎ 800 / 558-2110

**Part 1**

**Ever dreamed of giving up your day job and going full-time into music? The road can be rocky, but here's how one electronic musician went about turning his dream into reality.**

# THE YEAR OF LIVING DANGEROUSLY

**By Kofi Busia**

**EDITOR'S NOTE:** The following article, originally printed in England's *Sound On Sound* magazine, tells how SOS reader Kofi Busia—an African living in England—funded, and then released, his own independent LP called *Oh Africa*. The article (one of the most popular SOS has ever run) will be reprinted in EM as a three-part series to encourage readers on this side of the Atlantic to follow Kofi's shining example. In part one, the author faces the insecurities of giving up his job for music, comes to grips with using modern technology for African music, and describes the difficult process of choosing his equipment.

I have loved music all of my life and played the piano for as long as I can remember, thanks in part to parents who paid for me to have lessons. About 18 years ago, when I was at university, my musicality entered a different kind of phase: I dreamt a lot about actually *being* a musician. I had been classically trained on the piano and that somewhat limited my style; I therefore learned to play the guitar, and used to be able to entertain my friends with it. I also started writing songs and—like everyone else—dreamed of topping the charts and changing the world, like Bob Dylan, Stevie Wonder, Marvin Gaye, John Lennon and others. I wrote over 200 songs and, at one point, even entered the *Melody Maker (a British music magazine—Ed.)* rock/folk contest! I got nowhere.

But all good things come to an end, and my university days

KIRSTEN HUGHES

The author, Kofi Busia, with some of the equipment he used to record his LP *Oh Africa*.

were soon over. I had to deal with reality; the time had come to stop these foolish dreams and earn a living. Eventually, I ended up running a small one-man business of my own.

Once you have been bitten by the music bug, however, it never really leaves you. I felt that the least I could do was put together a really good hi-fi system. I spent a lot of my hard-earned money and spare time buying and listening to records, but I still vaguely remembered my dreams. Something kept nagging at me that there must have been at least *one* good song among the 200 or so I had written. Occasionally, when I heard really dreadful songs in the Top 40, I wondered if mine had really been so much worse than that. Other people seemed to be megastars with not even one good song to their name! Still—I carried on, coping with tax returns and the like. I always had a piano and guitar around and played whenever time would allow. This was not much, and I certainly never had time to write anything. Time passed slowly—I grew, developed; eventually got married; had a kid.

After a while my wife made me a proposal. She could see how much I loved music and loved playing. "Why," she said, "don't you take time out from your business and be serious about your music? After all, you have worked your guts out and haven't had a holiday for over 15 years."

I was a bit dumbfounded, but she was quite serious. She would go back to work to support me; we could sell the house; I would look after our daughter in the daytime; the evenings would be mine. The thought was intriguing. Did I really have the courage and conviction? Now that I had been put on the spot, was I just a romantic poser, or was there something serious underneath? Before making such a major decision though, I thought I should find out if the old musical skills were still there. Also, could I actually play and write music, or were those memories just nostalgia for my youth?

After some careful thinking, and some realistic evaluation of the kind of music I wanted to make, it became obvious: get a synthesizer. But which one? I could not *believe* how the music-making scene had changed. Nothing made sense any more—the technology was just outrageous. I knew no names; I decided to just go by my ears. After all, choosing your instruments properly has *always* been part of the musician's craft. For several weeks I went to every music shop in the area and just played and listened. Eventually, I went for the synthesizer that seemed to make great sounds that I liked and had great versatility.

Next problem: I couldn't afford it. Out with credit cards; home with the machine. It said on the front: "Yamaha DX7." I knew about Yamaha; they made motorbikes. God alone knew what "DX7" stood for. There was obviously a whole universe here I knew nothing about. But I was ready, willing and eager to learn.

**I knew about Yamaha; they made motorbikes. God alone knew what "DX7" stood for.**

Man, but it was good to be playing again. I felt right at home just playing and practicing and running through all the amazing sounds I had bought. But more than that, I could sense a few songs in the background waiting to emerge.

After a couple of months of soul-searching, I eventually decided that it would at the very least be enormously satisfying and very great fun to take up my wife's proposition. Even if no financial success came of it, I would really enjoy it and feel fulfilled. Even if I ended up re-starting my old business, at least I would know I had given myself a fair break. So, the decision was made. I wound up my business; we put our house on the market and looked around for a much smaller one; I started researching for some more gear; and we went almost totally broke.

I knew—musically and artistically—where I wanted to go and what I wanted to do. I knew I would be working completely alone with some fairly complex, percussion-based material and arrangements. It was obvious from my reading around that I would have to investigate and check out this MIDI stuff thoroughly,

because it seemed to allow for what I wanted. I knew I had gone and bought myself a *digital* synthesizer, and I'd read that it was incredibly hard to program. This did not particularly bother me, for I didn't know what a *non-digital* synthesizer was, how it differed, how to program one, or what it did that was so different. The most important thing to settle was the price to ask for our house—which depended largely on what kind of equipment I was going to buy! As for what to choose, I just started from where I was and what my needs were likely to be.

As a keyboard player, I was already finding the DX7's keyboard very frustrating; it was so short and stumpy. None of the magazines I read ever seemed bothered by the length and feel of the keyboard, but it was a major factor to me. So I formed my first rule. *I* was the one who was going to be using the equipment. It did not matter if other people felt I was wasting my money. What mattered was an environment in which I felt comfortable and creative. I longed to be able to let my fingers rip, properly. Obviously, a better keyboard was called for. I came across the concept of the "master keyboard," and getting one became one of my priorities. Eventually, I decided on the Yamaha KX88. I love it and have never regretted buying it. It has proved its worth many times.

I also foresaw, from the kind of music I was writing, that a second synth would be very helpful. I knew that the Yamaha DX7 could only play one sound at a time and I had already wished for moments when I could play different sounds simultaneously. I had learned enough to know that I only needed an "expander module" now, and not another synth. Again, I went by my ears. I had liked the sound of the Korg DW8000 synth when investigating before and, after listening around again, still liked it. So I chose the expander version, the EX8000.

I was *very* attracted to the Oberheim Matrix 6R, but could not spend enough time trying it out because it was not sold locally; also, its range of instantly available, plug-in sounds was not as good as the Korg. I *did* intend to learn how to program my own sounds, but I also wanted to make music straight away when I opened the box. Although I was attracted by samplers, I felt that learning my way around digital and analog programming would keep me fully occupied for a while, and left those for another day.

Then came the hardest battle of all. What was I to do for rhythm programming? As an African aiming to write African music, percussion was important to me, but I simply did not like the sounds of any of the available drum machines—most of them were so artificial, and in my music the drums would often be right up front, not in a heavily produced background.

Further, I would be working with what are known musically as *additive rhythms*. A song in 4/4 time, 96 beats per minute, four minutes long, has 96 bars of music. Working with additive rhythms, every single bar would be completely different, and I could not find any drum machine that would remember that number of patterns, never mind the time and staggering complexity of programming them.

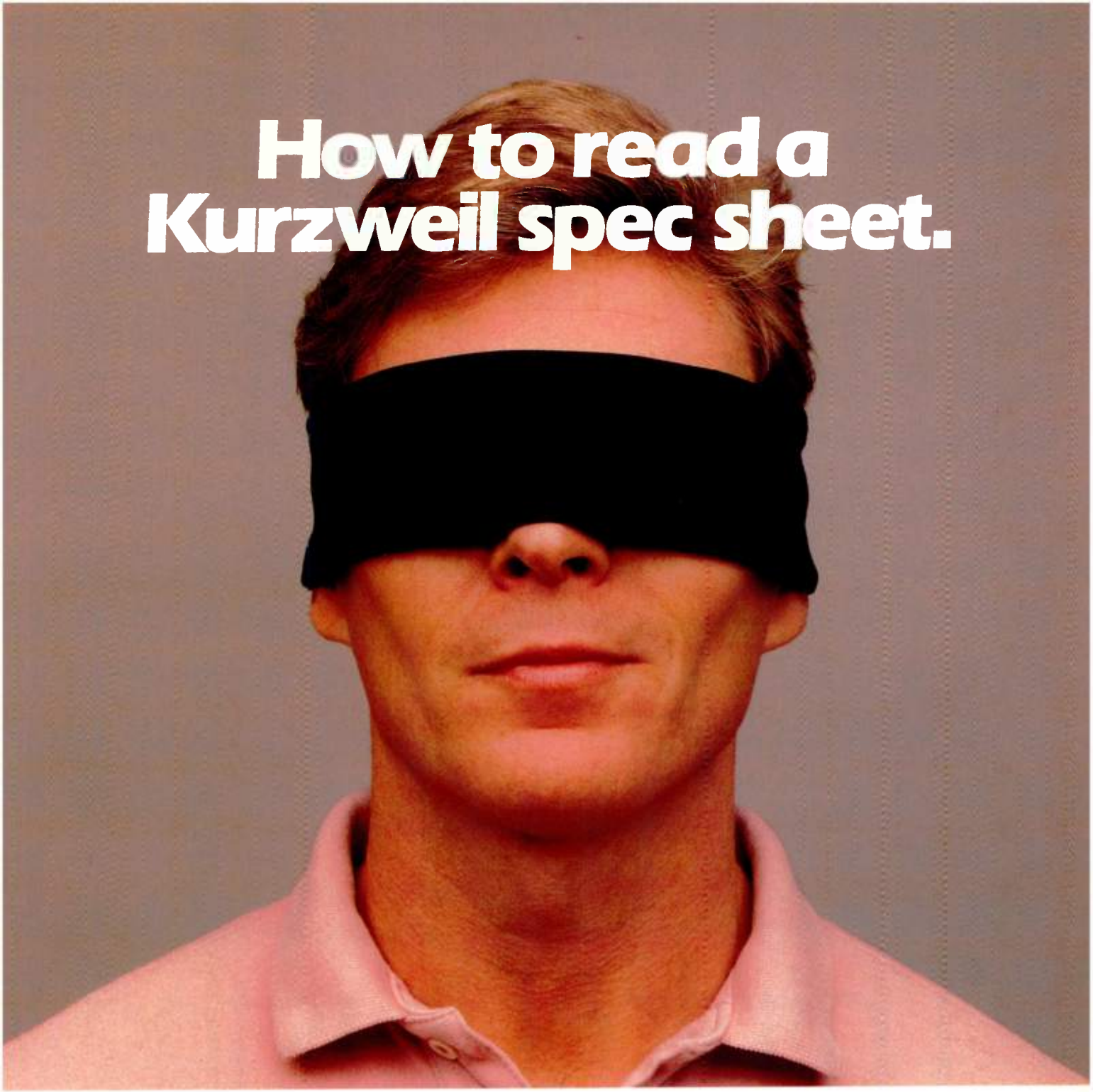
After a frustrating time researching drum machines, it suddenly hit me that I did not necessarily have to buy a *drum machine*. The gadgets I had seen both made the sounds and remembered how to re-create the patterns. I could, instead, just go for a drum *synthesizer* to create the sounds and a *computer* to do the memorizing. I knew from experience that computers were fast, efficient and powerful, and that software (often) made the machine behave intelligently. The thought of being able to "word process" music seemed more and more attractive; I was in a situation where I had to be a full band myself, and the thought of a computer standing in for a few backup musicians was definitely worth checking out.

Having decided on external pattern storage (courtesy of the computer), I could now look at using a dedicated drum system for producing the sounds. Eventually, I settled on the Simmons SDS9 and MTX9. They had a fairly sophisticated MIDI interface and a collection of percussion sounds that could be easily edited, modified and stored. Working with additive rhythms, the important thing is the varying relationships of the instruments to each other—carefully chosen, subtle timbral and temporal changes. Being dedicated drumming equipment, the Simmons units handled this easily. The Simmons could also be played from pads, my master keyboard, or the computer. It was made for the serious drummer and dominated the Top Ten. What more could I ask for?

For the production end, I knew I would need a mixing console. Choosing one was hard at first, as I had absolutely no engineering or mixing experience, and I started again from my requirements and my budget. I looked and listened, and eventually decided on the Seck 1882. A lot of knobs and switches made absolutely no sense to me, but even with my lack of experience, a little intelligence and guesswork made it reasonably obvious what a particular control did, just by its position.

Secondly, although it appeared designed for ease-of-use by ignoramuses such as myself, it seemed to have a functional depth that would allow me to use it in more sophisticated ways as my experience grew. The Seck was not short of places to put things in or take them out. Although I didn't know what all those jacks did yet, they were there for the time when I *did* find out. I could see that there was plenty of scope. Further, although the 1882 was designed for use with an 8-track recorder—it would only put out eight signals at once—you could choose

*—continued on page 43*

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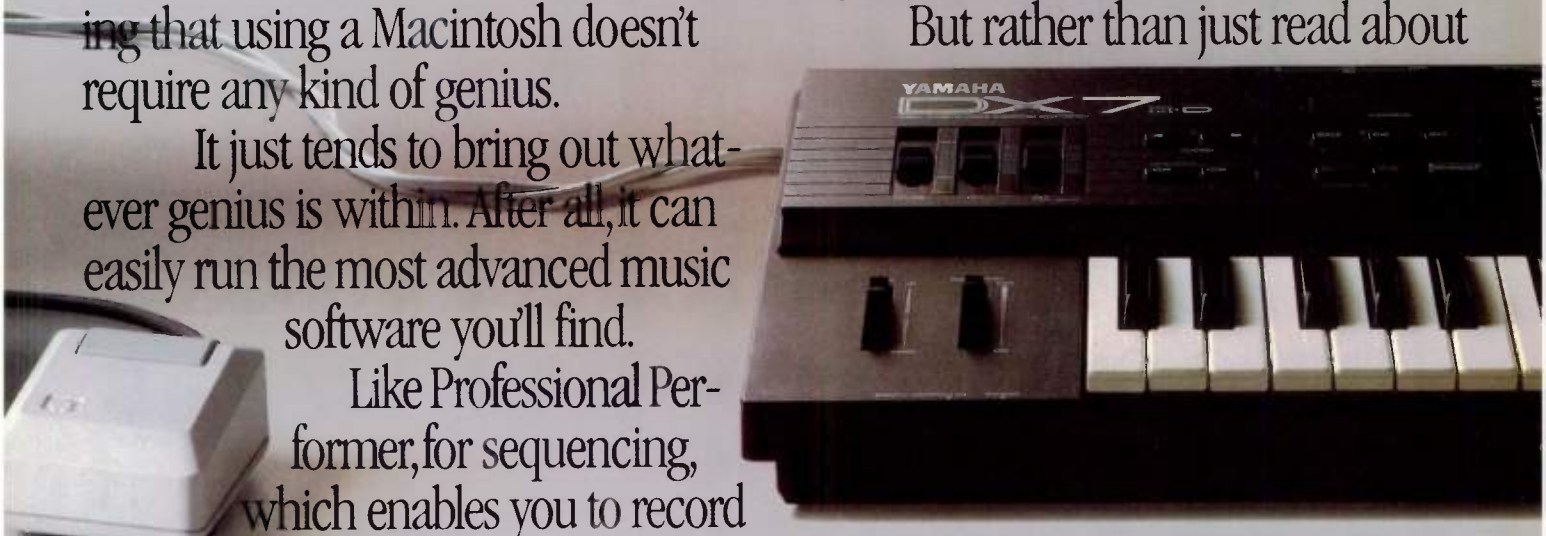


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—from page 38, YEAR OF LIVING DANGEROUSLY

which eight out of a possible 16, and you could use it with a 16-track. And of course there was its size. It's beautifully light and compact for what it does, and there was not going to be a lot of room in our new house.

The next step was the tape recorder. I could not afford a 16-track and since the computer-based sequencer would let me lay down sequencer tracks "live" to stereo without going to multi-track anyway, I decided on a Fostex Model 80 8-track.

I was now running out of money. We would never sell our house if my projected gear cost too much, so I decided to compromise. I knew absolutely nothing about the production end of the music business, but after a lot of careful reading and study and a little listening, I decided that if ever I went into a studio I would make sure they had good equipment and a friendly engineer, and what *I* was doing was writing the music, not being a producer. That meant I wouldn't have to invest in a lot of studio-quality signal processors.

I chose a Yamaha GC2020 compressor because I could understand what one was for, and all the reviews praised it highly; but otherwise, when it came to effects units I was completely baffled. For my own primitive work and knowledge, I went for the Roland DEP-5 because it could do lots of different things at once, whatever they were and whatever that meant.

Finally, I rounded off by choosing two patch bays—one ordinary one (for audio signals) and one MIDI. I had gotten very tired of plugging leads in and out of the backs of things with my hi-fi system, and I wasn't about to go through all that again. I wanted to just sit down, relax, make music and write, not worry about patching things up every five minutes. After all, that was what all this sacrificing and reduction in living standards was about.

I had a very good hi-fi system based around a Quad amp and some first-class loudspeakers that a friend and I had put together many years ago. These, and my Beyer Dynamic DT100 headphones, could be used for monitoring.

I now knew what equipment I wanted. We could therefore fix a price for the house, sell it and buy another place to live, hopefully without eating into this very important musical fund. One fine day we got a buyer for our house; then we found another place and bought it. We moved in. Next, I ordered the gear, the cardboard boxes arrived, I unpacked them all and . . . well, next installment, I'll tell you how I came to terms with my equipment and MIDI, my journey through programming, what I learned about sequencing, and recording in a studio. See you then. **EM**

*(The end result of Kofi Busia's efforts is an unusual album entitled* Oh Africa, *released by African Records International [44 Cowley Road, Oxford OX4 1HZ, England] and distributed by EMI/Jet Star.)*



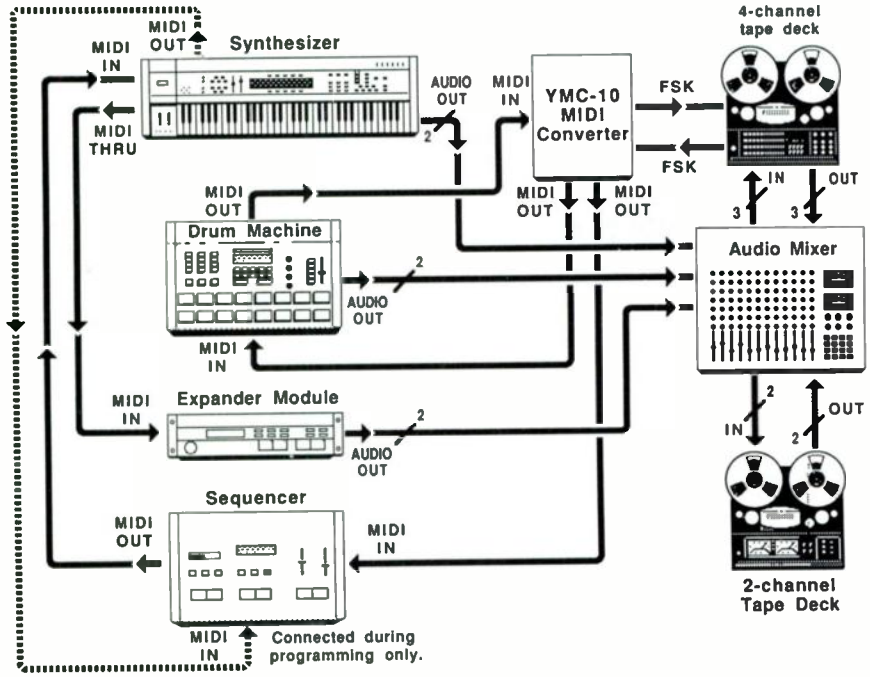



**FIG. 7: Sync-to-tape facilities allow you to layer sequencer parts and drum patterns on tape and retain proper synchronization.**

—from page 28, MIDI MULTI-TRACKING

record large orchestrations with only a 4-track. The YMC10 links digital MIDI recording technology with analog tape recording.

## PHASE EIGHT AND BEYOND

What can we possibly do to improve the studio setup of phase seven? Plenty.

*Recording:* You can upgrade your 4-track to an 8- or 16-track; you can enhance your mastering capabilities by using the audio tracks of a Beta or VHS Hi-fi VCR. Even better, analog-to-digital converters such as the Sony F1 record 16-bit digital sound onto the *video* track of any (not just a Hi-fi) video tape. Mastering with either of these methods can rival or equal the quality of compact disc recordings, especially if mastered directly from a digital sequencer/MIDI recording setup. In addition, digital audio tape (DAT) may be available soon.

*Audio mixer:* As I mentioned, there's never enough audio channels in your mixer; upgrades are always useful.

*Expander modules:* The more expander units you have, the more you can master from live (sequenced) performance, and bypass the multi-track stage.

*Patch bay:* A patch bay can save considerable time when reconfiguring your studio for different recording and playback scenarios. *(See Dean Heinbuch's article on patch bay basics in this issue.—Ed.)* **EM**

***John J. Volanski** has an MBA and a BS/EE and works as engineering manager at Ball Systems Engineering Division in San Diego. His home studio includes instruments ranging from an ARP Odyssey (modified for MIDI) to a Yamaha DX21 and a custom-built 16 x 4 mixer.*

# SPXFILE:
# An SPX90 Librarian

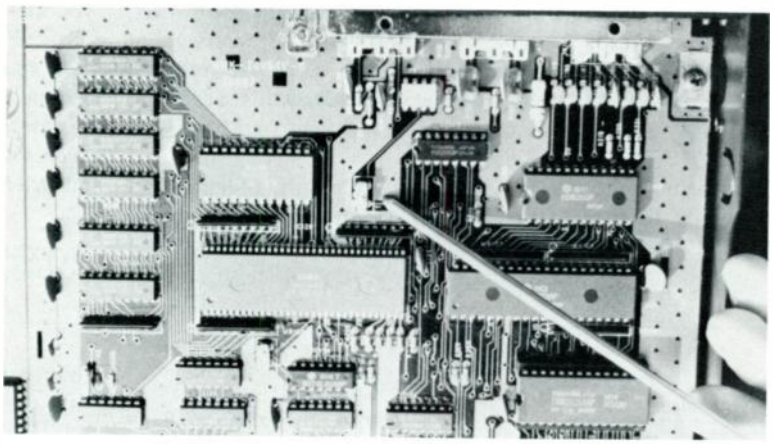


FIG. 1: Where to find the mysterious Thru-to-Out conversion switch.

**Yamaha's SPX90 is a versatile and affordable digital multi-effects unit, but its memory has been a locked door—until we found the tool to MIDI Thru the bars and get the programs Out.**

BY CARTER SCHOLZ

## IT HAPPENED TO A FRIEND OF MINE.

The day before a gig, his SPX90 developed amnesia. All the programs he'd been saving in user memory for months were gone. Backups? Backing up data is like flossing your teeth: you know you ought to, but who bothers? And the problem here is that the SPX90 is literally impossible to back up. There's no MIDI Out. There's no cassette port. It's positively medieval (MIDIeval?)—the only way to archive SPX90 data is with paper and pencil. Until now.

SPXFILE is an IBM/clone program that can upload and download all SPX90 (or SPX90II) user memory, in single programs or in a bank, once you've made a simple, quick modification inside the SPX90 (which Yamaha says will not void your warranty).

```
{ Copyright (c) Carter Scholz 1987 }
{$I mpu.inc}

const
  MaxBuf=$7FFF;  msglen=96;  kind=$4D;
  ProgNumOffset=15;
var
  MidiData, mem, chksum: byte;
  i, B, choice: integer;
  SysEx, Quit, done: Boolean;
  FileName: string[14];
  buffer: array [0 .. MaxBuf] of byte;
  MidiFile: file of byte;

procedure SaveFile (len: integer);
  begin
    rewrite (MidiFile);
    for i:=0 to len-1 do
      write (MidiFile, buffer[i]);
    close (MidiFile);
  end;

procedure GetFile;
  begin
    reset (MidiFile);
    for i:=0 to filesize (MidiFile)-1 do
      read (MidiFile, buffer[i]);
    close (MidiFile);
  end;

procedure Request (mem:byte);
  begin
    putdata ($F0);   putdata ($43);
    putdata ($20);   putdata ($7E);
    putdata ($4C);   putdata ($4D);
    putdata ($20);   putdata ($20);
    putdata ($38);   putdata ($33);
    putdata ($33);   putdata ($32);
    putdata (kind);  putdata (mem);
    putdata ($F7);
  end;

procedure Receive (mem:byte);
  begin
    Request (mem);
    done:=false; sysex:=false;
    repeat
      GetData (buffer[B]);
      if buffer[B]=$F0 then sysex:=true;
      if buffer[B]=$F7 then done:=true;
      if sysex=true then B:=succ(B);
    until done;
  end;

procedure Send (mem:byte);
  var
    i:byte;
  begin
    buffer[B+ProgNumOffset]:=mem;
    done:=false;
    chksum:=0;
    for i:=0 to msglen-3 do begin
      putdata (buffer[B]);
      if (i>=6) and (i<=msglen-3) then
        chksum:=chksum+buffer[B];
      B:=succ(B);
    end;
    chksum:=(not(chksum)+1) and $7f;
    putdata (chksum); putdata ($f7);
    B:=B+2;
  end;

procedure SaveProgram;
  begin
    write ('Save which program? (1-90) ');
    readln (mem);
    Receive (mem);
    SaveFile (B);
  end;

procedure SaveBank;
  begin
    for mem:=31 to 90 do Receive(mem);
    SaveFile(B);
  end;

procedure LoadProgram;
  begin
    write ('Load program ',filename,
      ' to which user memory? (31-90) ');
    readln (mem);
    GetFile;
    Send (mem);
  end;

procedure LoadBank;
  begin
    GetFile;
    for mem:=31 to 90 do Send (mem);
  end;

procedure Menu;
  begin
    clrscr;
    writeln ('SPXFILE ');
    writeln ('1. Save a program.');
    writeln ('2. Save all programs.');
    writeln ('3. Load a program.');
    writeln ('4. Load all programs.');
    writeln ('0. Quit.');
    writeln ('Make a choice: ');
    readln(choice);
    if (choice<>0) then begin
      write ('Filename? ');
      readln (filename);
      assign (MidiFile,filename);
    end;
    B:=0;
    case choice of
      1: SaveProgram;
      2: SaveBank;
      3: LoadProgram;
      4: LoadBank;
      0: Quit:=true;
    end;
  end;

{ **** MAIN PROGRAM **** }

begin
  resetMPU;
  putcmd ($3F);   { set MPU in UART mode }
  Quit:=false;
  repeat
    Menu;
  until Quit=true;
  resetMPU;
end.
```

**LISTING 1: The SPXFILE program.**

## INSIDE THE SPX: THE MOD

Open the SPX90 and look for a dinky switch at the back of the circuit board, near the MIDI jacks (see **Fig. 1**). It's labeled "SW105." When this switch is set toward the front (the factory setting), you have MIDI Thru, just like the back panel says. But when you toggle it backward, the MIDI Thru jack becomes a MIDI Out. (Of course you lose the MIDI Thru function.)

The SPX90II has the same switch in the same place, but it has to be set *forward* for this program. In either case, the factory setting is "Thru." Unless someone else got to the switch before you did, just change it to the opposite position.

*Voila.* With MIDI Out enabled, the SPX90 responds to System Exclusive bulk dump requests. SPXFILE's job is to issue the request, and store the dumped programs to disk.

## THE PROGRAM

I wrote SPXFILE in Turbo Pascal for the IBM PC because of this language's popularity, readability, and speed. Programming in Pascal breaks a big problem into sub-problems, and the sub-problems into smaller parts, until you can write a simple procedure to handle each part.

Our *big problem* here is to save and load single SPX programs and SPX banks to and from disk. We can break this into four distinct tasks, and tackle them one by one: 1. save one program to disk, 2. load one program from disk, 3. save a bank of programs, 4. load a bank of programs.

**1.** Saving a program to disk requires two steps: first, get the program data from the SPX90; second, save it to disk. Getting the program can be further broken down into: a) send a "dump request," and b) record the incoming data.

**2.** Loading programs is the reverse of saving them: first, get a program (or bank) from disk, and then send it (or them) to the SPX90.

**3.** and **4.** Saving or loading a full bank is just a matter of repeating the single-program save/load for every user memory space on the SPX90.

That's our program structure. We've broken the main "librarian" problem into four separate tasks, and decided that some of those sub-tasks need separate steps. Now let's look at the actual code (Listing 1).

## TAKE IT FROM THE BOTTOM

The main program, in true Pascal bass-ackwards fashion, is at the bottom of the listing. It starts by telling the MPU-401 interface to go into "dumb" (that means easy-to-program) mode. The Repeat-Until loop locks you in the Menu procedure until the variable Quit tests true (which happens when you type "0" for your menu choice), after which the main program resets the MPU-401, and ends.

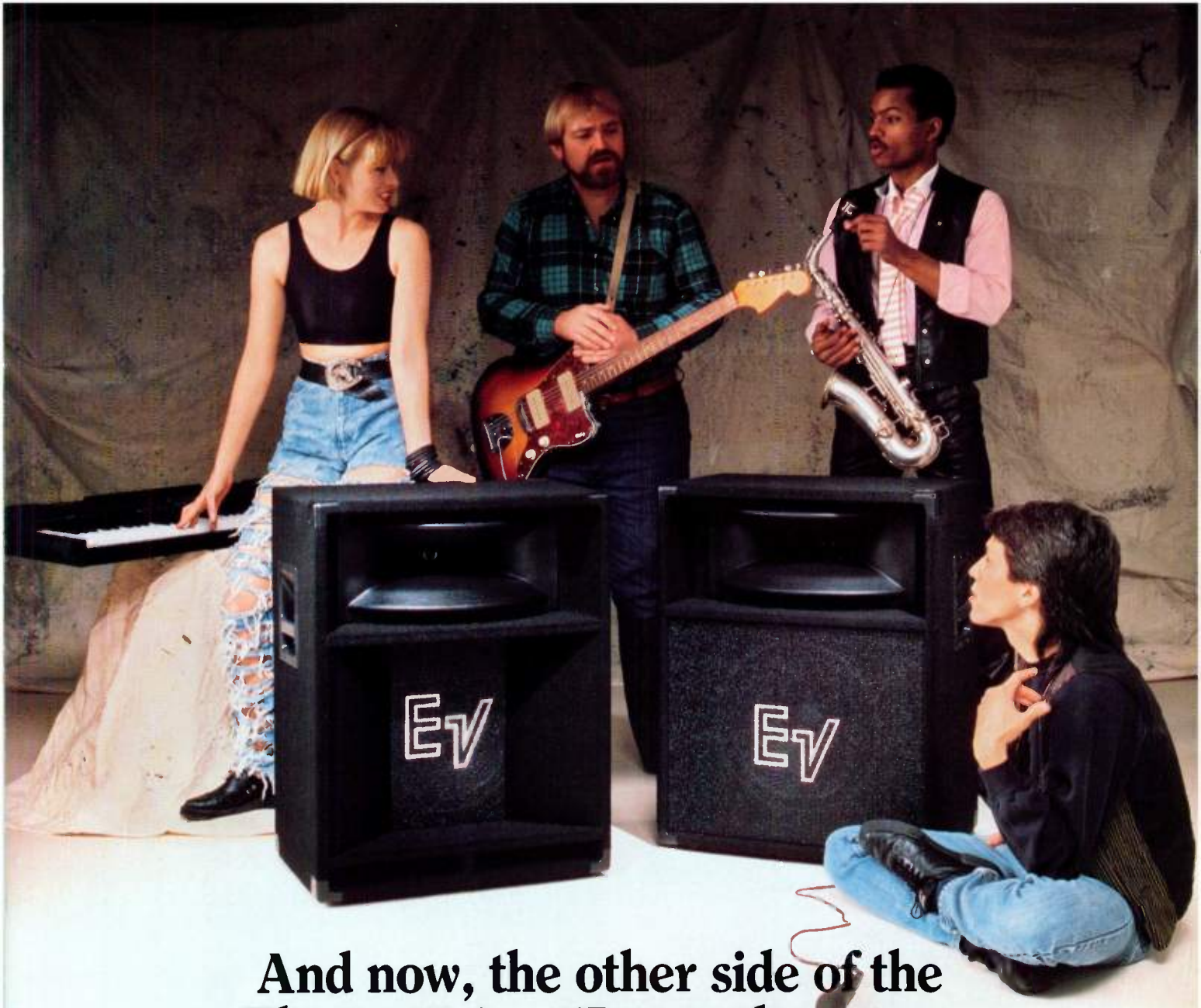
The procedure Menu acts as a traffic cop. It asks for your choice of action: SaveProgram, LoadProgram, SaveBank, and LoadBank. You are also asked to name MidiFile, which becomes the disk file for saving or loading. Then Menu directs you (via its case statement) to the correct procedure for the task at hand. As we mapped it out before, there are four possible tasks:

**1.** SaveProgram asks which user memory you wish to save from the SPX90. Allowable values are from 1 to 90, so the presets are also available—user memory goes only from 31 to 90. SaveProgram then calls Receive(mem), which uses Request (mem) to request a dump from memory location "mem "and records all incoming System Exclusive data. System Exclusive data always starts with byte $F0 (hexadecimal) and ends with byte $F7, and that's what Receive looks for. After Receive is done, SaveProgram goes on to call SaveFile(B), which writes B number of bytes (counted by Receive) to MidiFile.

**2.** LoadProgram calls GetFile, which checks the size of MidiFile, and reads that number of bytes into memory. It then uses Send(mem) to transmit that data into user memory number "mem" of the SPX90. (If you've followed me so far, relax, we're almost home.)

```
const
  dataport=$330;
  statport=$331;
  drs=$80;
  drr=$40;
  ack=$fe;

procedure GetData (var MidiData:byte);
  var
    j: byte;
  begin
    j := 0;
    repeat
      j := port [statport];
    until (j and drs)=0;
    MidiData := port [dataport];
  end;

procedure PutData (MidiData:byte);
  var
    j: byte;
  begin
    j := 0;
    repeat
      j := port [statport];
      if (j and drs)=0 then
        j := port [dataport];
    until (j and drr) = 0;
    port [dataport] := MidiData;
  end;

procedure PutCmd (cmd:byte);
  var
    j: byte;
  begin
    j := 0;
    repeat
      j := port [statport];
    until (j and drr) = 0;
    port [statport] := cmd;
    repeat
      GetData(j);
    until j=ack;
  end;

procedure ResetMPU;
  var
    j: byte;
begin
  repeat
    j := port [statport];
    if (j and drr) = 0 then
      port [statport] := $ff;
    j := port [dataport];
  until j = ack;
end;
```

**LISTING 2: MPU-401 driver routines.**

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**3.** SaveBank works like SaveProgram, except it doesn't ask you for a memory number, because it's going to download all of them, from 31 to 90 (the user locations) It also loops through repeated calls of Request (from 31 to 90), collecting the data from every user memory slot (and adding it to the buffer) before writing the entire collection to a single disk file via SaveFile.

**4.** LoadBank reads MidiFile from disk, and sends the contents to locations 31 through 90, by repeated calls of Send.

And that's the whole of it.

## THE SECRET: SYSTEM EXCLUSIVE DATA FORMATS

SPXFILE couldn't work if Yamaha hadn't built certain System Exclusive commands into the SPX90. These "bulk dump" commands are obscurely and somewhat misleadingly documented on page 24 of the SPX90 user's manual. Our *Request* and *Send* procedures show a bit more clearly how they're used.

Request sends the dump request, which initiates the bulk data dump from the SPX90. It plugs in the kind of data requested ($4D asks for programs, $54 asks for the internal patch maps) and the program memory location or patch map bank (mem) wanted.

Send(mem) needs to be a bit tricky, so you can restore a program to a slot other than the slot from which it came. When the SPX90 dumps data (refer to Listing 1), it sends not just the program data, but also the number of the memory position from which the data came. Send gets in there to change the program number if need be, and to adjust the checksum (an error-checking scheme that serves no purpose here that I can see except to complicate a poor hacker's life). Send lets you save program 37 to disk, for instance, and then send it back to the SPX90 as program 78, or whatever number you want.

## FINE PRINT

SPXFILE uses a core of procedures that I developed to work with the MPU-401 interface. These procedures are based on code examples in the MPU-401 (and Voyetra OP-4001) manual. They comprise the file MPU.INC (Listing 2), which is included into SPXFILE at compile time by the first line in SPXFILE.

SPXFILE has been tested on both the SPX90 and the SPX90II. In order to keep this code short enough to publish, some procedures have been simplified or eliminated (in particular, some of the error-checking routines—so enter data carefully!), but the shortened code has been thoroughly tested. A diskette containing the complete, unabridged source code, including MPU.INC, with a compiled, ready-to-run version for IBMs and clones is available from Carter Scholz, 2665 Virginia, Berkeley, CA 94709, for $10. The complete version allows for access to all System Exclusive parameters (e.g. Program Change mapping), not just the patches. A companion program, SPX-EDIT, a full-screen SPX90/SPX90II editor/librarian, is available without source code for $20. **EM**

*Carter Scholz is a freelance writer, musician and computer consultant. He has been playing keyboards for nine-tenths of his life, and electronic music for half of it.*

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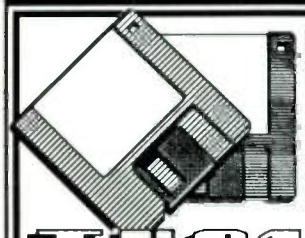

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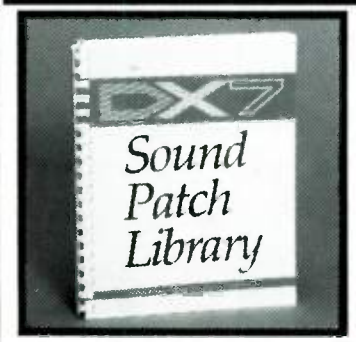


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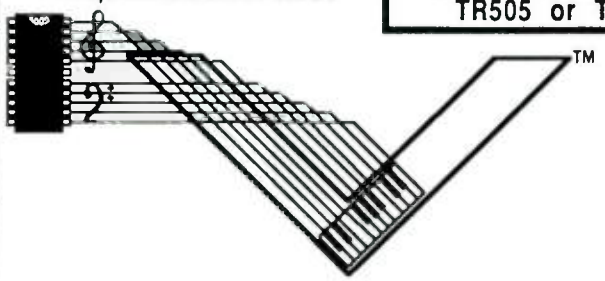

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# Mac POWER USER = POWER MUSER

**PART 3:** Advanced Techniques

**BY CHRISTOPHER YAVELOW**

**We've almost turned our Macintosh from Clark Kent to Superman, but a few details remain. How would you like your Mac to work for you while you sleep?**

As we stressed in parts one and two of this series, if you want a computer to connect you as simply and efficiently as possible to the muse, you need to boost its performance with some "power tools." Without these extras, you'll find yourself waiting for floppies to load, files to print, and finders to find. Having covered desk accessories in part one (along with a listing of manufacturers whose products are mentioned in this series) and power utilities in part two, now it's time to put this all together and design a power environment for creative production. At this advanced level, you'll begin to customize program code to suit your specific needs, automate longer tasks using macros, and start taking advantage of Apple's new *HyperCard* software.

## THE RESOURCE EDITOR

The first item on the agenda is using *ResEdit*, the resource editor, to customize your software to serve your personal requirements better. There isn't enough space in this article to describe ResEdit's operation fully, but a brief mention of some of its possibilities should give you ideas (and you can always read the manual). Caution: always work on a *copy* of your program when using ResEdit.

Editing the CURS (cursor), ICON and ICN# (icons), PAT (patterns), PICT (picture definitions), and FONT (fonts) resources is straightforward so we'll skip directly to the good stuff: ALRT (alerts), DITL (dialog item list), DLNG (dialog template), MENU (menus), PREC (printing record data), STR and STR# (strings), and WIND (window template) resources. By diddling with these resources in ResEdit, you can easily customize the text and location of all alert and dialog boxes or any messages that the program sends you; redesign dialog boxes and windows so the buttons and user items are where you want them; add items to windows and dialog boxes; set the default parameters for window locations and sizes; and add non-standard page-size printing capabilities. You can also modify program menus by adding or removing command key equivalents, changing the way they are displayed, and even adding menu items (some of which may or may not be functional, but all of which may be informative). If you used *FixJT* to remove the copy protection from your legally pur-

ILLUSTRATION BY PABLO HAZ

chased music software for the purpose of installing it onto your hard disk, you can use ResEdit to remove the vestigial CODE, DLOG, and DITL resources associated with the protection scheme, thus reclaiming some space on your hard disk. You probably don't want to mess around with the DSAT resources because DSAT stands for "Deep S*** Alert Table"—need I say more? As an example of resource editor hacking, note how I've changed QuickDex to give room for more information, and to assign specific lines to certain types of information (**Fig. 1**).

## MACRO MAGIC

Next, you'll want to leave your Mac on 24 hours a day for a variety of reasons: first, so you can access your hard drive from a remote location, and second, so it can take care of all sorts of time-consuming things while you sleep—like quantizing all the sequences you created that day, converting them into notation (and printing them out), sending and receiving your electronic mail (which is usually cheaper at night anyway), printing your next day's calendar and any other documents you might need printed, backing up your hard drive to your back-up hard drive, and finally loading up your synths with all the patches, samples, and setups you'll want when you come back in the morning. At the very least, you'll want to create a "start-up" macro which will do some of the most important of these items every time you boot up the Mac—Apple's new *MultiFinder* has implemented somewhat limited capabilities along these lines.

Macros perform a procedure consisting of multiple operations, in response to a small number of operations (typically one or two keystrokes or mouse movements). Part two of this series already discussed some simple macros created using *QuickKeys*. The simplest macros to generate are those a program creates by observing your behavior. Telecommunications packages such as *Red Ryder* and, to a certain extent, *Microphone*, include this ability. While you are logging onto a BBS or network you can instruct Red Ryder to "Write a Procedure for Me." Red Ryder will "watch" everything you do, and you can "play back" this procedure (macro) the next time you want to log onto the same BBS. Both Red Ryder and Microphone will install a button on your screen for each log-on procedure. Then, all you have to do is press the button, and the macro sets up the telecommunications parameters, dials the phone, and responds to all log-on prompts with the proper information, including your password. (Power users upload and download in blocks of 1Kbyte, sometimes called Y-Modem, rather than the 128-byte

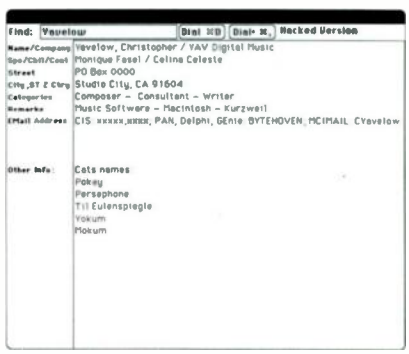


**FIG. 1: A "hacked" version of QuickDex using ResEdit to provide more space for information and adding labels to specific lines.**


**FIG. 2: CIS Navigator is a "must have" for Macintosh users of CompuServe.**

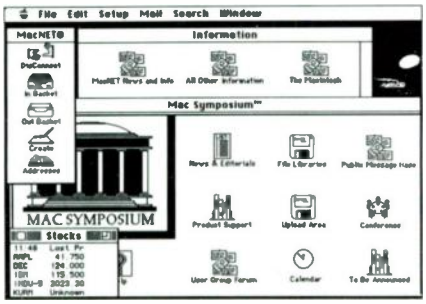


**FIG. 3: MacNET's software, required to access the MacNET network, uses the standard Macintosh user interface to provide "idiot proof" telecommunications.**

blocks that are the usual default. Most current telecommunications software and BBSs support this method, which can save at least 25% of your time.) Telecommunications macros can get very elaborate, to the point of installing BBS-specific menus for navigation, automatically uploading and downloading e-mail, forum messages, and files, as well as waiting until specific times of the day to go from network to network until all your telecommunications business is complete. Naturally, you will be using a 2,400-baud modem (better yet, 9,600- or 19,200-baud), having applied the same logic you used when you bought that slightly more expensive car with the best miles-per-gallon rating to save money in the long run.

Some telecommunications networks have custom software for automating your interaction with them. These will set up times for automatic log-ons, file directory searches, auto up- and downloads of large numbers of files, and other such conveniences. Notable "must-haves" for power users include *Desktop Express* for MCI Mail, and the super power tool, *CIS Navigator* (Fig. 2) for CompuServe (and *AppleLink* if you are lucky enough to have access to this service). *MacNET*, a hot new item just released last January, is



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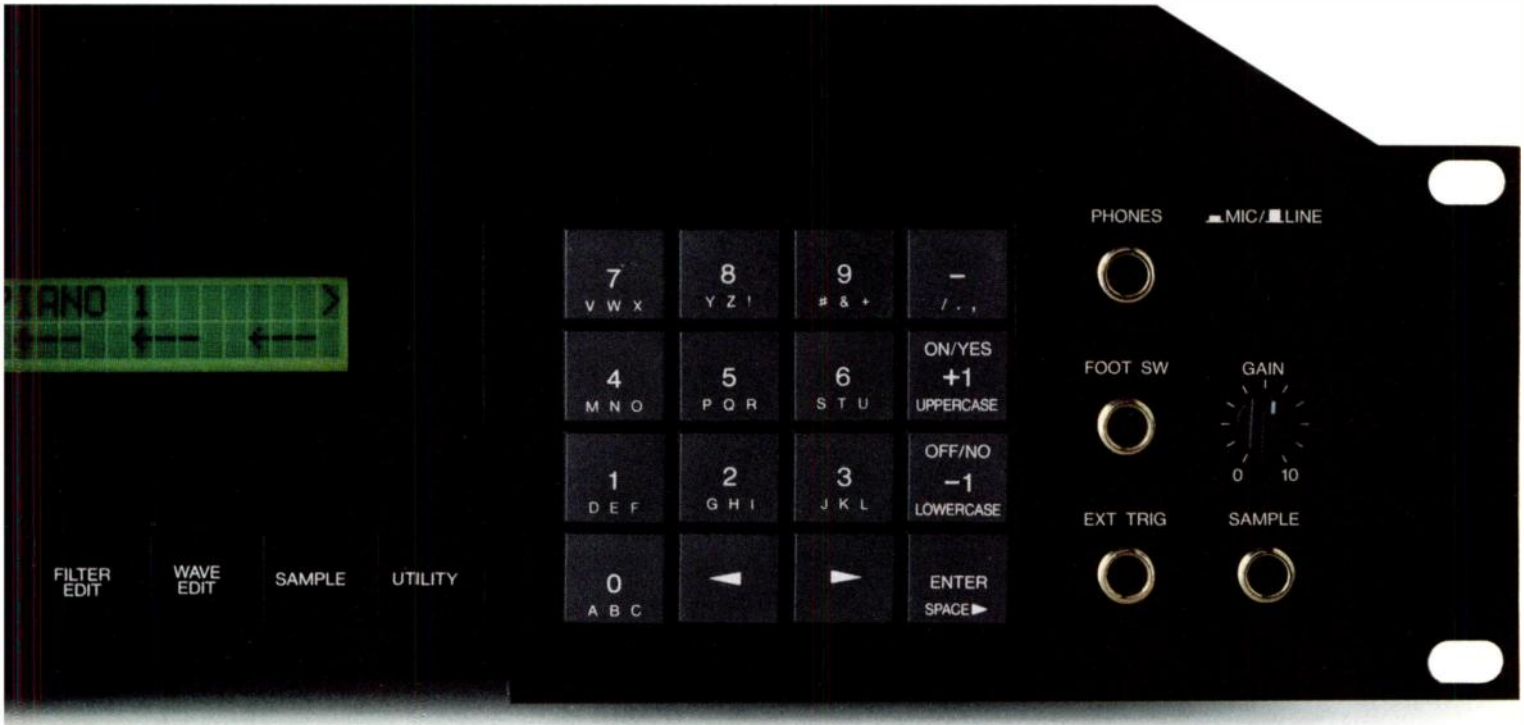

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## Expert Systems

An *expert system* is a type of computer program with its roots in artificial intelligence (AI). While early AI research was dedicated to creating general-purpose programs that could solve a wide range of problems, it was soon perceived that the more generalized a program was, the less effective it became in the realm of specific problems. In the face of this discovery, many computer scientists began creating specialized programs dedicated to duplicating human expertise within the scope of a narrow problem area. Such programs are referred to as "expert systems."

The process of building an expert system relies on effectively transferring a human expert's knowledge to a computer program. It is not necessary that the human expert (referred to as the "domain expert") be a computer scientist, merely an expert in the field to which the program is dedicated. The "knowledge engineer" who extracts the domain expert's expertise does not deal only in concrete facts, but invokes problem-solving strategies, heuristics and "common sense" tactics. The resulting knowledge-base quickly grows to vast proportions; hence, issues of data representation and efficient searching techniques become of paramount importance.

Although expert systems are becoming more common in the business world (see *Time* magazine, March 28, 1988), it is only recently that microcomputers have become powerful enough to meet the requirements. Microcomputers like the Macintosh have become fast enough to execute extremely complicated decisions in near real time—performing millions of operations between two notes in a piece of music, for example. Memory needs having been met, new data representations make it possible to keep track of all necessary musical rules at the same time, and provide the benefits of knowledge equivalent to years of advanced musical training built right into the software.

A good one-sentence definition of an expert system is: "a program that enables non-experts to function as though they were experts." Laurie Spiegel's *Music Mouse* (published by Opcode Systems) was the first Macintosh package to fulfill this criteria. It was even advertised with the words, "No music notation or keyboard skills needed." Broderbund's *Jam Session*, a more recent release, promises (and delivers) "all the musical thrills without the musical skills."

Even the earliest scoring programs, such as *Professional Composer*, allowed people with little skill in notation to produce technically correct scores, but the printed output was not up to most publisher's standards. Now, the second-generation music processors such as *HB Engraver* (HB Imaging), *Music Publisher* (Graphic Notes), *Finale* (CODA), *High Score* (Southworth), *MasterScore* (Passport), and the as-yet-unreleased *Nightingale* from Advanced Music Notation Systems (who are staying *incommunicado* until they release their package) have been developed with the aid of professional engravers (as "domain experts") and include many more expert system features.

An important aspect of an expert system is that it be able to react differently in situations that are similar, yet have somewhat different conditions. On a small scale, one can use the conditional branching capabilities of Affinity's *Tempo* macro utility to create a system that branches to (triggers) a specific macro (a set of menu, dialog box, mouse, and keyboard actions) when certain conditions are met. I've used Tempo to create an extensive set of 160 conditional macros that "branch" to one another upon encountering specific conditions. My system (the Music Slave) emulates my normal work habits in quantizing a large body of MIDI sequences created with *Performer*, then converting them into conventional music notation using Professional Composer. Tempo corrects the clef errors in the resultant files, determines the correct LaserWriter page reduction for maximum page coverage, and finally prints the scores. The Music Slave then goes on to do any number of specified tasks, such as downloading and uploading e-mail and printing the next day's appointment schedule.

The important thing is that the whole process takes place unattended, while the author sleeps at night.

**—CY**

software for running the very Mac-friendly BBS of the same name (**Fig. 3**). Aside from all the previously mentioned options, MacNET will even beep at you if one of your stocks goes above or below a certain level. This service follows the Mac user interface so well that when you log on, it's almost as if a 5,000-Meg hard drive has magically appeared under your Mac. Although *Desktop Express* doesn't have macro generating capabilities *per se*; its simplicity lends itself to short QuickKeys sequences (See the May '88 **EM**).

Remote access to your Macintosh is getting easier and easier. Although I never travel anywhere without my back-up hard drive, it's still nice to know that in the event of that drive crashing, I can always telephone my main Mac and retrieve my data from anywhere in the world. Currently, the software for this is the *Agent/Courier* package, although newer packages with more bells and whistles are under development. It is only necessary to leave your Mac and modem on, running Agent (or, if your Mac is doing other chores while you're out, create a macro that puts your Mac into Agent mode at predetermined times of the day). Then, when you need access to it, dial your modem from the remote location using the Courier portion of the software and begin transferring files. You can do this in both directions, too, so it is easy to transfer anything you've picked up in your travels back to your main hard drive for safekeeping.

Macros in general fall into two categories: *non-branching* and *branching*. With the branching variety, it is possible to create large macros which, if designed correctly, can function much like an *expert system* that will emulate you as the "expert" of your music domain. (*Expert systems* are computer programs created by a "knowledge engineer" who has extracted problem-solving strategies and heuristics [rules of thumb] from a "domain expert" for the purpose of duplicating human expertise in a narrow problem area. See the sidebar for more on

this.) If you're just getting started with macros, it's probably best to start with the non-branching kind.

Several utilities, such as *MacTracks*, *Automac*, and *Touch'n'Go*, allow for quick construction of non-branching macros. As mentioned, QuickKeys could be considered a member of this category and so can *Tempo*, but we will examine Tempo later since it is the only macro utility with branching capabilities. The recording of macros is typically as simple as turning on the utility's recorder function via a desk accessory, going through the menu, dialog, mouse, and keyboard actions to be recorded, and finally saving the macro with a name and associated single keystroke (usually involving combinations of the shift, option, control and command keys).

For example, after using the first release of *Professional Composer* for a month, I discovered that applying the software to my personal compositional work habits required many repetitive tasks involving multiple menu, dialog box, and mouse actions. I quickly devised a set of about a hundred macros to automate these tasks to a single keystroke; I used MacTracks because it was the only macro package available at that time. Early on, I discovered the importance of arranging these keystroke combinations in a logically mnemonic manner. So, to transpose a region up a semitone, I use command-1; command-2 transposes up two semitones, and so on. Likewise, preceding the same keystroke combinations with the option key transposes down by the indicated number of semitones. I created a

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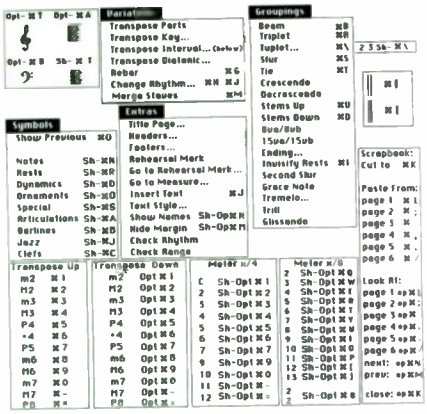


**FIG. 4: The author created this help screen (viewable with the ArtGrabber DA) for the macros added to Professional Composer.**

similar organization with meter signature insertions (all appending the shift key), and also for pasting to or copying from any of the first six pages of the scrapbook (Fig. 4).

## THE MAC "MUSIC SLAVE"

Now we come to the final *raison d'etre* for this series—macros with branching, and the building of control panels for these macros with HyperCard. Since Tempo is currently the only utility that permits branching, and is an excellent program anyway, it is the software of choice for this task. My main Tempo macro, which I call "Music Slave," is comprised of seven large macros consisting of about 160 smaller macros. It is designed to run while I am away or asleep; following is a summary of its operation.

When I leave my studio after a day's work, I press the keystroke combination "shift-option-command-k" (the mnenomic is SHOCK) and that starts Music Slave. First the macro makes back-up copies of all the *Performer* sequences I created that day (in case there is a power outage in the middle of the night), then quantizes each track of each sequence to the value indicated in a track-list log, as maintained using the *miniWriter* desk accessory. Next, Music Slave converts sequence files to Professional Composer files, corrects the clefs (adding bass, alto, and tenor where required), connects the staves, adds measure numbers, correctly sets the page reduction for the total number of staves, and finally prints each file, after which it moves the printed files to an archive folder. (Note: this underscores an important reason for having two floppy drives —one for each key disk needed to unlock Performer and Professional Composer while you are not around to insert the disks.)

If the last line of my track-list log is the word "BRANCH," the system automatically branches to another macro of my choosing. Typically this will load all the patches, sound sample files, and keyboard setups into my synths for when I return to the studio; it might also use *DiskFit* to back up my hard drive incrementally if I left the back-up drive connected to the SCSI bus. In either case, after it finishes with all the music files, it looks at the Mac clock. If the time is earlier than 4:30 a.m., Music Slave starts logging onto my telecommunications accounts, one after another, downloading all my e-mail and new forum messages, and sending any mail it finds in a folder named "e-mail to send." Depending on the size of the files, my print spooler may still be running during telecommunication. Finally, the system opens up my *Smart Alarms Appointment Diary* and prints my next day's schedule. Thank you, Mr. Mac.

Magic? Hardly! Obsessive power using? Maybe. Yet the Mac just saved me eight hours of busy work. To explain all the details of operation would require another article of this size, but the fundamental principles of Music Slave's operation rely on Tempo's ability to look up a value or string in the clipboard and then loop, pause, or branch to another macro based upon what it finds on the clipboard. The track-list log file serves as the macro's controlling script. At strategic points, Music Slave opens the log file with the miniWriter DA, cuts off the top line to the clipboard, then examines the clipboard contents to decide which macro to branch to next. For example, if it sees "Track 19" on the clipboard, it will branch to a macro that selects track 19. Then it goes back to the clipboard and if it sees "dotted 16th notes," it will branch to a macro that quantizes the track to dotted 16th notes. Each time the system goes through this loop, it quickly opens the calculator DA and adds "1" to the value it finds there. When the sequences are quantized and saved as Professional Composer files, Music Slave will then open the calculator and copy the value it finds there to the clipboard (this represents the total number of tracks or staves). Depending on this value, it will branch to the macro that sets the appropriate Laser-

Writer page reduction for the maximum page coverage for the specified number of staves. Setting the clefs in Professional Composer relies on a conditional branching loop similar to the Performer quantization loop (see **Fig. 5** for Tempo's easy interface to conditional branching, looping, and pausing).

Although Music Slave takes all night to run, I also wanted to access its power on lunch and dinner breaks, too. To do this, I created a Music Slave "control panel" with HyperCard (**Fig. 6**). Using the *PostEvent* XCMD available from most BBSs, I created a stack that reads in Performer files, places them on an index card, then opens a separate card for each sequence. The sequence's own card provides check-boxes to specify the quantization value for each track, as well as its eventual clef when converted to notation. The main control button "Do it" converts this information into the Music Slave's needed track-list log file and calls up the relevant portions of the macros specified by the "Quantize," "Convert to Notation," and "Print Buttons," all of which present the option to either return to HyperCard or stay in Professional Composer or Performer after completion.

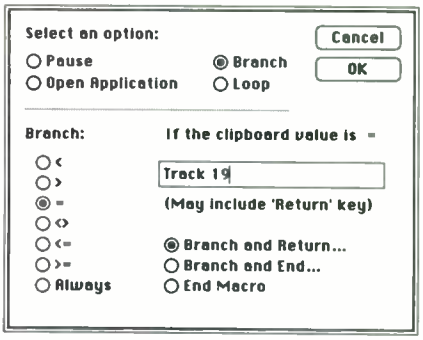



**FIG. 5: Tempo, a macro-making utility, provides these three types of conditional operations: "Pause until...," "Loop until...," and "Branch if...."**

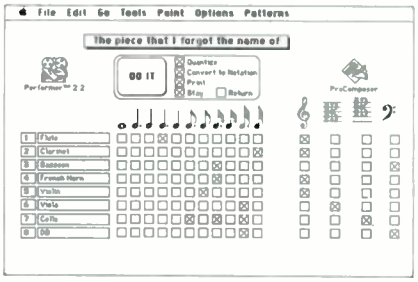



**FIG. 6: This HyperCard stack (running the PostEvent XCMD) was constructed by the author as an interface to the large Tempo macro, "Music Slave."**

With the recent addition of MIDI XCMDs to HyperCard (thanks to Tom Newman and Nigel J. Redmon), the power musing potential of this wonderful program has increased by several orders of magnitude. By the way, I used a whole different set of power tools to write this article: Living VideoText's *More*, Microsoft Word's *Spelling Checker*, Microlytic's *WordFinder Thesaurus* DA, and Doug Clapp's *Word Tools*. But that's another story! At the moment I find myself thinking, "if I manage to use the Mac to save any more time, I'll probably start time-traveling into the past." **EM**

---

*Christopher Yavelow is a computer-assisted composer who has become well-known as a writer on this topic. He received graduate degrees in music composition from Boston University and Harvard, diplomas from several noted European conservatories, and his works have received some three dozen international awards and fellowships.*

# BUILD An Eight-in, Eight-out MIDI PATCH BAY

Do you spend your creative energies repatching MIDI cables? Let the travails, tribulations and triumphs of one MIDI-crazed musician help you make the right connection.

BY CARTER SCHOLZ

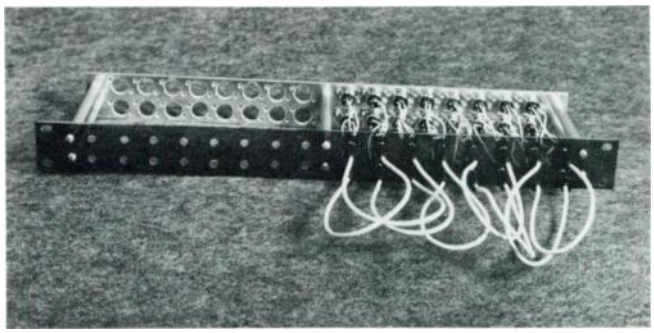
Oh, it started innocently enough. I just wanted to hook up my synthesizer to my computer. So I bought an interface and a couple of MIDI cables. That turned out to be so much fun that I got a second synth. And a mixer. And a reverb.

Somewhere in there I acquired another computer.

And suddenly I was up to my neck in MIDI cables, and a simple jam had become a major production. I would start with an idea, and 20 minutes later I'd be leaning, peering, and groping around the back of my equipment with one hand, holding seven or eight MIDI cables in the other, trying to remember just what it was I was trying to do.

Enough! After checking out the various MIDI switching boxes on the market, I figured I could build something adequate for my needs for about a tenth of the price, and I believe I've done it.

My eight-in, eight-out, rack-mount, low-tech marvel won't remember patches, won't respond to MIDI Program Change, and won't blink LEDs at you, but it *will* send any of eight MIDI inputs to any of eight MIDI outputs. Depending on your tools and skills, construction should take four to eight hours. Parts costs will vary depending on what you can scrounge and what you have on hand; if you buy everything at retail, figure $40. Tools are discussed as needed.



**The completed eight-in, eight-out, rack-mount, low-tech MIDI patch bay marvel.**

## RATIONALE AND MATERIALS

Sixteen DIN jacks on the rear panel are connected directly to 16 mini phone jacks on the front panel. MIDI equipment is plugged into the rear, and patch cords are plugged into the front panel to connect the Ins to the Outs.

A MIDI cable has two active data wires, plus a shield. The front panel of the patch bay is made from an insulated material, so what's normally the ground of the phone jack floats, enabling it to carry one of the MIDI data lines, while the tip carries the second.

For the length of the patch cords (and inside the patch bay), the MIDI data goes unshielded. In practice, using these unshielded cords hasn't been a problem for me, but if you're subject to excessive RFI or nervousness, you may want to spend the extra money on stereo jacks, and use stereo cable for your patch cords, so you can have two conductors for data,

and can keep the shielding unbroken. If you do that, use a metal (conductive) front panel rather than the plastic (non-conductive) one I describe.

Front and rear panels are held together with six four- or five-inch stand-offs, available from many electronics suppliers. If you can't find them, another (and cheaper) alternative is to buy three feet of 10-32 threaded rod at a hardware store and hacksaw it into six six-inch pieces. (You'll have to clean up the threads at the sawn ends carefully, so they'll take a nut. Use the hacksaw and possibly a rattail file.) A nut and lockwasher on both sides of each panel will hold it in place. I used six members to attach the two panels because the front panel needs support in the center to keep from bowing.

Acrylic plastic makes a good front panel. You'll want a 1¾ by 19½-inch piece (the size of a 1U rack unit) ⅛ of an inch thick. I got a good-sized hunk of scrap for free from a local plastics supplier. For a price, the supplier will cut it to size; otherwise, use a table saw, or score the plastic deeply along the cutting lines with a matte or X-acto knife. Then clamp a straightedge to the scored line and, *with even pressure along the score*, bend until it breaks. Acrylic is temperamental stuff, and getting a clean break along a score can be difficult. So beg or buy enough for a couple of tries.

Once you've gathered your materials (check the parts list below), mark the two panels for drilling. I found I could fit all 16

## PARTS LIST

1¾-inch × 19½-inch × 1/16-inch (or ⅛-inch) aluminum
1¾-inch × 19½-inch × ⅛-inch acrylic (or other non-conductor)
16 mini phone jacks
16 5-pin DIN jacks (180°)
6 threaded stand-offs
hookup wire & mounting hardware

mini jacks and all 16 DIN jacks in one half of the rack panel, leaving the other half free for future expansion. If you plan to expand, drill the extra holes *before* assembling the unit.

Rough indications of hole size and placement for front and back panels are given in **Fig. 1**. Use these only as guides, deriving your own measurements from the jacks you actually use. Exact placement of jacks is not critical, so long as

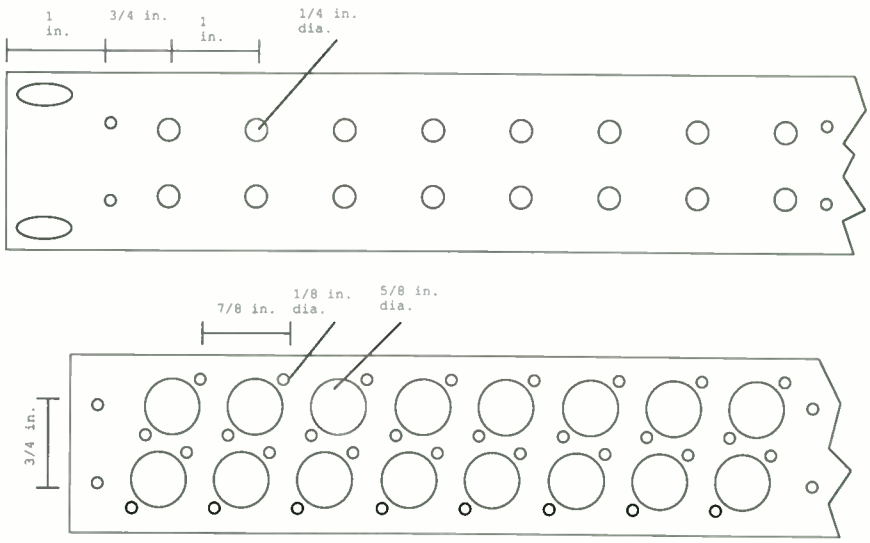



**FIG. 1: Rough indications of hole size and placement for front and back panels.**

there's room for all of them. What is important is that the six stand-off holes on each panel line up. Drill these holes in one panel first, then use that as a template for the second panel. Don't forget the back panel isn't as long as the front one —it has to slip into the rack—and align them accordingly, along the center axis.

## FABRICATION

Drilling acrylic is about as tricky as cutting it. Use a drill bit that's not too aggressive (i.e., it should be fairly dull), and a low drilling speed. Go easy. Too much force exerted too fast will crack the plastic. Remember, you've got almost 30 holes to drill in the front panel—so exercise patience and control. Take breaks if you need to.

You don't have to use plastic. On my first try (after breaking my only piece of acrylic), I ended up making my front panel from a piece of Finnish birch veneer I found lying around. Even so, I had to work carefully, so as not to split the wood.

The holes on the ends of the front panel used to mount the unit to your rack should be oval, to accommodate rack variations. I drilled two ¼-inch holes side by side, then joined them by cutting out the excess material with an X-acto knife.

For the rear panel, I used ⅛-inch aluminum, 1¾ × 17 inches. This is the thickest material I recommend; 1/16-inch should work fine, and will be easier to drill or punch. I drilled three ⅛-inch diameter holes in a line for *each one* of my MIDI jacks—the two outer ones for the mounting screws (size 4-40), the inner one as a pilot hole for the body of the jack.

DIN jacks are big. You need a ⅝-inch hole to mount them from the outside of the panel. A chassis punch should work on thinner aluminum, but I had to buy a hard-to-find ⅝-inch drill bit. (A hole saw might also work, if you can find one that size.) The holes can be slightly smaller if you choose to mount the jacks on the inside of the panel. I drilled my ⅛-inch pilot holes out to ¼-inch, and from there to ⅝-inch, using a drill press. If you're using a handheld drill, clamp the aluminum securely, and drill slowly, because it will tend to chatter.

Lastly, debur all the rough metal edges with a file so you don't tear a finger open during assembly.

## ASSEMBLY

Mount the jacks securely on front and rear panels. Use 4-40 machine screws and bolts for the DIN jacks if they don't come with their own mounting hardware. Make sure all jacks are oriented the same way! A nutdriver of the proper size is helpful for tightening the minis (mine needed a 5/16-incher).

Fasten the panels together with the stand-offs as in **Fig. 2**. Tighten them, making sure there's no flex or twist between front and rear panels.

One at a time, wire the tips of the mini jacks to pin 4 of the DIN jacks opposite, and the grounds of the minis to pin 5 of the DINs as in **Fig. 3**. Or vice versa—pin 4 to ground, and pin 5 to tip. It doesn't really matter; just make sure you're consistent, and recheck your con-

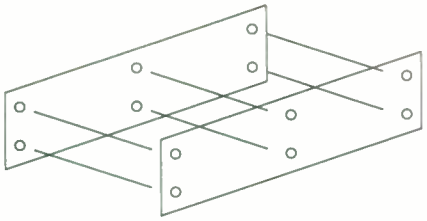


**FIG. 2: Fasten the panels together with the standoffs, making sure there's no flex or twist between front and rear panels.**

sistency before soldering. See Fig. 2 for the weird numbering of DIN jacks. Don't mistake the "shunt" of the minis (if present) for the "tip." I used standard 24-gauge hookup wire to make these connections. When you're sure the connections are correct, solder.

If you've decided to use stereo phone jacks, pins 4 and 5 should be connected to the left and right tips, and the shield to ground. For maximum RFI protection, use shielded stereo or twisted-pair cable rather than hookup wire for this connection.

Make eight 12-inch patch cords (male-to-male mini), and label the ins and outs on the patch bay panels, front and rear. Conventionally, the top row of each panel is "in."

## TESTING . . .

Test your work by routing a MIDI circuit through the patch bay with all the patch cords in place as shown in the photo on page 63. Plug the MIDI Out of a sequencer (or keyboard) into "in 1" of the rear panel, and connect the MIDI In of a synth to "out 1" of the rear panel. Start the sequencer (or reverse these connections and play the keyboard).

Got output? Good. Now move the sequencer's MIDI cable down the row to each of the remaining rear panel inputs in turn, following it with the synth's MIDI cable. Each connection should produce output. If you have any dead circuits, check your soldering first, but don't rule out the possibility of a bad jack or a bad patch cord.

That's it. You're ready to wail. May you never need to grope around the rear of your equipment again.

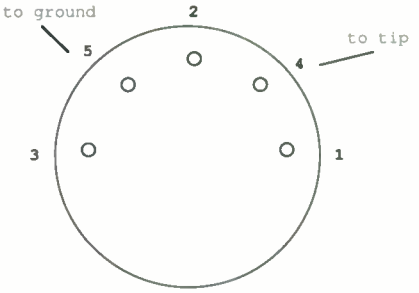



**FIG. 3: Wire the tip of each mini jack to pin 4 of the opposite DIN jack, and the grounds of the minis to pin 5 of the DINs.**

*(Thanks to Robert Rich, Maurice Weitman, and Daniel Schmidt for their suggestions and assistance in the design and construction of this unit.)* **EM**

*Carter Scholz is a freelance writer, musician, and computer and MIDI consultant. When it comes to building things, he is all thumbs.*

# YOU CAN TAKE IT WITH YOU

The first synthesizers filled rooms with tubes, cables and just plain stuff. How times have changed—interested in cramming a complete MIDI studio into a toolbox?

BY DAVID FARRENS

## PROBLEM: Do you recognize one of these scenarios?

FIG. 1: The briefcase MIDI studio. The slide-out drawer provides access to compact effects devices.

- There it sits: the beloved home studio for which you worked so hard. Want to record something? Oh, well, don't really have the time right now. It's such a hassle plugging everything in. Maybe tomorrow. Or next month...

- The phone rings. It's your best friend, and he wants you to come over and do some recording. So now you have to unplug everything and put things in their boxes...

- Seven more hours to Minneapolis in the band bus. You've memorized your five cassettes two months ago. If you could just work on that idea you had for a song...

- It's 2 a.m. You're still sitting around in the lab, tending to your genetic engineering experiment. If only you had some way of bringing your music gear along with you, so you could get some practicing in while thousands of drosophilla carry on their time-consuming and rather uninteresting mating rituals.

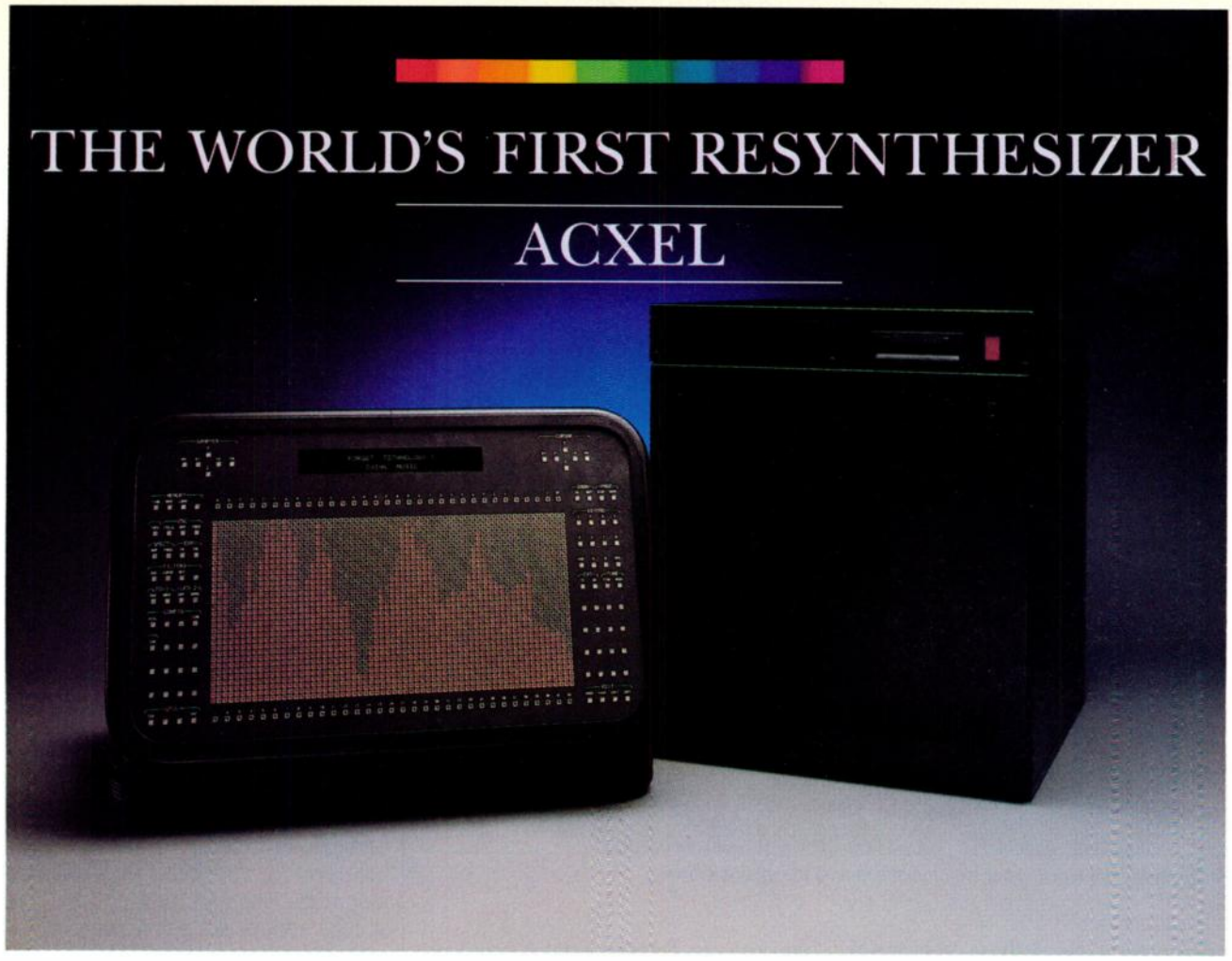
## SOLUTION: Organize all of your stuff into a mobile portable studio.

I once wrote an article titled "The Fostex X-15, a Portable Studio on a Strap." The problem with this article was that the title was misleading: a 4-track cassette player, even with a mixer, does *not* a studio make. You have probably seen advertisements for portable studios, and all of them exhibit the same flaw that my article did.

My solution was to design my own personal, dream portable studio: a box with all the necessary "studio things" built into an easily carried, ready-to-go box that travels anywhere and

# THE WORLD'S FIRST RESYNTHESIZER

## ACXEL



The ACXEL is the very first system to use Artificial Intelligence for simulating musical sounds. Simply enter your sound; the ACXELIZER (Acxel's sound analyzer) will *automatically* program a large number of "Intelligent Synthesis Cells" (ISC) and combine them so as to form your *resynthesized* sound.

The GRAPHER™ allows you to modify the ISC settings at the touch of a finger, hearing the results in REALTIME. Numerous effects can then be achieved: time compression and expansion, polyphonic transposition, voice processing, simulated phasing, timbre interpolation, harmonizing, attack exacerbation, FM, double DLFO modulation, simulated multi-mode filtering, detunable additive synthesis for macro-chorus effect, inverted enveloping, echo, speech synthesis, noise simulation plus millions of new possibilities attainable ONLY through the resynthesis process.

The GRAPHER is a new type of terminal, adapted to facilitate realtime operations on the ACXEL. It is user friendly and beautiful to behold. When close to it, you feel the urge to touch it. Please do! The GRAPHER's surface is skin-sensitive to every finger movement, providing instantaneous visual feedback of the modifications performed. The ACXEL would have been workable without the GRAPHER; but then what would have come first, your programming skills or your musical personnality?

The ACXEL is not a sampler: the resynthesis process is comparable to the way the *"human brain"* actually perceives a musical sound. To settle for anything less could stifle your musical creativity...

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# THE WORLD'S FIRST INTELLIGENT SYNTHESIZER

**FIG. 2: An AC line filter/power strip mounts behind the effects drawer.**

ends, once and for all, those problems of MIDI portability. Although this was designed around my existing equipment, you shouldn't have too many problems adapting the concepts to your own set of gear. And the price is right: not including the equipment I already owned, I spent a total of $45 to build my portable studio.

## HOW TO DO IT

The system I built was originally going to just be a prototype, and it isn't elegant-looking (for proof, see **Fig. 1**). My one nod towards style was to use black duct tape instead of gray. But I never found it necessary to upgrade it, so it retains its chic starving-musician look.

Before jumping head first into making your portable studio, here are some tips.

*Organize your equipment* and make decisions on how you would like your system to work. Leave those dreams of 24-track studios behind—the key word here is *portable*.

*Measure everything.* Time spent doing this beforehand will save you a lot of time later returning things that just don't quite fit.

*Measure everything again; plan and think.* I don't mean to be redundant, but I will be anyway. Time spent planning is not only a lot of fun, it can lead to (at the least) semi-creative thoughts. For example, as I was designing my system I realized that I would be able to eliminate one piece of "must buy" equipment by replacing it with one I already owned. If you're like me, this sort of revelation is enough to keep you happy with yourself for a whole week.

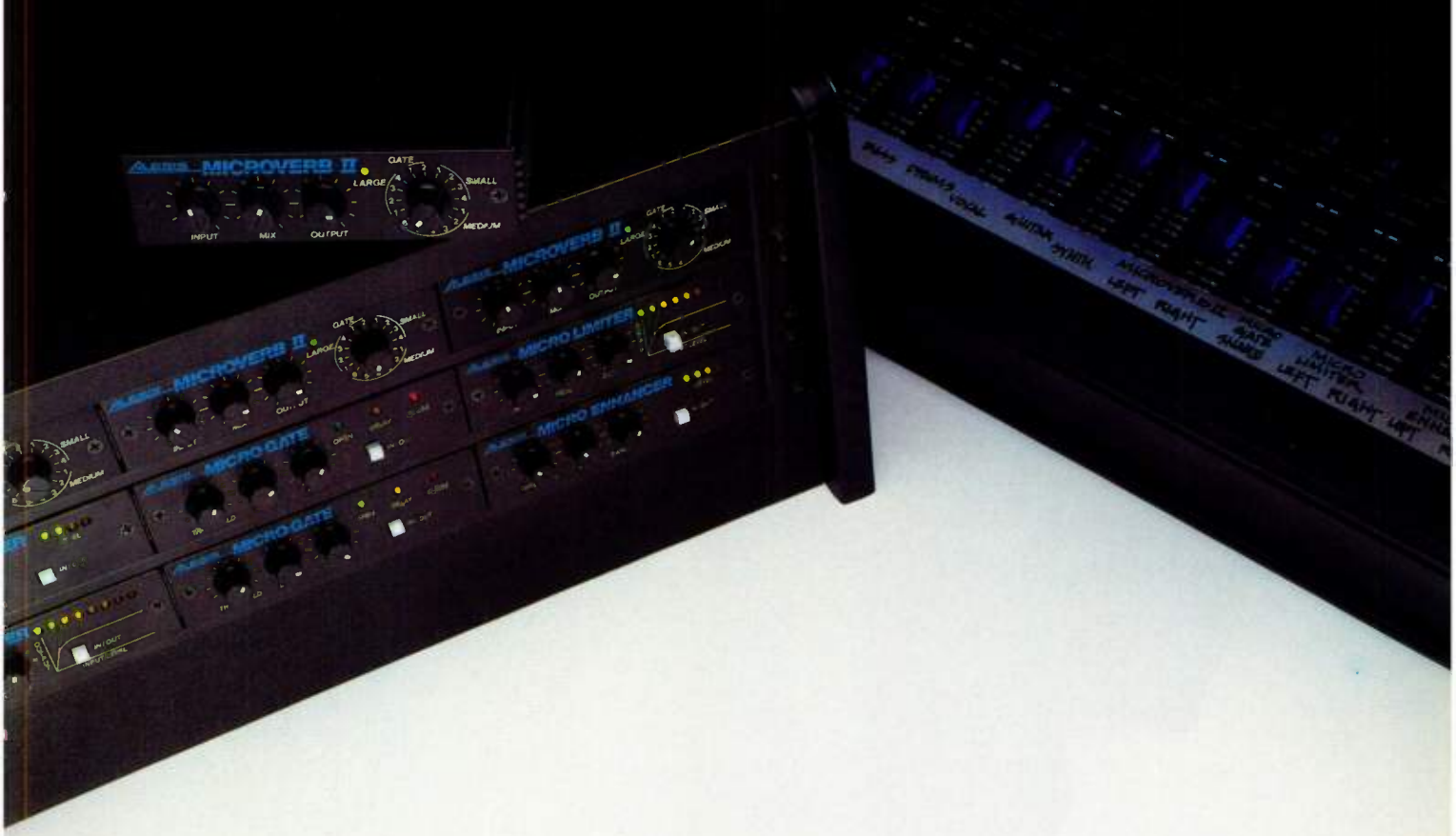
*Look for existing equipment that will fit your needs.* Many premade boxes—such as rugged plastic tool boxes and tackle boxes that are light and easy to cut or mold—will probably work better (and look better) than anything you could make yourself. Trust me on this one. Unfortunately, most tackle boxes are too short for most keyboards. (Those of you shopping for a keyboard should note that the Yamaha DX100 is shorter by two inches than the CZ-101, making it easier to fit in most tackle boxes, which tend to be shorter lengthwise than tool boxes.) I ended up using a black molded plastic American Eagle tool box. It only cost $32 and saved me a *lot* of headaches.

If what exists on the market doesn't fit your original design, consider changing the MIDI equipment you planned to use. This sort of equipment Darwinism often gives better results in the long run, giving you a much leaner, meaner machine.

*Consider ergonomics in your portable studio design.* By using a little forethought,

*—continued on page 73*

# Dedicate




Dedicating yourself to your music often means working long hours at your mixer experimenting with effects. But, sometimes this can be frustrating. Like when you get the urge to add reverb to a vocal and you find yourself running around the back of your mixer fumbling with cables. Getting confused. While your concentration and your music suffer.

Serious studios solve this problem by connecting each effect send on the mixer to individual signal processors. Always plugged in. Ready when the ideas come. *Dedicated.* Turn a couple of knobs and you hear results. Instantly.

Until now, though, dedicated signal processing was only affordable in high budget studios.

Alesis has a solution. **The Alesis Micro Series.**

Led by the new MICROVERB® II, the Micro Series comprises the four most important signal processors in any recording rig: Digital Reverb, Limiter/Compressor, Gate, and Enhancer. Designed with the Alesis magic that combines totally professional features with ridiculous affordability, they're at home with 4 tracks . . . or 48.

**These are the essential, required processors for modern music production.** Whether it's records or demos, or serious fooling around, connect all four in your system and start making music as fast as your ideas come. Relaxed. Polished. Professional sounding.

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Both the EPS and SQ-80 feature an Ensoniq exclusive—the Poly-Key polyphonic pressure sensitive keyboard. With this expressive breakthrough, *each individual note* has its own aftertouch control over volume, brightness, vibrato, pitch, or dozens of other dazzling effects. You get far more creative control over your sound than with any other synth or sampler.

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The EPS is the only sampling keyboard that can keep on playing *while* sounds load. With the Ensoniq Direct Memory Access (DMA) technology you get the power to play non-stop, *even when changing sounds.*

The EPS presents a new level of creativity and expression with Instant Patch Select. Two "Patch Select" buttons give you instant access to four alternate sound patches. Now you can add effects like growls and squeaks to a sax sound as you play—just like a sax player.

The EPS is loaded with more features than any other sampler on the market—20 dynamically-assigned voices, 8-track polyphonic sequencer, expandable memory and the ability to play the library of over 2500 Mirage sounds with greater fidelity.

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The SQ-80 can produce the broadest range of sound of any digital synth. It has all the sounds you need for any performance—fat analog brass, clear and expressive strings, multi-sampled piano and airy, ambient choral sounds—120 choices at the push of a button.

And, as a MIDI master keyboard, the SQ-80 has no equal. No other keyboard has the expressiveness of Poly-Key, the performance power of an 8-track sequencer, a built-in MIDI disk drive and as straightforward a control section.

### Hear and feel the power...only at your Ensoniq dealer.

See your Ensoniq dealer today. Get a complete demonstration of the power of the SQ-80 and EPS. For live performance you will hear and feel why Ensoniq is the right choice. For the name of your nearest authorized dealer call:

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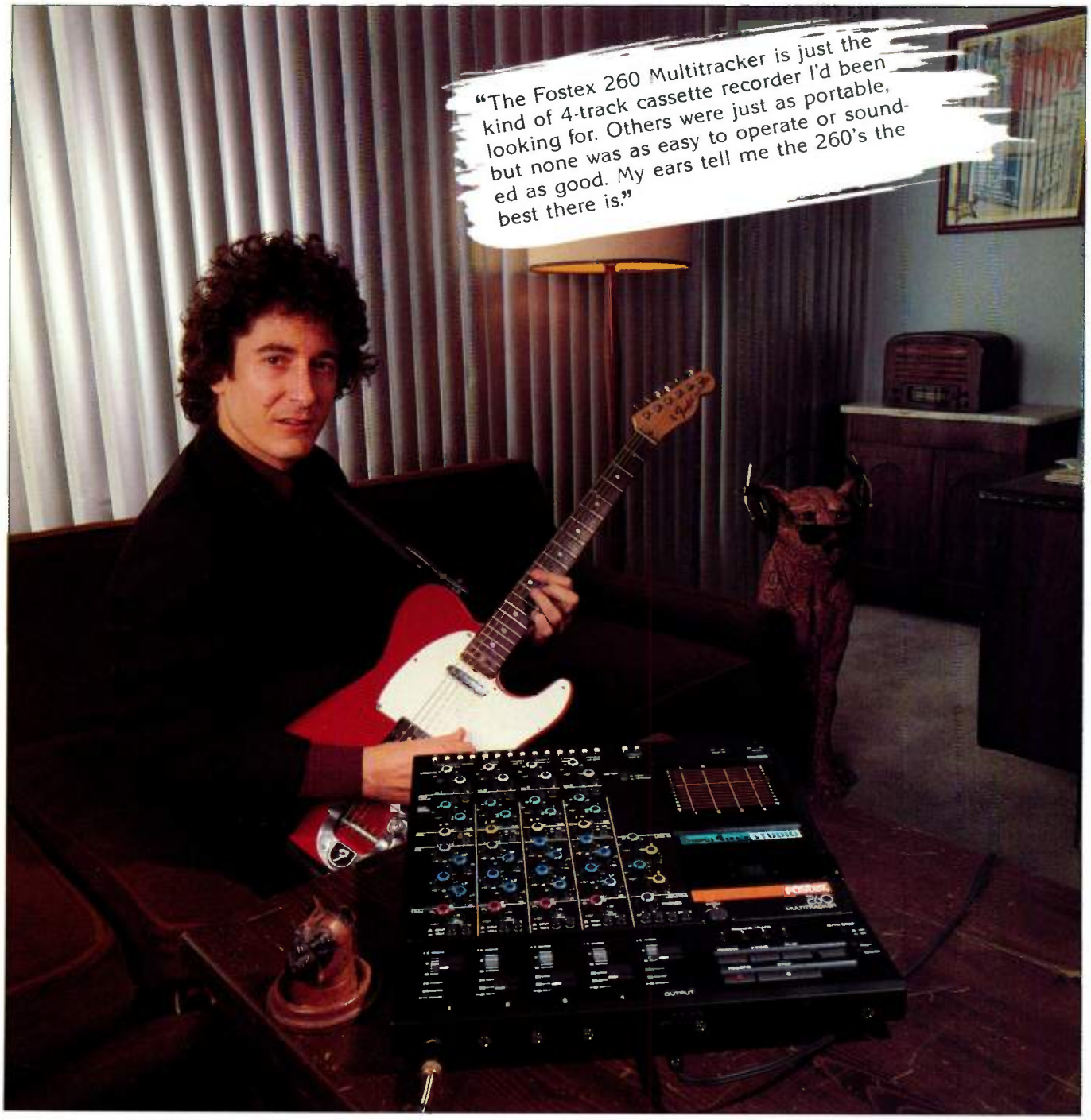
THE TECHNOLOGY THAT PERFORMS

# STAN RIDGWAY
# ON FOSTEX

The former lead singer for Wall of Voodoo iscurrently working on the follow up album to "The Big Heat," his first solo endeavor. Stan also composes for film soundtracks and performs with his new band, Chapter Eleven.




The Fostex 260 Multitracker features: 6 inputs • High speed 4-track recording with advanced noise reduction • Sweepable EQ • Switchable meters • Two headphone jacks • More buss flexibility than any other 4-track cassette/mixer available.

FOSTEX
Personal Multitrack

—from page 68, PORTABLE STUDIO

I only have to plug in the main power cord and everything is ready to run. This "hard wiring" of your studio is almost a necessity with a small box, since you don't have the room to plug and unplug things every five minutes.

## THE DESIGN

Enough rambling, here's the scoop on the equipment I used.

*The box*: the molded plastic tool box I mentioned measures 26.5 × 11.5 × 11.5 inches. I modified the box carefully with a sharp knife, and secured equipment with duct tape. (Velcro strips also work, and allow you to pull the equipment out of the box when you want.) I use cords with 90 degree right-angle plugs to save space.

*Keyboard*: my main axe is a Casio CZ-101; the two most important considerations were size and multi-timbral capability, to accommodate a small sequencer at a later date.

*Drum machine*: small, versatile and inexpensive are the key concepts here. The Roland TR-505 fits all the requirements.

*Four-track cassette deck*: my Fostex X-15 is very small, rugged, and also old, so I don't mind banging it around.

*Sequencer*: for those of you who want to record MIDI sequences along with, or instead of, 4-track tape tracks, a number of small MIDI sequencers are available. The Korg SQ-8 is small, and would do the job.

*Mixer*: the Fostex MN-50 mixer/compressor has enough inputs to let me plug in everything at once. You don't want to have to plug and unplug in the confines of a box this size—or anywhere, for that matter. (Though the compressor in this unit works, it seems a bit noisy, and I use it mainly as a mixer anyhow.)

*Microphone*: although I use an old ATM model 31, with a ¼-inch plug adapter, I would like a smaller microphone. (*The Sony ECM-50 and the Shure SM98 are both good, tiny mics that can be mounted on drums, saxes and other acoustic instruments. Also, the Audio-Technica ATM5R, possibly the world's smallest hand-held vocal mic, delivers a very good sound.—Ed.*)

*Headphones*: my headphones are small Audio-Technicas. The miniscule Sony Turbo-nudes that fit inside your ear are another space-saving option.

*Effects*: the Boss DD-2 digital delay, my old guitar pedal, is the smallest digital

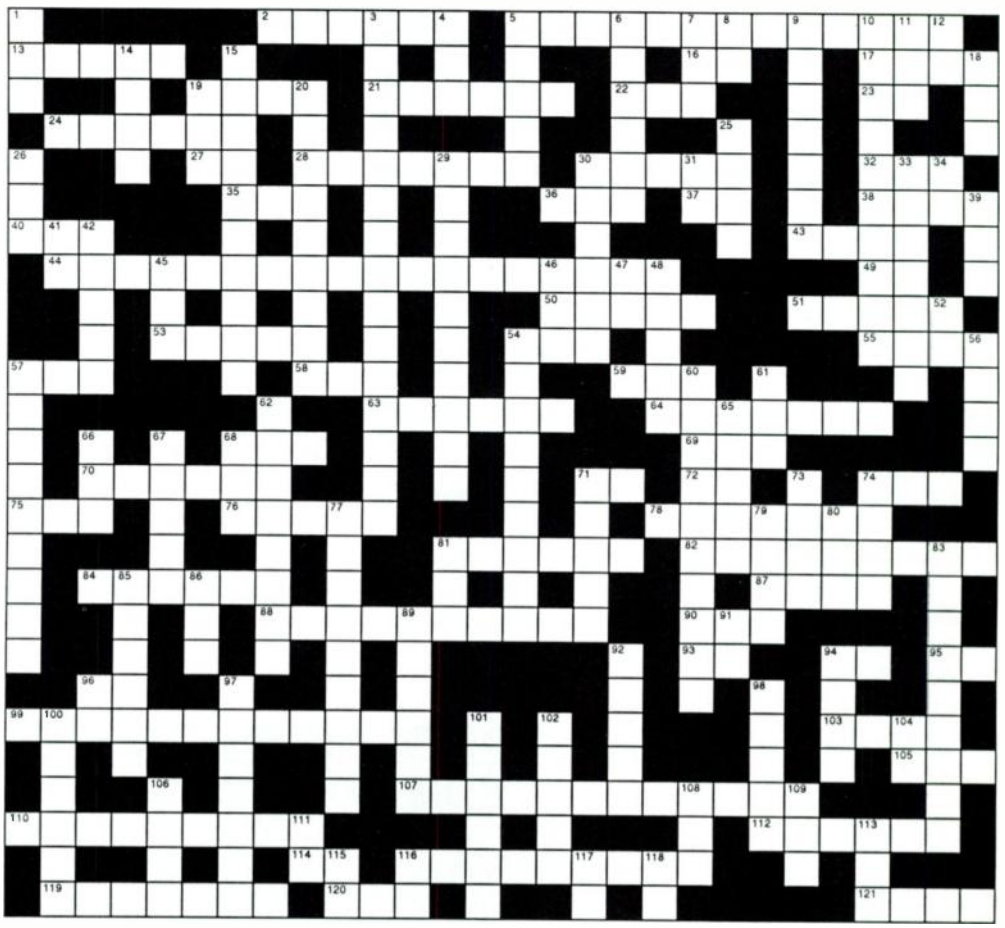
—continued on page 76

ELECTRONIC MUSICIAN'S

# Mystery Word Matrix

**BY VANESSA ELSE**

**SIT BACK. RELAX.** Unwind from a long day and tickle your brain cells by solving the EM crossword puzzle. Don't try to do it all in one night, because you might overload and burn out; savor the experience. Then, let us know whether or not you like puzzles geared toward electronic musicians. If you *do* like it, you could make copies for your friends (make them before you start to solve the puzzle; see notice below) or hand them out the first day of an electronic music/recording engineering class to see how much the students know. Some fun, eh?



## DOWN

**1.** A device that changes information of a continuous nature into a corresponding set of numbers *(abbrev.)*

**3.** Composed of manipulated acoustic sounds (2 words)

**4.** To access a signal at a particular point

**5.** The programmable point on a keyboard which defines the separation of two different sound ranges

**6.** 24 _____ per quarter note

**7.** Electronic Industries of America *(abbrev.)*

**8.** Developed by Nicola Tesla *(abbrev.)*

**9.** An effect described as pitch shift due to motion

**10.** Sound-generating unit

**11.** Type of display difficult to see on a dark stage unless back-lit *(abbrev.)*

**12.** Conversion process which changes numbers into continuous signals *(abbrev.)*

**14.** Standardized serial data transfer protocol for small computers *(abbrev.)*

**15.** The way in which file data is structured (2 words)

**18.** A type of transistor in which a small positive base current results in a large negative collector current *(abbrev.)*

**19.** Device which changes numbers into continuous signals *(abbrev.)*

**20.** Microphone type based on capacitance

**25.** What you have when you get one watt from one ampere.

**26.** Synonym for voltage, electrical potential *(abbrev.)*

**29.** The quality of an electronic circuit that exhibits an increased impedance to AC signals the higher they are in frequency

**30.** A computer interface that transmits only one bit, word, or channel at a time

**31.** A type of meter on audio tape decks that is a measure of signal on a decibel scale

**33.** Cable that consists of a braided shield and a center conductor

**34.** Same as 12 DOWN

**39.** Controversial recording medium

**41.** Souped-up Macintosh

**42.** _____ Shulze

**45.** Short for that which is measured in Farads

**46.** A record company

**47.** To the same extent or degree; like or _____

**48.** Short for type of battery that can be recharged

**52.** Edison tried to discredit 3-phase form of electricity in favor of this form

**54.** Performers love to be in this

**56.** $10^3$

**57.** A recursive computational procedure

**60.** The failure of the magnetization in a body to return to its original value when the external field is reduced

**61.** Standard video format common in Europe that is not compatible with the NTSC standard

**62.** About a million sets of eight bits

**65.** A random signal

**66.** Memory which can be read from, or written to, at will *(abbrev.)*

**67.** A set of instructions that can be recalled by a single command

**68.** Short for a device that varies resistance

**71.** The key one presses to send an instruction to the computer to be processed

**73.** A country bordered by Thailand

**74.** Transducer on a tape deck

**77.** Mathematical, exponential relationship

**79.** Disk file format that records data on only one side *(abbrev.)*

**80.** Synonym for earth *(abbrev.)*

**81.** Large Scale Integration *(abbrev.)*

**83.** To adjust the operating characteristics of a device to match a standard

**85.** Portable computer

**86.** Adapter that enables audio signals to be recorded onto the video tracks of a VCR, thus providing higher fidelity

**89.** The region with a less attractive potential for charge carriers than the sink

**91.** A combination of interconnected circuit elements all on the same substrate *(abbrev.)*

**92.** The unit of frequency

**94.** The button one presses to hear the tape

**96.** Advanced IBM-PC that uses an 80286

**97.** Analysis of waveforms as a summation of sine waves

**98.** 117 DOWN for clones

**100.** Device capable of turning a mic-level signal into a line-level signal

**101.** A waveform that contains all odd harmonics

**102.** What a performer does extemporaneously

**104.** Same as 41 DOWN

**106.** To reset the system

**108.** The overall amount of distortion in an audio processor *(abbrev.)*

**109.** The organization that establishes standards for radio and television engineers *(abbrev.)*

**111.** Same as 41 DOWN

**113.** Type of microphone technology that minimizes phase cancellations

**115.** Abbreviation for 44 ACROSS

**116.** General designation for home computer later usurped by IBM

**117.** The software that directs routine computer functions *(abbrev.)*

**118.** Time constant

## ACROSS

**2.** When a computer asks you a question

**5.** To measure a signal and maintain that level for a specified time duration (3 words)

**13.** _____-chaining can lead to MIDI time delay

**16.** Same as 91 DOWN

**17.** Examine sequentially part by part

**19.** Compact, for one

**21.** _____ voltage

**22.** Load accumulator

**23.** Optical-based digital recording medium

**24.** A high-level computer language

**27.** Degree program for those learning how to design hardware for computers *(abbrev.)*

**28.** The upper frequency limit of a sampler as determined by this theorem

**30.** Short for a mechanism that enables tape deck transports to sync up to SMPTE time code signals

**32.** Same as 11 DOWN

**35.** Many said rock 'n roll was just a _____

**36.** Organization for audio engineers *(abbrev.)*

**37.** Agency that oversees electrical safety *(abbrev.)*

**38.** To put data (often an entire file or program) into a computer's memory

**40.** A tape synchronization system in which tones are used rather than clock pulses *(abbrev.)*

**43.** Organization that has developed standards for the recording industry *(abbrev.)*

**44.** Extremely popular, thought-provoking music magazine

**49.** A state in the USA with an electronics company as its namesake *(abbrev.)*

**50.** A high-level computer language

**51.** Legendary LucasFilm device never marketed

**53.** _____ Shifter

**54.** They make sophisticated mixing boards *(abbrev.)*

**55.** Where one would keep signal processors

**57.** Same as 36 ACROSS

**58.** The button one presses to initiate the process of transferring input signals to tape *(abbrev.)*

**59.** Beer-drinking music is sometimes called oom-_____ music

**63.** Occurring in an unpredictable manner

**64.** _____ range

**68.** Fairlight synthesizers use a light

**69.** The syllable for the fifth tone of a diatonic scale

**70.** Pertaining to representation by a continuously variable quantity

**71.** Abbreviation for 107 ACROSS

**72.** The syllable for the seventh tone of a diatonic scale

**74.** What one would probably hear if plagued by a ground loop

**75.** Memory that can't be altered

**76.** Wave _____

**78.** A MIDI instruction

**81.** Play in a smooth, flowing style

**82.** Also known as Q, peak, or emphasis

**84.** 5¼ or 3½

**87.** Disk format that uses both sides of a floppy

**88.** Discovered by Bardeen, Brattain and Schockley

**90.** Sound chip in the Commodore 64

**93.** Same as 91 DOWN

**94.** Approximately equal to 3.1415

**95.** Same as 91 DOWN

**96.** Same as 96 DOWN

**99.** PC-900

**103.** Common envelope generator configuration

**105.** Hearing mechanism

**107.** That which alters the frequency response

**110.** Sinusoidal components of a complex waveform

**112.** A digitized sound

**114.** Degree program for those learning about electronics

**116.** Piece of phenolic or epoxy-glass with pre-punched holes (2 words)

**119.** A repeating event

**120.** MIDI Time Code *(abbrev.)*

**121.** A MIDI mode that assigns each voice to a different MIDI channel

**ANSWERS ON PAGE 118**

—from page 73, PORTABLE STUDIO

delay that I've seen. I hope to modify it to act as a chorusing device as described in the December '87 EM.

Astute observers may have noticed that all the stuff I've mentioned can be battery powered. This was one of my main goals in designing the system: if everything is battery powered, one can record in a bus, in a canoe, or while attempting to scale the twin towers of the World Trade Center (of course, you can only scale one tower at a time). However, like most things, battery operation looks better on paper than it works in real life. By the time you've crammed all of this stuff into a small box, it's a real drag to take it all back out again to change the batteries, so I've incorporated a power strip in my system (see **Fig. 2**) to save wear and tear on the system—not to mention keeping the environment free from all those dead batteries. Still, total mobility, if you need it, *is* possible.

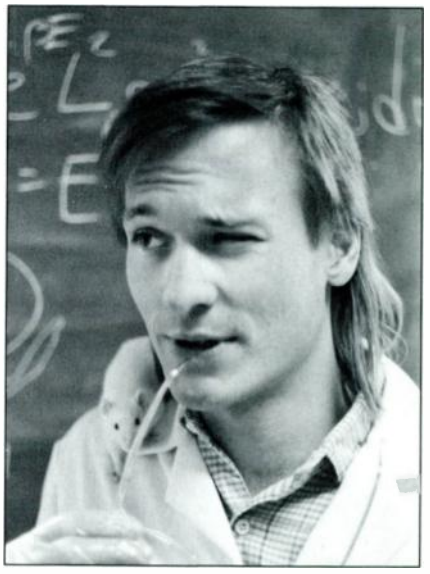
## WISH LIST

Having assembled my portable studio, I realize it will inevitably grow, and there are several directions I have in mind. A Scholz R&D Rockman is a battery-powered multi-effects unit that gives your guitar a great sound, and is quite small. Miniature, battery-powered speakers like the kind Radio Shack sells eliminate the need for headphones, or hooking up to a stereo. They'd also turn the system into a hi-tech boom box, which is just what the world needs.

As you can see, the imagination can run wild with this sort of thing, and any grouping of equipment will work, as long as you can make it fit into a small space. The important thing is to use what you have to its fullest potential.

## TIME TO MOVE ON

This kind of portable studio is possible because of the current trend towards small, portable instruments. Combine them into a small, easily transported package, and you not only can make your music anywhere, but you'll have an "instant studio" which requires minimum setup time. This will help maximize your creative time—do you want to make music, or plug and unplug cords? Good luck with your portable studio, and remember—bears are attracted to sawtooth waves going through lowpass filters, so be careful. **EM**



*David Farren is in two bands: Speed-Stick, a comedy music trio, and The Return. He is currently working on his PhD in photobiochemistry at the University of Nebraska.*

## SPECIFICATIONS

**TAPE FORMAT**
- ½ inch AKAI original cassette tape (MK20)

**HEAD CONFIGURATION**
- Super GX recording/playback head

**WOW AND FLUTTER**
- 19 cm/s: 0.03% (W-RMS) ± 0.05% Peak (DIN/IEC Weighted)
  9.5 cm/s: 0.04% (W-RMS) ± 0.06% Peak (DIN/IEC Weighted)

**DISTORTION**
- 19 cm/s: 0.5%, 0dB (315Hz third harmonic distortion)
  9.5 cm/s: 0.8% 0dB (315 Hz third harmonic distortion)

**DYNAMIC RANGE**
- 115dB, 1kHz (19cm/s, 9.5 cm/s)

**FREQUENCY CHARACTERISTICS**
- 19 cm/s: 50Hz – 20kHz, 9.5 cm/s: 50 Hz – 16kHz

**SN RATIO**
- 94 dB (NAB A – WTD, 315 Hz, 3% third harmonic distortion)

**CROSS TALK**
- (Between neighboring channels) 55 dB, 1 kHz (19 cm/s, 9.5 cm/s)

**EQUIVALENT INPUT NOISE**
- MIC: –126 dB

**PARAMETRIC EQUALIZER**
- HIGH: 1.5kHz – 15kHz ± 15dB
  MID: 350 Hz – 5kHz ± 15dB
  LOW: 40Hz – 800Hz ± 15dB

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WRH

If you've ever been unhappy with the way your phasing effects sound, here's a project that'll smooth those ups and downs.

# THE SMOOTH PHASER

BY THOMAS HENRY

Here's a new type of phase shifter, suitable for use with electric guitars or line-level instruments, that you can build easily and inexpensively. It's called the Smooth Phaser not only because of its clean sound, but also because it produces an incredibly even and fluid-like effect. If you're yawning, "Oh...another phase shifter," then read on, because this one really is different.

Phase shifters create an eerie "swooshing" or "jet" effect that generally adds a lot of "body" to an ordinary signal. Most commercial units utilize a triangle wave generator to sweep the sound from the low end to the high end and back again. Unfortunately, musical parameters are generally nonlinear in nature, and so the constant sweeping of a triangle wave (which is linear) generates a very uneven sound. Typically, the sweeping through the bass region passes by too quickly and the phasing in the treble range seems to drag on and on. Not so with the Smooth Phaser. By using certain semiconductor tricks, we can even out that response, creating a phasing action that sweeps uniformly through the bass and treble regions. But that's not all; the Smooth Phaser also supports low-noise operation, a variety of front panel controls, and the ability to gang several units for synchronized phasing. If this all sounds good to you, then read on.

## HOW IT WORKS

Before starting to build the Smooth Phaser, take time to see how the critter works. **Fig. 1** shows the complete schematic. Now before fainting at the apparent "complexity" of the circuit, be aware of the fact that most of the details are actually contained inside those silicon marvels, the ICs. For example, amplifiers A1 through A4 are all contained inside one chip, IC1. In fact, there are only three chips used in the entire circuit, so the actual construction is really quite simple.

But let's get back to the theory first. The phase shifting action is created by phase delaying a signal a certain amount, and then mixing that delayed version with some of the original signal. As the

ILLUSTRATION BY JACK DESROCHER

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WRH

amount of delay is changed, additions and cancellations occur throughout the passband producing the characteristic "swooshing" effect.

In this circuit, the phase delay is created by IC1, the SSM2040 voltage-controlled filter chip. This is a four-stage device; each stage corresponds to amplifiers A1 through A4, respectively. We'll say more about the modulation of the phase delay in a while; for now let's trace the audio path.

The Smooth Phaser was designed to be compatible with a variety of signal inputs. Many guitars can be plugged directly into J1 (leaving R32 up full), while others with weak pickups may need to be preamplified first. On the other hand, organs, synthesizers and line-level devices may be interfaced as well, simply by taming the signal a bit with attenuator R32. My unit is built into a pedal board, designed around the system described by Craig Anderton in his book *Electronic Projects for Musicians*, and is compatible with all of those circuits (like compressors, fuzzes, preamplifiers, ring modulators, etc.).[1] The Smooth Phaser should also be usable with tape recorders, P.A. systems and other line-level devices, simply by backing off on R32 a bit.

After the audio signal is introduced into the circuit, op amp A5 buffers it and splits it in two. Part of the signal is fed to the phase delay network via R10, while the rest is sent to the blend control, R38. As mentioned earlier, the phase delay is created by IC1 (corresponding to amplifiers A1 through A4 in the schematic). Part of the output of IC1 is fed back to the second stage via the regeneration control, R19. This control affords you a great variation of sounds. In general, a low setting on R19 produces a soft, subtle warm effect, while a high setting creates some very intense "jet" effects.

IC1 also feeds the polarity-changing circuitry designed around op amp A6. By flipping switch S1 open, positive phasing is realized and this is quite ethereal in quality. Closing S1, on the other hand, generates negative phasing, which is bassier and more filter-like. The output of the polarity changer feeds to R38—the blend control we saw earlier. With the blend all the way towards A5, the straight signal is passed to the output. With the control near the middle, a traditional phased sound is created. As an extra bonus, however, turn the blend control all the way towards A6 and you get a *neat* vibrato sound that can add vibrato to instruments that normally can't be modulated in this way (like pianos, or my voice).

The output is conditioned by op amp A7 to make the signal a bit cleaner and more stable. To achieve this goal, R26 and C8 roll off the low end at about 20 Hz, while R22 and C2 taper the high end at about 20 kHz. The op amp also buffers the output signal from the blend potentiometer, and then presents the final result to jack J3.

Having analyzed the audio path, let's look into the control voltage circuitry, where a lot of the magic occurs. The control signal is first generated as a triangle wave by the Schmitt trigger/integrator LFO comprised of op amps A9 and A10 and associated components. A9, in conjunction with R21 and R25, forms a Schmitt trigger with set points of -5V and +5V. A10, along with R35 and C10, makes up an integrator, whose output will be a triangle wave, also with an amplitude of -5V to +5V. The triangle wave output drives LED D2 so that you get visual confirmation of the rate of oscillation, which is determined, by the way, by potentiometer R37, and varies from about one cycle every ten seconds to about 10 Hz.

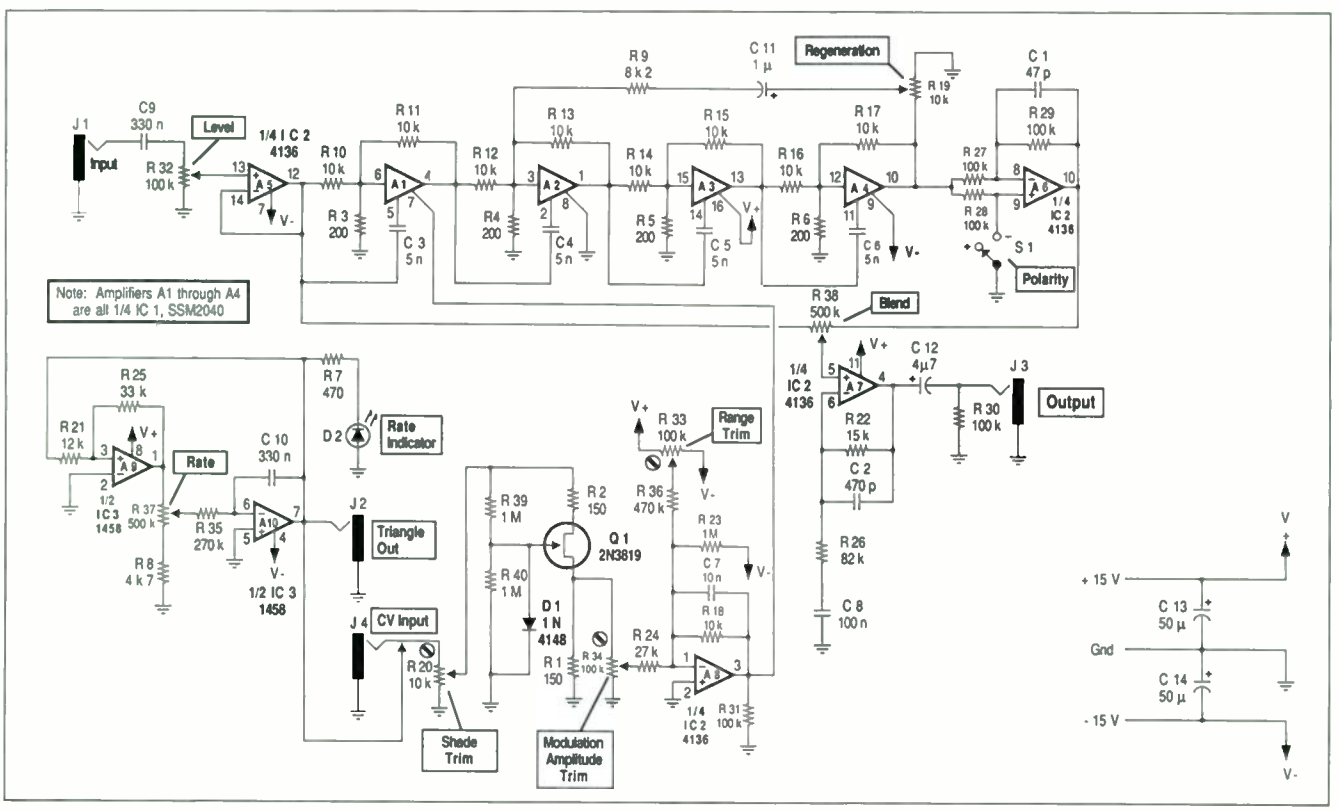



**FIG 1: Schematic for Thomas Henry's Smooth Phaser**

The triangle wave control voltage is made available at jack J2, so that other units may be slaved to it. In addition, the triangle is also fed to J4, which is configured as a "break jack." With no plug inserted in J4, the LFO feeds the rest of the circuitry, as in any phase shifter. But when a plug is inserted into J4, the connection from the LFO is broken, so that the phaser now follows the external control voltage. Thus, the Smooth Phaser can be either a master or a slave.

The control source being used is fed to trimmer R20, which attenuates the signal somewhat before presenting it to the control voltage "warping" circuit. The warping circuit, designed around D1 and Q1, has the duty of altering the strict linear action of the triangle wave to something approaching a full-wave rectified sine. We don't really have to know much about this circuit, other than that the output waveform sweeps IC1 in the desired fashion. That is, the phase shifter moves fairly slowly through the bass region and then speeds up when it gets into the treble region, and *voila*, the smooth sound we wanted. For more details on this interesting warping circuit, see references 2 and 3.

The control signal is further modified and buffered by A8, whose output then feeds pin 7 of IC1. Pin 7 is the control voltage input for the VCF. Now notice several important details at this point. First, R31 acts as a "tie-down" for this sensitive pin of IC1. Furthermore, C7, in the feedback loop of A8, removes any objectionable clicks in the modulation and even better, dumps off any strong RF interference which may be floating around in the air. Finally, the three trimmers associated with this section of the Smooth Phaser, namely R20, R34 and R33, are used to tweak up the shape of the control wave so that it has exactly the desired response. We'll see how to adjust these in just a bit.

That's all there is to understanding the Smooth Phaser. Well, not really, but it is certainly enough to get us going on building the beast. For more information on phase shifters, see reference 4. In the meanwhile, let's get building.

## BUILDING THE SMOOTH PHASER

Building the Smooth Phaser is easy and will yield excellent results, but only if you are patient and tidy. Messy, "whip-it-up-in-a-minute" construction methods will probably produce a phaser that's noisy,

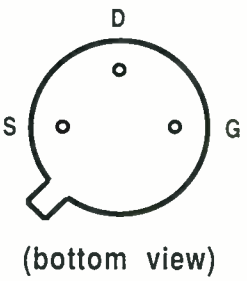
erratic or even nonfunctional. So please, take your time and do it right; you won't regret it. My final version is (to my ears) the best phase shifter around and pleases me to no end. Here are some tips to get you started in the right direction so that you can repeat my results.

First, you need to get the parts. **Fig. 2** shows the parts list. Most of the components are easy to find except for the SSM2040. I suggest getting it directly from the manufacturer who will accept single unit orders.[2] In terms of hardware, I built mine on a Radio Shack "Digital IC Experimental Breadboard" (Cat. No. 276-154A) using point-to-point wiring. This board is about 4 inches by 5 inches and provides plenty of room to arrange the circuit comfortably. One hint: don't make a rat's nest; rather, route the wires neatly and in straight lines. Use sockets for the three ICs, and flea clips for the external connections to the pots, switch and so on.

| | |
|---|---|
| **Resistors** | |
| R1, R2 | 150 (150 Ω) |
| R3-R6 | 200 (200 Ω) |
| R7 | 470 (470 Ω) |
| R8 | 4k7 (4.7 kΩ) |
| R9 | 8k2 (8.2 kΩ) |
| R10-R18 | 10k (10 kΩ) |
| R19 | 10k linear pot (10 kΩ) |
| R20 | 10k trimmer (10 kΩ) |
| R21 | 12k (12 kΩ) |
| R22 | 15k (15 kΩ) |
| R23 | 1M (1 MΩ) |
| R24 | 27k (27 kΩ) |
| R25 | 33k (33 kΩ) |
| R26 | 82k (82 kΩ) |
| R27-R31 | 100k (100 kΩ) |
| R32 | 100k audio pot (100 kΩ) |
| R33, R34 | 100k trimmer (100 kΩ) |
| R35 | 270k (270 kΩ) |
| R36 | 470k (470 kΩ) |
| R37 | 500k audio pot (500 kΩ) |
| R38 | 500k linear pot (500 kΩ) |
| R39-40 | 1M (1 MΩ) |
| **Capacitors** | |
| C1 | 47p (47 pF) |
| C2 | 470p (470 pF) |
| C3-C6 | 5n mylar (0.005 μF) |
| C7 | 10n mylar (0.01 μF) |
| C8 | 100n mylar (0.1 μF) |
| C9, C10 | 330n mylar (0.33 μF) |
| **Semiconductors** | |
| D1 | 1N4148 diode |
| D2 | red LED |
| Q1 | 2N3819 FET |
| IC1 | SSM2040 VCF IC |
| IC2 | 4136 quad opamp |
| IC3 | 1458 dual opamp |
| **Miscellaneous** | |
| J1-J3 | ¼" OC phone jack |
| J4 | ¼" CC phone jack |
| S1 | SPST switch |
| | wire, circuit board, sockets, solder, front panel, knobs, etc. |

**FIG 2: Parts list for the Smooth Phaser**

**FIG 3: Pin-out of the 2N3819 FET**




I really like rack-mounted stuff, so I built my Smooth Phaser behind a standard 1U panel of 1¾ inches by 19 inches. This provides plenty of room for the four potentiometers, four jacks, one switch and the LED.

**Fig. 3** shows the pin-out for the 2N3819 field effect transistor. This is provided for your convenience, but be aware that different manufacturers may use different pin arrangements on their FETs. In any event, the source and drain may be interchanged with no ill effect.

My Smooth Phaser is one of the quietest units I have ever heard. To insure yours is too, be neat and obey all the shielding rules. Particularly, you *must* use shielded wires for any critical electrical paths to reject RF interference and hum and to avoid clicks from the Schmitt trigger. Shield the wires to: pots R32, R38 and R19, switch S1 and jack J1. Connect the shield wire to ground only on the circuit board side to avoid ground loops.

## ADJUSTING AND USING THE SMOOTH PHASER

After building the Smooth Phaser and confirming that it doesn't emit fire or smoke on power-up, proceed to tweak the three trim pots. Start by connecting an audio source of about 1V peak-to-peak to the input at J1. Then connect the output jack J3 to an audio amplifier set for a comfortable listening level. Turn R32 full on, and R19 and R38 to about the midpoint of their rotations. Adjust R37 for a rate of about 2 or 3 Hz. Now set the three trimmers to the midpoint of their rotations. You should hear some phasing

action now, although the sweep may be somewhat limited.

Start by adjusting R20 until you notice the phasing is equally spread out between the bass and treble range. Then adjust R34 so that the phaser is modulated as much as possible, but without any "dead" time. Dead time means that there is a certain voltage that can be applied to pin 7 of IC1, after which an increase in voltage will not cause an increase in phasing to occur. Tweak R34 to avoid this. Now adjust R33 to set the basic range. This control determines in what part of the audio spectrum the phasing will occur. Bass players take note; you aren't forgotten. R33 can be used to maximize the phasing effect for your instrument too.

After tweaking these three trimmers, "go around the horn" several more times to insure that you have the phasing response that's most pleasing to your ears. (The trimmers do interact to a small extent.) There's a lot of room for tailoring the sound here, so take advantage of it and tweak to your heart's content. When I adjusted my unit, I spent about 20 minutes with the trimmers and gave the unit a real critical listening test under a variety of circumstances and with a variety of instruments. When I was all done, I was very pleased with the results. In print, these instructions may seem difficult, but actually the adjustment process is quite easy.

And now you're ready to play with it. For starters, try some simple phasing. Set the blend to a mid position and the rate control to about 1 Hz. Keep the regeneration to a minimum for a warm, melodic effect, or really crank it for some outer space stuff. Now try the polarity switch and notice the difference between positive and negative phasing. To try the vibrato effect, turn the regeneration to a minimum and the blend control to the full processed side. Set the rate control to about 7 Hz and then notice the incredibly realistic vibrato sound.

If you have built two of these units, you can gang them for series or parallel action, or even inverted action (like the old Mutron Bi-Phase units). To synchronize the control voltages, connect J2 of one unit (the master) to J4 of the other unit (the slave). Or if you prefer, connect any source of 10V peak-to-peak control signals to J4 for external sweeping. The sky's the limit, so start dabbling and see if you don't think this is the smoothest phaser around.

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[1]Anderton, Craig. *Electronic Projects for Musicians.* (New York: Music Sales Corporation, 1980.)

[2]Solid State Micro Technology for Music, Inc. (makers of the SSM2040), 2076B Walsh Avenue, Santa Clara, CA 95050.


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*Thomas Henry played guitar professionally for ten years to put himself through school. Currently he is an assistant professor of computer science at Mankato State University in Minnesota. Aside from computers and electronics, Thomas has a passion for Victorian literature, Sherlock Holmes and the works of Oscar Wilde.*


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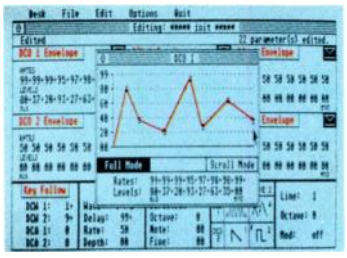

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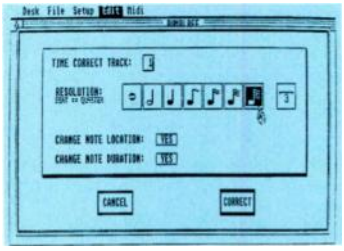

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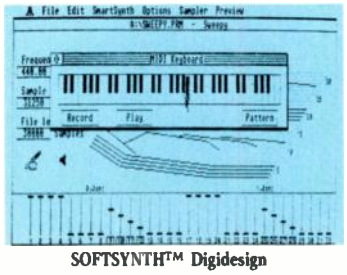

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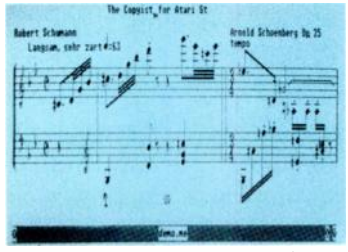

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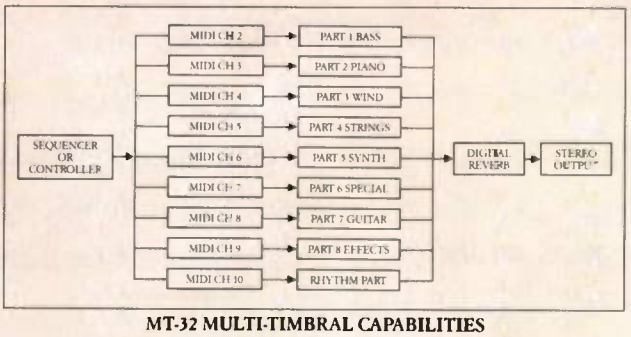


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# Questions & Answers:

# PARTS

**If you're party to gear whose parts are part of the problem, here's part of the solution.**

BY ALAN GARY CAMPBELL

**Q. What the heck is a zero-ohm resistor? I've seen them mentioned in parts lists.**

**A.** It's a jumper wire surrounded by a composite body in the shape of a resistor (see **Fig. 1**); this keeps the wire up off the circuit board to avoid shorts to traces below. The body has a single black color-code stripe, indicating zero resistance—hence the name.

**Q. What spare electronics parts should I take on the road, just in case?**

**A.** Electronic musical instrument designs vary greatly, making it impractical to carry spares of everything; however, these frequently used components are a good place to start: 741 op amps; 1458, 4558, TL072, and LF353 dual op amps; TLO84 quad op amps; 7805, 7812, 7912, 7815 and 7915 linear voltage regulators; 7404 TTL hex inverters; 74LS08 low-power Schottky quad 2-input AND gates, 74LS74 dual D flip flops, and 74LS138 decoders; 4011B CMOS quad 2-input NAND gates, 4051B and 4053B multiplexers, 4016 and 4066 quad bilateral switches; 2N3904 NPN transistors; 2N3906 PNP transistors; 1N4148 silicon switching-diodes; 1N4000-series 1-amp rectifier diodes; high-brightness jumbo red LEDs; an assortment of ¼-watt, 5% carbon film resistors; and an assortment of ceramic-disk and monolithic-ceramic capacitors, in the 50 to 100 working-volt range.

To consolidate your op-amp inventory: the 4558 dual op amp can substitute for the 1458; the TL072 and LF353 are interchangeable, and either can substitute for the 4558 *or* 1458 (in other words, for duals, just carry the TL072 or LF353).

Don't substitute low-power Schottky ("LS" type) TTL for regular TTL (or vice versa) unless you know what you're doing—the current source/sink requirements are different; likewise, don't substitute low-power Schottky for HC-series ICs (or vice versa). Don't substitute the older A-series CMOS for B-series (unless otherwise specified, CMOS ICs are assumed to be B-series).

For bipolar transistors used as switches, almost any replacement type is suitable, except in MIDI output driver circuits—2N3904 types are not fast enough. A higher-numbered 1N4000-series rectifier diode can replace a lower-numbered one; for example, if a 1N4002 is not available, use a 1N4003 or 1N4004. Regular LEDs can sub for high-brightness types, they're just not as bright.

Also, it's wise to get service manuals for your gear to peruse the parts lists and take on the road with you. Obtain spares of components used in quantity, and of any specialized parts such as Curtis Electromusic or SSM VCO, VCF, VCA, and multi-function ICs; 5532-type low-noise op amps; unusual RAMs; or odd-value electrolytic or tantalum caps. Don't forget to carry spare power cords (Radio Shack carries a standard CEE-type three-conductor detachable power cord, catalog number 278-1257) and fuses.

**Q. How do I know which op amps I can substitute for others?**

**A.** This can be a complex mat-

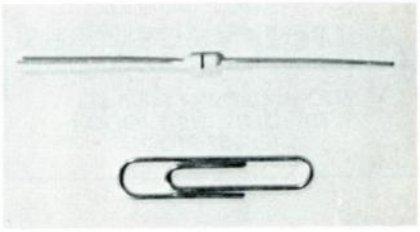
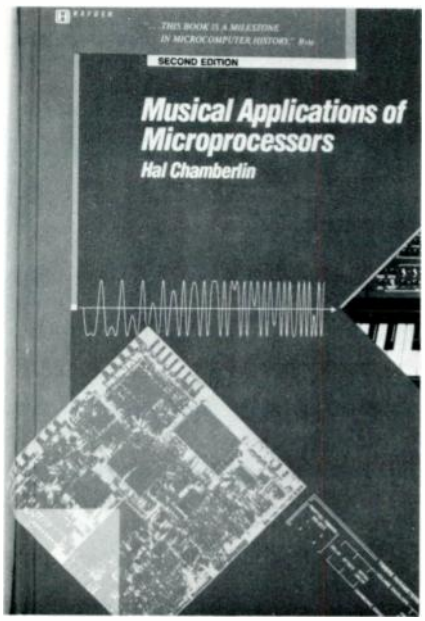


FIG. 1: Zero-ohm resistor


PHOTOS BY BILL KINNAMAN

FIG. 2: Ceramic-encapsulated EMI suppressor




**Back in print: Hayden Books has published a new edition of Hal Chamberlin's classic text, *Musical Applications of Microprocessors.***

ter, but the first consideration is the *pinout*. For example, the 1458, 4558, TL022, TL062, LM358, LF353, TL072, and TL082 dual op amps all have the same pinout. In non-critical applications (e.g., when the amp is used as a control voltage summer or buffer), you might substitute any one for another; and you can often substitute a more advanced op amp for a simpler one (as with the TL072/LF353, 4558, and 1458, above), with an attendant improvement in performance. For example, if you have an effects device that uses 4558s or 1458s, you can improve its signal-to-noise ratio by replacing them with TL072s or LF353s.

But for specialized applications, you'll need more specific information in order to choose the best substitute part. For example, in low-power circuits (e.g., a battery-powered effect) you might use the TL022, or LM358 (which also works with a single supply), though the TL062 is also relatively low-power and has a higher input impedance; and so on. Things get really complicated when you want to replace an externally compensated op amp with one that requires a different compensation scheme, one that's internally compensated, or one that has a pinout that's almost—but not quite—the same (time to grab the X-acto™ and cut some traces).

Your best recourse is to refer to manufacturer's databooks, and study the op amp specs carefully before proceeding. Most university and tech school/community college libraries hold databooks, if you don't have access to them at work or at home.

**Q. Can I substitute low-power Schottky TTL for HC-series logic ICs? They're supposed to be pin-for-pin compatible.**

**A.** The logic functions of HC-series ICs *are* LS-TTL-compatible. It's a fairly straightforward matter to construct a LS-TTL-based design using HC components instead, to provide lower power consumption and other advantages. But that doesn't mean that you can replace, say, the 74HC04 in a CZ-101 Reset circuit with an 74LS04, though you might be tempted to since HC-series ICs can be hard to find. Fortunately, most mail-order parts suppliers now carry HC-series ICs. Check the ads in the back of *Modern Electronics* and *Radio Electronics*.

An aside: you *can* sometimes replace 74HCT-series ICs with 74LS, but not always. Is this confusing, or what?

**Q. Is it okay to use Radio Shack parts for repairs and do-it-yourself? I've heard that some of them are seconds and untested parts.**

**A.** Only the *Archer Pak*™ component series—poly bags containing quantities of generic diodes, transistors, LEDs, etc.—includes less-than-first-quality parts; and you definitely do *not* want to use these for repairs or serious DIY. For example, some Archer Pak generic 2N3904-type transistors that I tested exhibited alarmingly low reverse-breakdown voltages, and several transistors were defective right out of the bag.

Nonetheless, the other parts in Radio Shack's line are first quality, as are their electronics chemicals (discussed in the July '87 "Service Clinic"). Some of the parts may come from manufacturers' overruns, but this should not affect component performance. Of course, the Shack's blister-packed components cost more than mail order parts, but where else can you buy a 4066 CMOS quad bilateral switch at 5:30 on a Sunday afternoon?

**Q. Is there a fast, safe way to service equipment containing blown pigtail fuses?**

**A.** You can bridge a blown,

soldered-in 1¼-inch pigtail fuse with a special fuse clip designed for this purpose. Radio Shack carries a good quality Buss brand clip, part number 270-1219. This provides a semi-permanent fix, but it's more reliable to desolder the old fuse and replace it.

**Q. What are those weird-looking things on Casio circuit boards, that look like a cross between a ceramic cap and some resistors, and have three leads coming out of them?**

**A.** Those are ceramic-encapsulated hybrid EMI-suppression networks (see **Fig. 2**)—also used in Roland equipment—containing two small, cylindrical inductors, in series, with a capacitor tapped from their common connecting point to ground. These networks are wired in series with the inputs and outputs on many Casio instruments for EMI filtering. They seem to work pretty well.

**Q. How can you tell if a surge suppressor is worn out?**

**A.** Without sophisticated test equipment, you often can't. Some suppressors, like the Radio Shack models 61-2793 and 61-2791, have an integral LED to indicate device failure, but most do not. Frankly, I'm skeptical of the reliability of such indicator schemes. If the suppressor receives a transient large enough to destroy its MOV, might that not also destroy the LED? As a rule of thumb, simply replace inexpensive cube-tap type suppressors yearly—more frequently if a suppressor is known or suspected to have been exposed to a hefty transient. Similarly, outlet strips and AC line conditioners that contain MOVs and similar suppression elements should be serviced yearly, and those elements removed and replaced. Caution: if you elect to perform service of this type yourself, **MAKE SURE THE OUTLET STRIP IS UNPLUGGED BEFORE DISASSEMBLY. QUADRUPLE-CHECK ALL WIRING BEFORE REASSEMBLY AND POWER-UP. OBSERVE PROPER AC SAFETY PRECAUTIONS.** If you are not sure how to proceed, refer the work to a qualified technician.

By the way, MOVs don't exactly "wear out." They can withstand repeated exposure to transients within their power-dissipation range, but beyond that, they may fail.

**Q. Where can I obtain the RCA SK-403 surge suppressors that you recommend? I haven't been able to find them.**

**A.** Check the Bell System Yellow Pages, under "Electronic Equipment & Supplies—Wholesale & Manufacturers." Look for an electronics parts supplier that carries the RCA SK line of semiconductors. While you're there, pick up an *RCA SK Series Solid State Replacement Guide*. The SK line includes a wide range of TTL, CMOS, and linear ICs; diodes; transistors; thyristors; metal film resistors; etc., and is a good local source for these.

**Q. Where can I obtain right-angle PC-mount DIN jacks? Local dealers carry only the panel-mount kind.**

**Q. Where can I get ¼-inch phone jacks with insulated (plastic) bushings?**

**A.** The GC Electronics line includes a right-angle PC-mount DIN jack, catalog number 33-983. Any GC dealer can order these for you, if they don't have them in stock.

Mouser Electronics, 2401 Highway 287 North, Mansfield, TX 76063 ☎ 800 / 992-9943 (requests for catalogs only), carries a simlar PC-mount DIN jack, catalog number 16PJ109, and also carries an insulated-bushing phone jack, catalog number 16PJ086. Write or call for a catalog and ordering information.

**Q. Where can I get rugged push on/off-type switches to use as footswitches? The switches I get from local parts stores don't last a week!**

**A.** Arrow Hart manufactures push switches that are so strong a brontosaurus couldn't break them! Check the Yellow Pages under "Electric Equipment & Supplies—Wholesale," and look for a dealer that carries Arrow Hart products. Ask for model 81114 DPST and model 81117 DPDT pushbutton switches (if they don't have them, they can order them).

**Q. Can I use regular piano strings to replace broken ones in my CP70?**

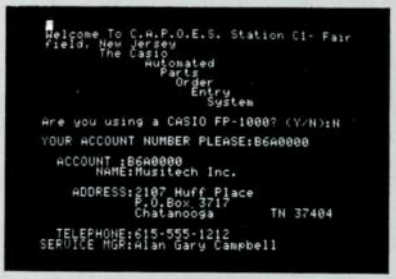
**A.** You should use only Yamaha factory-replacement parts for the lower, wound strings; but you can use generic piano strings to replace the upper, bare ones —just be sure to get the gauge right (check it with a micrometer), and don't install any strings that are rusted or tarnished.

## C.A.P.O.E.S. to the Rescue!

In the August '86 "Service Clinic," I reported on Casio's remarkable personal computer-based service data reporting system. Now they've done it again, with the **C**omputer **A**ssisted **P**arts **O**rder **E**ntry **S**ystem, or C.A.P.O.E.S.

This system allows any service center with a Casio parts account to order parts via a personal computer and modem, from any one of seven regional on-line order-processing centers (orders are shipped from the Casio Parts Center in New Jersey). The service center is billed only for the parts and shipping costs; there is no minimum order and no service charge. To paraphrase Casio's descriptive literature, C.A.P.O.E.S. solves the problems of: "it got lost in the mail," "the Postal Service is too slow," "the order line is always busy," "the parts center was closed for lunch," "you can't order after hours," "the person on the phone was rude," "the person on the phone was an idiot," "a $25 minimum is too high," and, "New Jersey is too far away to call."

C.A.P.O.E.S. is very user-friendly, and you don't need any fancy hardware to access it. I got good results with a used Franklin 1000 Apple clone and a simple 300-baud modem (though




the system will also operate at 1200 or 2400 baud). C.A.P.O.E.S. prompts you for every entry, provides alternate part numbers for obsolete parts, and even allows you to type in a description, for later search, if you don't know the part number. You can easily review an entire order at any time, and select from a wide range of shipping methods, and of course, if you save your telecom buffer to disk, you have an instant record of your order.

You get all this convenience just by subscribing to Casio's Technical Information Service (a bargain in itself) and getting a Parts Account Number. Kudos for C.A.P.O.E.S. to Casio, and Casio's service manager, Ted Grier.

**Casio Technical Information Center**
570 Mount Pleasant Avenue
PO Box 7000
Dover, NJ 07801

**Q. I need parts and a service manual for my old Electrocomp 101 synthesizer, but EML is out of business. Help!**

**A.** Though EML has "officially" been out of business for about two years, you may still be able to obtain service manuals and some parts. Contact: EML, PO Box H, Vernon, CT 06066. Regarding substitutions for unavailable parts and tough service problems, try to find a local service center with experience in analog synth service; they should be able to help.

## SERVICE UPDATE

Regarding out-of-production Oberheim products, such as the 2/4/6/8-Voice, SEM-1, OB-1, OB-X, OB-Xa, OB-SX, etc. (ECC/Oberheim does not support these units): parts are available from Magic Music Machine, 1207 Howard Street, San Francisco, CA 94103 ☎ 415 / 864-3300; service and owner's manuals (and an OB-8 MIDI retrofit) are available from Magic Parts, 1537 Fourth Street, Suite 198, San Rafael, CA 94901 ☎ 800 / 451-1922, or 800 / 525-0022 (CA). The two companies are no longer related. Also, some errata for and additions to the "Sources" Service Clinic in the February '88 EM: The Sam's book *Electronic Music Circuits*, by Barry Klein, is out of print as of December '87, although there might still be some copies in stores. Thankfully, Tab Books has released a topically similar title, *Build a Better Music Synthesizer*, by EM author Thomas Henry. But now the good news: *Musical Applications of Microprocessors*, by computer-music whiz Hal Chamberlin, is back in print! You can get it from any Sam's dealer, or through the Mix Bookshelf ☎ 800 / 233-9604 or 415 / 653-3307. Other stuff: Heathkit now offers a catalog that focuses solely on their home-study courses and electronics trainers; write for a copy of the *Heath Education Catalog*, Heath Company, Benton Harbor, MI 49022. Radio Shack has added yet another title, *Communications Projects*, (catalog number 276-5015) to the Forrest M. Mimms Engineer's-Mini-Notebook series. McGraw-Hill's *Electronics Assembly & Fabrication Methods* is now titled *Electronic Techniques: Shop Practices and Construction*, and emphasizes shop techniques only. **EM**

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

# THE EXPERIENCED SEQUENCER:

## 12 Tips for the Roland MC-500 and the Yamaha QX5

Equipment manuals can only go so far; the real learning process comes with experience. This EM author spent a lot of time with two popular sequencers and came up with some quality information.

BY TERRY KENNEDY



**Both the Roland MC-500 and the Yamaha QX5 are computers dedicated to musical sequencing.**

**EDITOR'S NOTE: In a number of her projects, including the recording of her band, Chemistry Set, Terry Kennedy used both the Roland MC-500 and the Yamaha QX5 sequencers. She developed a dozen useful ideas for maximizing the effectiveness of these dedicated units, and wants to pass the benefits of her learning curve on to EM readers.**

The Roland MC-500 and the Yamaha QX5 are two hardware sequencers that are fairly easy to use, reasonably priced, currently on the market and—not co-incidentally—popular with musicians. (See the sidebar for more details.) If you own one of these units or are thinking of buying one, these tips should help you use them to your best advantage.

### 1. Pre-production Time-saving Techniques

*Outline/Structure.* All music—even improvisational material—has some degree of structure. The more structure you can define at the outset of a project, the more *focus* your song will have. You can always change your mind and break the rules along the way, but at least establish the guidelines at the start.

When you begin working on a song, determine the approximate number of measures you will need. In the MC-500, use the edit functions to insert all the necessary measures for all tracks simultaneously. This way you'll have the flexibility to use functions like copy and move right away. In the QX5, you'll only be able to do this in track one (which we'll discuss later).

One of the most important facets of

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music is the relationship between repeated and surprise elements. In the first stage of establishing a repeat motif, put your backbone—the rhythm tracks—down first, to serve as the basis for working on the intricacies of melodic and harmonic elements. When this is done, you can go back and spice up your rhythm, harmony and melody tracks with surprises for your listener.

Trim down variables. Internal memory gets eaten up quickly, so when you're editing, bring only one song at a time into internal memory.

Deactivate MIDI continuous controller functions (such as aftertouch or pitch bend) that you don't expect to use. Do this at the beginning of a programming session, and you'll waste less time and memory.

### 2. Using Sequencers with Drum Machines

Syncing your drum machine to your sequencer is a crucial step in the sequencing process. If you program a song into your drum machine and then use the sequencer simply as a "clock" to play the drums, you can experience timing/synchronizing problems, especially when restarting in the middle of a sequence.

To be sure the drum machine will start in sync with the sequencer, record the song from the drum machine into the sequencer via MIDI. This will allow you to alter one measure or one beat at a time in the sequencer without changing your basic patterns in the drum machine. You'll also be able to start, stop and continue your song from any point in the sequence rather than going back to the beginning every time you want to review something.

The MC-500's "rhythm track" defaults certain assignments of drum sounds to MIDI note numbers. Many drum machines (e.g., the Yamaha RX11, Sequential Circuits Drumtraks, and Oberheim DX) do not have the same note assignments, so if you're working with one particular drum machine most of the time, change the MIDI note assignments directly in the sequencer and *save them* to disk. This way you won't have to set them again unless you want to reprogram your drum note assignments for a given song.

To set the MC-500 rhythm MIDI/note assignments, call into memory an existing song that has the assignments you want. Erase the song from memory (yes, be daring, live a little) by pressing *Shift 4*. Although the rhythmic and melodic elements (the notes) will disappear, your MIDI/drum note assignments will remain and you'll be able to program rhythm patterns or transfer drum "songs" from your rhythm machine into your sequencer.

### 3. Saving/Storing

I can't stress this enough: *save* frequently. You'll thank yourself for investing the time in the (hopefully infrequent) event of a *crash* (Creatures that Routinely Arrest Something that's Happening), that generally happens when you least need it.

### 4. Merging Tracks

Unlike lanes on the New Jersey Turnpike, merging tracks in a sequencer can be great fun when you want to maximize performances on a limited machine. However, if you don't plan to use more than four tracks on the MC-500 (excluding the rhythm track), or eight tracks (including drums) on the QX5, don't bother merging. Either keep things simple, or keep them well-organized by charting the best tracks to be merged. Once merged, tracks can be extracted by using the *Unmerge* function.

There can only be one merged track of material per song on the MC-500, but you can keep merging to this destination track as long as memory permits. So, if you have merged material on track three and unmerged material that you wish to merge on tracks one, two and four, you must meld the tracks to track three or an error message will appear, the machine will lock up (*ouch*), and you will have to

## Equipment Profile

The world of music sequencers is divided into two parts: software and hardware. *Software sequencers* are application programs—just like word processors, graphics programs and so forth—that you load into a personal computer. *Hardware*, or *dedicated* sequencers, are themselves computers that are permanently loaded ("dedicated") with a sequencing program. Hardware sequencers are more compact and portable than fully implemented computers, making them good for using on live gigs. Since they need to do just one job, they are often less powerful and therefore less expensive than buying both a personal computer and a sequencing program.

Two of the more popular dedicated sequencers around are the Roland MC-500 (list price $1,395) and the Yamaha QX5 ($595 list).

To describe them briefly, the QX5 has eight tracks—which can contain data from any of 16 MIDI channels—and 32 macros. (A macro can be a musical phrase, a program change, or a complete track.) The unit which can store up to 20,000 notes and can filter out certain kinds of MIDI data to conserve memory. It can record in real time, step time, and can punch in and out. With the QX5, you can edit tracks (clear, exchange, copy, and merge); measures (copy, delete, remove MIDI data, create measures, quantize and crescendo) and individual events (aftertouch, pitch bend, control range, mode and program change, macro calls and tempo changes). The QX5 saves its sequences on cassette tape or, by use of an optional disk drive, on 2¼-inch disks.

The MC-500 stretches the concept of a dedicated sequencer by dint of its built-in 3½-inch disk drive. With this drive, you can both save and load your sequences to and from disk, as well as load *different* application programs optimized for many different functions. Currently available applications include a performance package, a librarian and a rhythm program. Because of this, Roland refers to the MC-500 not just as a sequencer, but as a "music computer." As a sequencer, the MC-500 stores 20,000 notes, uses four tracks plus a 999-bar "rhythm track" for drum sequences, and a tempo track for controlling tempo. The unit can merge tracks, punch in and out, copy, insert, delete, erase, transpose and shift MIDI channels. It also sends and receives MIDI Song Position Pointer data, and has two MIDI Outs that can be assigned to any MIDI channel.

*—Tim Tully*

reboot, probably losing information. (See suggestion #3.)

Performance notes: if you're thinking of using an MC-500 for performance purposes, you probably won't be able to fit an entire set's worth of songs in internal memory, unless you load a series of non-complex (from the machine's standpoint) songs or a short set of more involved songs. If necessary (and affordable), two MC-500s can be linked with a MIDI patching device to switch between them (either that or get your rap together and talk with the audience between songs to fill the gap).

## 5. Source and Dump Tracks

One of the easier methods of keeping tabs on your sequencer information is to bounce the track you're working on (source track) to another track (work track) which you can retrieve later. In the QX5, track one is where the basic editing functions—copy, delete, insert, and so forth—must be performed. Only a few parameters (e.g., MIDI channel and tempo) can be altered without moving a dump track to track one. This manufacturer limitation can be handy if you have a tendency to create and forget, but it's a pain every time you want to make a small change to a track *other* than track one.

On the QX5, from tracks two through eight, bounce the track you want to edit to track one and make your changes. Then listen to track one compared with the track you bounced from. If everything is copacetic, bounce back from track one to the source track. (Remember: the source track will be erased once you do this, so be certain the edited track is to your liking.) When you're satisfied with the newly transferred track, erase the material on the source track. This will prevent useless information from cluttering the sequencer and will also give you more tracks with which to work. In addition, it will be easier to remember what stage you were at if you have to continue your editing at another time.

To keep things organized, write down: your MIDI channel/instrument assignments, which tracks have been edited, which are to be edited and what you feel they will need. Not many musicians create, edit and record completely polished songs in one session. Because of human burnout over many long sessions, don't trust your memory—*write it down*. The machine may have a more accurate memory for details than you do, but you are its master (at least some of the time).

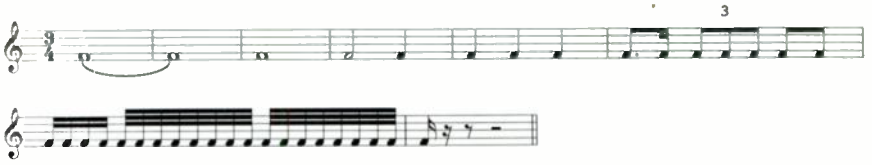



**FIG. 1: Simulate tempo changes using a series of longer to shorter notes.**

**FIG: 2 Create an apparent decrease in tempo with a series of successively longer notes.**

## 6. Synchronization

Before putting the sync tone to tape, listen to the first draft of your sequence at a few different tempi to check which one sounds best; the ideal tempo may or may not be the one you originally thought it would be. Then save the tempo information immediately. If you forget to do this and jump into recording a sync track to tape, you could be laying the code down at the wrong tempo. The default tempo in the MC-500 is 120. The QX5, in true Yamaha tradition, will default to the tempo of the last song in internal memory.

## 7. Quantization and Rhythm

Should you quantize by measure, phrase, section or song...or all of the above? That all depends on your intent, your technical ability and the amount of "human" or "machine" feel you desire. Gen-

erally speaking, if you hear a discernable rhythmic glitch in a bar or two, but the remainder of the song seems okay, just quantize the bar(s) in question. If you must have rhythmic precision in a sequence (e.g., repeating phrases in certain dance music), you might be better off quantizing the entire track and then going back and adding "humanizing" changes away from strict quantization, as necessary.

You can alter the rhythmic values of specific notes by *event editing* their clock pulses. (Check the manuals for details here.) This first requires that you go into *microscope mode* on the MC-500 or *event edit* on the QX5. Then examine an unquantized track, and you'll notice that not every note is exactly on a beat or a regular subdivision, such as an eighth or 16th note. Rather, the notes will be just slightly ahead of or behind these locations. If you want a track to feel more rhythmically exact, you'll want to make the notes start and end exactly on these points by quantizing (see your manual). To make your track sound a bit looser, shift the location of a note slightly *off* center. Push a location of 24 to 26 for a slightly laid back feel; move it to 22 for a more "on top of the beat" feel. Experiment and hear how this technique shifts the rhythmic feel of the part.

## 8. Pitch Changes

The overall key signature of a composition can be changed with the *Transpose* command. You can also change the pitch of any note in Event Edit or Microscope mode. You can change the pitch of each G#2, for example, to whatever you want it to be.

But on the QX5, to change all G#2s, for example, there's a more efficient method: *extract* all G#2s and put them on another track, change them all to the note you want, and merge them with the original track (see the owner's manual for step by step merge instructions). You'll need some open tracks to do this, so if necessary, save what you have to disk to allow more room.

On both the MC-500 and the QX5, pitch changes are limited to the 12-note, western chromatic scale. If you use microtonal tuning, you need a sound module that can store this information, such as the DX7II or the older DX7 with an E! board update. The QX5 or the MC-500 will accept this information as MIDI data. As a result, the actual pitch that's played depends on the sound module.

## 9. Tempo Changes

The MC-500 has a separate track for tempo, called the *tempo track*. This allows you to change tempo—by the measure—in several ways. One way is to record the tempo changes in real time. In other words, while you perform an accelerando or ritardando, the machine records and stores your actual playing information—



**MC500 FILE SHEETS**

DISK # _____ FILE/SONG NAME _____ DATE _____

| | Track 1 | Track 2 | Track 3 | Track 4 |
|---|---|---|---|---|
| | MIDI # | MIDI # | MIDI # | MIDI # |
| INSTRUMENT | | | | |
| NOTES | | | | |

**QX5 FILE SHEETS**

DISK # _____ FILE # _____ SONG _____ DATE _____

| | Track 1 | Track 2 | Track 3 | Track 4 | Track 5 | Track 6 | Track 7 | Track 8 |
|---|---|---|---|---|---|---|---|---|
| | MIDI # | MIDI # | MIDI # | MIDI # | MIDI # | MIDI # | MIDI # | MIDI # |
| INSTRUMENT | | | | | | | | |
| NOTES | | | | | | | | |

**FIG. 3: Track sheets like these can help keep track of things you don't remember.**

so you're changing the tempo as you play. The other way to do this is to use the *alpha dial*. This works best with a partner's assistance: turn the dial to increment or decrement as your partner is recording the part. This won't yield exact gradations of tempo, but can make the feel more human. The third way to change tempo is to punch in the beats per minute (BPM) on the keypad for each measure you want to change.

As an added trick, in *any* sequencer, you can simulate tempo changes in step time or real time. To suggest an increased tempo, use a series of longer to shorter notes. The ear hears this as a speeding up of notes, although in effect, your tempo remains the same. See **Fig. 1**.

(Another popular example of this effect is the ending of "Baba O'Reilly" by The Who. The tempo appears to increase because successive notes are shorter than the preceeding ones.) To effect a decrease in tempo, use the opposite principle: shorter to longer note values. See **Fig. 2**.

### 10. Gate Time and Note Length

Both machines have gate time controls that can allow the player to move the cutoff point of notes back or forward in time. You can't change gate times on either the MC-500 or the QX5 without editing each event. If you have a pitch that perennially sticks at a particular spot, it could be that your gate time is too long or that there's a MIDI note-on problem (your microprocessor is confused because the buffer zone is full). In either case, shortening the gate time will take care of the problem.

Some gate time values and their corresponding note values as they appear in the MC-500 or QX5 are shown below (4/4 time):

| Gate Time Values | Note Values |
|---|---|
| 24 | 1/16 note |
| 48 | ⅛ note |
| 96 | ¼ note |
| 192 | ½ note |
| 384 | whole note |

Note: unless you intentionally compose with long, sustained notes, if you read a gate time value of 2,000 or higher on a note, you might have a note that has been recorded as MIDI-latched, and needs to have its gate time shortened.

### 11. Using Sound Modules with Sequencers

One experiment we tried recently involved the "extraction" of a certain range of notes from a sequencer track in order to assign these notes to a particular drum machine, sampler or synthesizer. We recorded a drum song (composed of a number of drum patterns) into the QX5 and extracted the bass and snare. In the *event edit* mode, we found which note values corresponded to which drum sounds, and assigned these notes to a different MIDI channel (in this case, the same channel as the DX7, which was set for a bass guitar patch). When the sequence ran, the DX7 played its bass part locked right in with the drum pattern.

We had to lengthen the gate to accentuate the synthesizer sound. You can put emphasis on the downbeat (or any other area) by increasing the velocity and/or the gate time for the note corresponding with that beat.

### 12. Organize Information

The track sheets in **Fig. 3** can be used to help organize the myriad pieces of information you've collected in your sequencer. Use the boxes labeled "instrument" to log patch descriptions and synthesizer model, or drum machine, chip and tuning information. Use the "notes" box to record specs such as whether the track is merged, quantized, transposed, edited up to certain measure, and the number of measures to be fixed.

### Conclusion

By no means does this list cover all the little tricks available for either the QX5 or MC-500, but I hope it provides insights into areas where you may have been getting "MIDI-locked." **EM**

---

*Terry Kennedy is a singer, electronic musician and writer. A former teacher, she now works with a Macintosh by day and microprocessors by night. Her debut compact disc/album with Malaysian Pale,* Nature's Fantasies, *is available in record stores or by contacting Fortuna Records (4549 E. Fort Lowell, Tucson, Arizona 85712).*

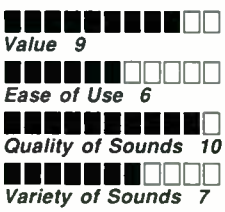
# FIRST TAKE

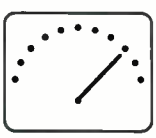
**THE RATING SYSTEM:** *First Take* is just that—people's first impressions of some of the latest products. Two different sets of ratings are provided by each reviewer according to their particular standards. The 11-step "LED meters" show a product's rating in a *specific* category (ease of use, documentation, construction, etc.; categories are chosen by the reviewer), while the 11-step "VU meter" shows the *overall* rating. The latter is not a mathematical average, since the reviewer may judge some specific categories as having more weight than others. For example, if a guitar synth is well-constructed, has great documentation, is easy to use, but doesn't track worth a hoot, it could have several very high LED meters but a low overall rating.

We would like to remind you that these are opinions, not gospel, and as always, **EM** is a communications medium that welcomes opposing viewpoints. We urge you to contact manufacturers for more information and, of course, tell them you saw it in **EM**.

## McGill University Master Samples

**($69 each. Three for $199, add $4 s/h)**




Just as I predicted several issues back, the idea of packaging sampler libraries on compact disc is a concept whose time has come. If you're shopping for a collection of individual, prerecorded musical sounds ready to be sampled today, you can find quite a few choices. In my search for the ideal assortment of orchestral timbres, I've discovered the McGill University Master Samples, aka, MUMS. MUMS features samples of over a million dollars' worth of beautiful, old instruments, including two 18th-century violins and a 16th-century viola, the oldest there. The instruments are played by concert performers and recorded with care; many of these sounds can only be described as full and sweet.

Under the auspices of McGill University in Montreal, the funding for the production of this sampler library came from a foundation grant. It seems that without the usual market pressures, the producers could take the time to seek and meticulously capture about 100 instruments on three discs, many with variations in articulation. All sounds were digitally recorded in stereo on a Sony PCM-3202 DASH digital 2-track. Some sounds, such as drums and ensemble violins, were recorded with reverb on one channel and dry on the other. A total of 2,267 individually indexed sounds offer every useable note in each instrument's range. You won't sample the full length of every note with any sampler I'm aware of, but you can divide up your keyboard map into as many divisions as your sampler's memory allows.

I'm impressed with the effort that went into insuring timbral consistancy within each set of notes.


**McGill University Master Samples**

Volume one consists of solo strings (violin, viola, cello, and double bass) and a violin ensemble, each played bowed, martellato, pizzicato, muted, and with harmonics. Some notes are played on both open and closed strings, and sustained sounds are played with moderate vibrato. Volume two is woodwind and brass, including a variety of flutes, piccolo, oboe, English horn, clarinets, bassoon, contrabassoon, trumpets, French horn, trombones, and tuba, some of them muted or flutter-tongued where appropriate. Volume three features not one, but *two* Steinway grand pianos (soft, loud, and plucked), five saxophones, and a slew of pitched and unpitched percussion instruments. Each disc is over an hour in length, so most symphonic instruments are well-represented on these three CDs.

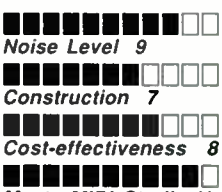
The duration of each sound ranges from less than two seconds to more than ten, with most weighing in between three and seven seconds. Given the limited memory of any sampler, I wish some of the sounds were shorter, but you can always trim them with envelope generators. Each instrument or variation is assigned a track, which seems logical, but if your CD player doesn't have indexing (and most don't), you have to scan through all the pitches to reach the one you want to sample. Perhaps one track per octave would have been more practical.

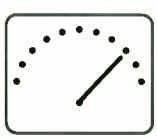
Compared to similar collections from other sources, the McGill University series is reasonably priced, sounds great, samples well, and best of all, you can buy the three discs one at a time. Each disc or the entire set of three includes a user's manual, with production notes, suggestions for multi-sampling, and a directory of sounds. If you're looking for an alternative to pre-sampled floppies or going into a recording studio with individual members of your local symphony orchestra, McGill University Master Samples should be one of the first places you listen.

*—Geary Yelton*

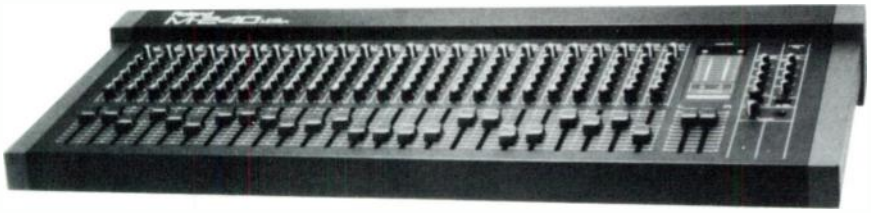
**McGill University Master Samples**
555 Sherbrooke Street West
Montreal, Quebec, Canada H3A 1E3
☎ (514) 398-4548

## Roland M-240 Line Mixer ($1,495)




Electronic music studios have different mixer requirements compared to other types of studios, which is why I've always built my own mixers—with lots of relatively low-impedance inputs, minimal EQ, a couple of mic preamps to handle the occasional acoustic instrument, and as many effects sends as I can cram onto the panel to feed outboard EQ and effects. Maybe I won't have to build my own any more, though, because Roland has applied the same philosophy to their M-240 and M-160 line mixers. (We'll be talking about the conventionally styled, 24-input M-240; the M-160 is a rack-mount version with eight fewer inputs and lists for $1,100.)



**Roland M-240**

All inputs and outputs use ¼-inch phone jacks, although the master outputs also provide XLR connectors. Inputs accept a nominal -20 dB signal, with the exception of the first two inputs, which are optimized for -50 dB (mic level) signals. Each input has a tri-color peak input indicator (green for active, yellow for caution, and red to indicate that you're about to clip). Each input also has three effect sends and one aux send (with associated master send controls), pan pot, and linear fader. The aux bus includes a pre/post switch; pre lets you set up a separate mono mix (say, for monitoring), while post is useful if you want to use the aux bus as an additional effects send.

Returns are handled cleverly. Returns 1 and 2 are stereo returns (although a single ganged control sets the return level) with a -20/+4 dB level switch. Return 3 is similar except the level is set to accept +4 signals. Return 4 is a mono input but can be panned anywhere in the stereo field. There are also direct bus inputs for the effects and aux buses in case you want to gang mixers together, and an input that feeds the headphone amp and nothing else. This is great if you want to listen to a click track, or comments from a stage hand, without having these show up in the final mix.

The two pre-master fader peak indicators are another considerate touch. They'll turn red if you're overloading (which is good to know *before* you turn up the masters).

I bench-tested the M-240 and confirmed Roland's specs for noise and frequency response, both of which are very respectable. Under worse case conditions—all preamps and faders up—the signal-to-noise ratio was -77 dB, unweighted. Under more typical operating conditions, the S/N hovers around -85 dB. Frequency response is given as 10 to 60 kHz; that's a bit pessimistic—the thing is almost ruler-flat from 10 to 100 kHz.

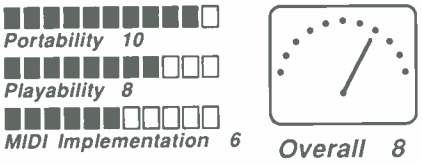
What is there not to like? Well, the unit uses a remote power supply. While this does keep hum and noise out of the mixer itself, it's a bipolar 21.5 VDC supply—anything but standard—so keep an extra on hand. Also, since the rotary controls are not mounted to the panel, the knobs wobble around when you move them, which is not a serious problem but can be disconcerting. Finally, I don't know how easy it would be to service the M-240—I popped the back panel and saw a maze of circuit boards and ribbon connectors. Fortunately, the components used in mixers are straightforward and tend to be reliable.

While line mixers are anything but glamorous products, if multi-output synths and drum machines are gobbling up your main mixer inputs, here's a nifty way to get things under control. And if you run an electronic music studio with a tight budget, this may be all the mixer you'll need for quite some time.

*—Craig Anderton*

**RolandCorp US**
7200 Dominion Circle
Los Angeles, CA 90040
☎ 213 / 685-5141

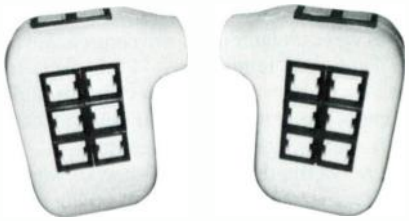
## P.K.I. Gun-Drums ($699)




At first I thought it couldn't be real: a complete electronic drum kit that fits into a shoebox? This is the stuff that dreams are made of. After spending over 20 years of my life lugging acoustic and electronic drums, stands, cymbals, cases, pedals and a host of other assorted paraphernalia to hundreds of gigs, the notion of a compact and highly *playable* percussion system is attractive. While a number of interesting controller designs have come to market over the years (such as the Palmtree Airdrums, Dynacord Rhythm Stick, and even wearable percussion suits), none of these stick-less wonders have come close to the style and feel of actual drumming.

Enter the P.K.I. Gun-Drums, a new system of percussion controllers that simulate a drummer's natural hand and foot movements quite closely and translate them into MIDI events and note values. Gun-Drums consists of two molded, pistol-grip style hand controls (hence the name "Gun-Drums"), each fitted with internal velocity sensors and rows of external switches that determine the sound and various timing effects. The hand units connect to a tiny 1½ × 2 × 5-inch belt-pack microprocessor (this also contains the ¼-inch input jacks for external hi-hat and double bass drum switches), and this feeds trigger data to a remote power unit. The power unit uses a standard MIDI Out jack for connection to your favorite drum machine or sampler. The bass and hi-hat footswitches are not included with Gun-Drums, but any garden-variety single pole, single throw (SPST) momentary footswitch (such as a DX7 sustain pedal) works just fine. You could also fabricate some easily to your own liking.

Operationally, Gun-Drums are quite simple: by setting a DIP switch inside the belt-pack, you configure the unit to your particular drum machine. There are presets available for Drumulator, Sequential Drumtrack 400, Korg, Roland TR-505, Roland TR-707, Yamaha RX11, E-mu SP-12, or a range of 13 MIDI notes from 36 through 48. If your favorite drum box isn't on the list, don't despair—P.K.I. can "burn" a custom EPROM for your machine as long as you provide them with the proper MIDI note information.



**P.K.I. Gun Drums**

This system's MIDI implementation offers both advantages and disadvantages: while the set-and-forget DIP switch settings were simple, dependable and nearly fail-safe in our tests, some sort of outboard MIDI controller or mapping device would be required if you wanted to change drum machines quickly—between songs at a live gig, for example—or wished to trigger the sounds of two different MIDI devices simultaneously.

I set the DIP switches on the unit for a Roland TR-707, connected the two devices with a MIDI cable, and *rocked.*

I started playing right away, and the first thing I noticed was how well two simple on/off footswitches performed as bass and hi-hat triggers. No subtle velocity or aftertouch effects here—just a solid, steady kick—and let's face it, 95% of the time, this is what a drummer needs to deliver anyway.

The real surprise came when I checked out the hand controllers. There's no mystery here—hold one in each hand, and while using your thumb to select one of the six voicing buttons on each controller, a quick forward snap of the wrist triggers a single note. Trigger your snare and tom sounds with the left hand (just as you'd do with an acoustic kit) while ride, crash, open/closed hi-hat, and such came from right-hand motions.

Now the fun part: pressing one of the right-hand controller's buttons initiates a "same" function; press it, and the right hand triggers the same drum sound as the left, allowing you to do two-handed rolls, paradiddles and everyone's favorite ratamacues. Playing the classic

'round-the-set-snare/multi-tom-roll soon became a simple matter of shaking the controllers while slightly shifting my left thumb position to select the appropriate "drum." After an hour of playing the Gun-Drums, I felt like an expert.

Besides remembering the location of the voicing buttons and coordinating their selection with wrist control, I found that a fairly hefty handsnap is required for cleanly triggering notes. This may be less noticeable to drummers in the "thrash and bash" category, but as someone who often plays in acoustic jazz ensembles (with 7As as my sticks of choice), the switch to Gun-Drums took me a bit of getting used to.

The top buttons on each handgrip include a "doubler" that triggers multiple notes for ultra-fast roll effects (or those 64th note ride cymbal parts you could never quite master) as well as volume up/down controls. Since the latter are "future-ware"—P.K.I. plans to implement them on the next revision of Gun-Drums—I can't report on their performance, but it sounds like a useable feature.

Overall, this drum-kit-in-a-shoebox works, and it works quite well. Of course, there is an undeniable sense of *cool* to be had playing a set of invisible drums (the connecting cables can easily be concealed under your clothing), and the idea of toting a couple of briefcases to a gig should certainly appeal to a lot of drummers out there.

Some suggestions for future versions would include a rack-mount electronics module with more extensive MIDI implementation, but there's no doubt P.K.I. has gotten off to a good start with the Gun-Drums system.

*—George Petersen*

**P.K.I.**
PO Box 832
Nipomo, CA 93444
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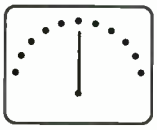
## Dominant Functions Tiff Sequencing Software ($99)

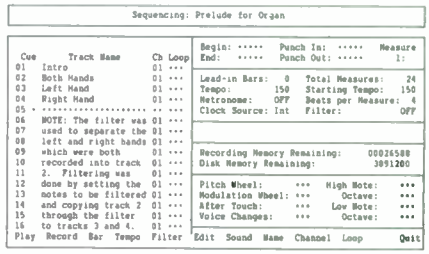

At $99, Tiff is the among the cheapest sequencing programs available for the IBM PC and compatibles. It's capable and user-friendly, but lacks many of the features (such as event editing and step-time entry) we've come to expect from sequencers, and, oddly for a low-end program, Tiff requires the use of a hard disk.

Tiff records on 64 tracks. All events on a track are assigned to a single MIDI channel, which may be changed, and you can loop or mute individual tracks. Editing is available for tracks only—they can be deleted, copied, moved, and transposed chromatically. You can't slide track events in time. Filtering of pitch wheel, mod wheel, aftertouch, control changes, and notes outside a specified range can only be done during recording or copying tracks, and Tiff can be synched to an external MIDI clock.

Since there's no quantizing, step entry or individual note editing, you'll need to have your keyboard chops together; the only way to correct mistakes is to record over them with punch-in. You can program record/playback to start and stop at any measures.

Beats per measure can be set between two and 16. Simultaneous loops of differing lengths can be played simultaneously, but the loop boundaries must fall on barlines. Individual loops must be shorter than 99 bars, and the length of the composite loop must not exceed the computer's memory. (So 17 against 31 against 23 might be a problem....)

Tiff's two screens are so easy to navigate and use, the documentation (42 looseleaf pages in a binder) is hardly necessary. The first screen is a *song librarian*, the second the sequencer itself. The song librarian features a long-overdue "first" for IBM sequencers: you don't have to name your song to conform to DOS's ridiculous file name conventions! (Picture Bach naming a piece, BRNDBRG1.SNG.) Tiff lets you enter up to 20 characters, including spaces, to identify your work. Excellent feature.




**Dominant Functions Tiff**

A less desirable feature is that Tiff automatically saves a song to disk every time a change is made or a new take recorded, making it tough to try changes without overwriting the old version. I don't like a program to write to my disk unless I tell it to, and anyway, some changes (like looping 99 measures) take a long time to finish writing.

What with its various limitations, Tiff is hardly anyone's dream sequencer, and at $99 is still a bit overpriced—there's at least one $150 sequencer out there that's more capable—but if you're on a budget, it's worth a look. Tiff is a solid, bare-bones program that does what it does well. If Dominant Functions adds more features, particularly editing, and keeps the price low, they could have a contender.

*—Carter Scholz*

**Dominant Functions, Inc.**
Box 836155
Richardson, TX 75083
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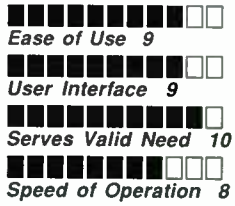
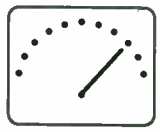
## Snap Software GM70 Companion (Mac $125, IBM $75)



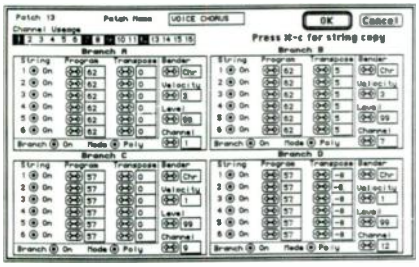

If you own a GM70 and a Mac (or IBM PC/XT/AT or clone), you need this program. I suppose that could be the end of the review, but let me explain.

Since the GM70 is a 1U rack-mount device with a relatively small display, a ton of parameters, and a limited complement of buttons, programming it can be very time-consuming. Because of this, one is not exactly tempted to spend a few hours pushing buttons in an attempt to discover the subtleties of multi-branch operation—let alone develop a full set of patches for all the available memory slots. Enter *GM70 Companion*.

GM70 Companion sends and receives

System Exclusive data to and from the GM70 rack-mount in various chunks: everything, the system (i.e., which controllers are assigned to which physical knobs and switches on the GM70's controller), patches 11 through 88, or patches -11 through -88.

*Library* windows contain a listing of all patches. Four windows may be on screen at any one time, thus allowing cut and paste operations between the various libraries. An *edit patch* window edits any selected library patch. (Looking at it reminds you just how many parameters there are in a GM70, and how grateful you are not to be stepping through them a parameter at a time using the front panel switches!) There are also a couple of copy options to make life easier.



**Snap Software GM-70 Companion**

Since you have to initiate bulk dumps and loads at the GM70, I'd like to see a help menu that would tell which GM70 buttons to press to initiate loads and dumps; I can always look it up in the GM70 or GM70 Companion manual, but having that information a mouse-click away would be nice. This is a small point, but one I'd like to see taken into account in future revisions. (Note: since this review was written, Snap has included a series of help directions in the GM70 Companion program.)

The software is straightforward. The preliminary manual I had exhibited a few rough edges, but nothing serious (it's much better than some "final" manuals I've had the displeasure of using). The program didn't crash, and the few harmless bugs I caught were fixed within two weeks after I alerted Snap Software to the problem.

What's most important about this program is that it lifts the veil of inscrutability from the GM70. As I said at the beginning, if you own a GM70 and a Mac or PC, you need this. Kudos to Snap for addressing a market which is far from lucrative, yet desperately needs this kind of program. The disk is not copy-protected, but if you rip it off—well, don't be surprised if the patron saint of struggling software developers sees to it that your prize guitar suffers a similar fate. 'Nuff said.

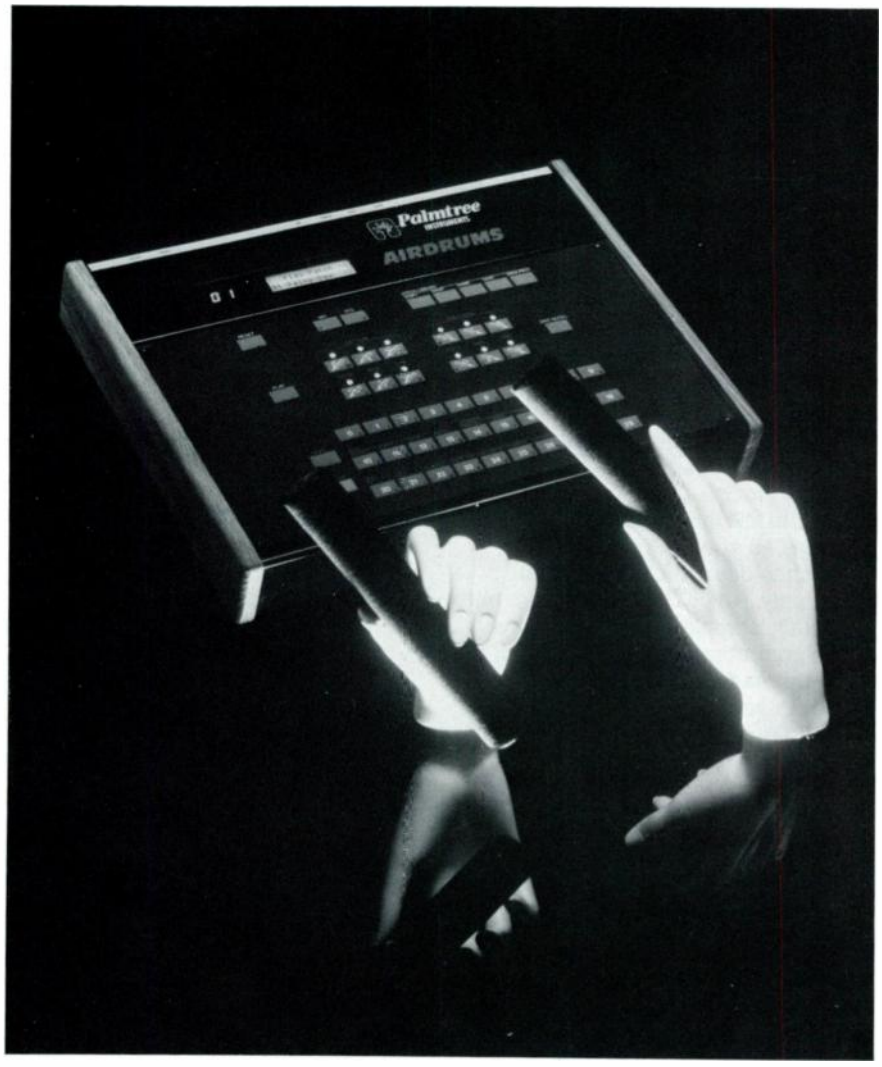
*—Craig Anderton*

**Snap Software**
1116 Janey Way
Sacramento, CA 95819
☎ 916 / 451-9914

**EM**

# Palmtree Instruments' Airdrums

**"Well shake it up baby now. . . twist and point." We're not talking about a song from the '60s, but a hip new MIDI controller that's all '80s.**




BY PAUL D. LEHRMAN

"MIDI MARACAS" they've been called. They look like a couple of the things you're left with when you've finished a roll of toilet paper, only with wires hanging out of them. Watch someone playing them, and you'll think he's conducting an orchestra, playing tennis, driving a Harley and doing the Watusi all at the same time. You don't hit them, suck them, squeeze them, or blow into them, but they're the most fun you can have with MIDI without getting permission from the Supreme Court.

The Airdrums, made by a small California company called Palmtree Instruments, are a completely new approach to MIDI controllers. They are "gesture capturers," or "positional sensors," that generate MIDI data when you shake, point, flip, throw, or twist them. They are a remarkable concept for interpreting movement through space in four dimensions as music.

## SHAKE IT, DON'T BREAK IT

The business end of the Airdrums consists of two tubes, each about seven inches long and one inch in diameter, covered with a thin layer of foam. At the back of each tube is a socket, something like a modular telephone socket, but accommodating eight wires. Into each socket goes an eight-foot long cable connecting the tubes to a table-top controller box.

The cylinders detect motion in three directions: up/down, left/right, and clockwise/counterclockwise, which are referred to (remember the Mercury space capsules?) as *pitch, yaw,* and *roll.* Each direction has a positive and negative sense (up vs. down, left vs. right, clockwise vs. counterclockwise), which can be used to generate different MIDI information. Since the left- and right-hand tubes operate independently, that makes for a total of 12 different control events, otherwise known as directions or axes (that's the plural of "axis," not of "axe," and pronounced "ak'-sees").

Actually, to say that the tubes sense motion is not strictly correct: they sense the *stopping* of motion. This allows another type of MIDI data to be generated: velocity (you were wondering about that fourth dimension, weren't you?), which is based on the degree of *deceleration* when the movement in a particular direction stops; if the tube is moving quickly and stops or shifts direction abruptly, a high velocity value is sent, while if the tube stops gradually, a lower value is sent. This sounds a lot more complicated than it is, and the action of the tubes is really quite intuitive; think of maracas, which make noise not when you move them, but when they change direction or stop.

So far, so good. When you consider how such a system might be used, probably the first thing that comes to mind is percussion control: assign each axis to a different note on a drum machine, for example, right yaw positive to open hi-hat, right yaw negative to closed hi-hat, left roll positive to snare drum, left roll negative to kick, and so on. Doing this will allow you to play the drums standing in the middle of the stage, without ever touching anything.

## INTERPRETIVE GESTURES

But the Airdrums are capable of much more complex and subtle functions than simply triggering individual notes. The action of the tubes is only a small part of what the instrument is about. It's the interpretation of those actions that makes things interesting. Besides the tubes, the Airdrummer can use up to four foot pedals, whose action is completely programmable. MIDI information can also be input to the Airdrums in real time, from a keyboard, drum pad, sequencer, or whatever, and modified in sundry ways.

The job of interpreting all the gestures and data is up to the control unit, an oak-panelled 11 x 14 x 2-inch box containing clever and complex software. On the top of the box are LED and LCD displays, and 54 membrane switches used for several functions, including calling up *patches*—sets of functions and assignments for the tube's 12 motion axes. Up to 26 patches can be stored on board at a time, and accessed externally through MIDI program changes.

**You don't hit them, suck them, squeeze them, or blow into them, but they're the most fun you can have with MIDI without getting permission from the Supreme Court.**

Designing a patch means assigning a function to each axis, and the software gives you a wide range of parameters from which to choose. To start with, each axis can be turned on and off. This is helpful when you want to play something simple, or isolate one motion to work on a particular axis. There is also a parameter called *group mute* that turns off several axes all at once with a foot pedal.

Which MIDI notes are sent by a particular motion is determined by the *message* parameter, in conjunction with any incoming MIDI data. There are three types of messages. If you set the parameter on a particular axis to mono, movement on that axis will produce whatever note was most recently received at its MIDI input, which can be set to receive only MIDI data on a certain channel and to transpose the received data up to 99 semitones up or down. Since each axis within a patch has its own message parameter, different axes can be set to read different incoming MIDI channels, and transpose the data by different intervals.

Setting an axis to Poly Message mode means a trigger on that axis will send out all notes currently turned on at the MIDI input. Theoretically, if you want to have a motion trigger a chord in this mode, you would need to play and hold the chord on a keyboard with your free hand, but the footswitches can help make this function more useful.

The third choice for this parameter is *buffer.* When you press a button labelled *Save Notes,* all the currently on MIDI notes get stored in a buffer (memory location). Each axis gets its own buffer, which can contain up to eight notes, and be transposed 99 semitones. Each patch gets its own set of 12 buffers.

Keep in mind that each axis can use any of these message types, so, for example, *left positive pitch* can trigger a stored mono note, *left negative yaw* can play a chord coming live from a sequencer, and *right positive roll* can trigger a large chord previously stored in its buffer. These functions can also be made interactive by running a cable from one of the control unit's two MIDI Out jacks to the MIDI In. This sends the information produced by one axis into the mono or poly register of another, so the note and chord structures can be continuously changing.

A sensitivity control for each axis, called *Trigger Threshold,* sets a minimum motion-sensing level on the axis, below which no data will be sent. If the control is set to 0, almost any motion of the tube in the given direction will send data; at the maximum value of 99, only a good hard shake will generate data. The velocity range doesn't re-scale itself to the threshold setting, so when the threshold is low, the full range of velocities is available; when it's high, only high velocity values will be produced.

Then there's *Trigger Type.* This determines whether motion in a given direction will generate MIDI note-ons, note-offs, or note-ons followed by note-offs, with a programmable interval of up to about four seconds in between. One way of having direct control over note durations is to set up two axes so one turns a note or group of notes on, while the other turns the same note or group off.

## STEPPING IN

Helping to enhance the performance aspects of the Airdrums are the four footswitches, unfortunately not supplied with the unit, but any standard momentary footswitch such as a synth sustain pedal will do. You can use the normally open or

normally closed type (or both), and believe it or not, the software will automatically adjust itself to whichever you choose.

Since each switch has an up position and a down position, eight footswitch actions can be programmed. Nine functions are available for each action. *Hold on* holds notes at the MIDI input, which lets you enter multiple notes into a poly message without a third hand. *Hold off* cancels the hold. *Mute on* enables the group mute function described above, and *mute off* cancels it. *Increment patch* sets the Airdrums to the next highest patch number, and *decrement patch* sets it to the next lowest. Both of these functions wrap around, so incrementing from patch 26 gets you to patch 1, and decrementing from patch 1 gets you to patch 26.

Another pedal parameter is to select a *specific* patch number; yet another is to trigger a specific axis, with a predetermined velocity. That axis will be triggered from the pedal even if it is otherwise muted; for example, you could assign a cymbal crash to right positive roll, mute that axis from the front panel, and then assign the axis to a foot pedal, with the result that regardless of any accidental rolling by your right hand, the only time you will hear a cymbal crash is when you step on the pedal. The final pedal parameter is *null*, or no action, which is used when you want the action of stepping *on* the pedal to do something, like change a patch, but you don't want anything to happen when you take your foot *off*.

Keep in mind that any of these parameters can be assigned to any action of any pedal. If you wanted to, you could have Pedal-1-Down turn on Hold, Pedal-1-Up trigger an axis using the Poly message, Pedal-2-Down increment a patch, Pedal-2-Up trigger a different axis, Pedal-3-Down release the Hold turned on by pedal 1, etc.

## ON THE BUS

OK. I hope you're with me this far, because now it's going to get a little complicated. Hey, no one said it was going to be easy.

When you trigger a note or group of notes with the tubes or pedals, you're not just sending them out the MIDI Out jack. First you have to put them on an output bus (which is cheaper than flying . . . sorry). There are 12 output buses, and within each patch, each axis gets a bus assignment. You can assign more than one axis to a particular bus. If you're using the Airdrums simply to control a drum machine, you'd most likely assign all of the axes to one bus.

Each of the buses then gets assigned to a MIDI channel, and again, you can assign multiple buses to a channel. Unlike the axis-to-bus assignments, which are patch-specific, the bus-to-MIDI channel assignments are global.

The buses are primarily for use with non-percussion synthesizers because they can give you direct control over note duration by setting up two axes to play note-ons, and assigning them to the same output bus. When you trigger one axis, its notes will sound; as you trigger notes from the other, the notes from the *first* axis will be cut off. It works the same way with any number of axes assigned to a bus: only the notes from the axis that was triggered *last* will sound.

**If you've followed to this point, you're either helplessly confused or your mind is in overdrive thinking of ways to use this thing.**

Therefore, you can play melodies in real time, with each axis corresponding to a different note, and each time you play a note, the previous note stops. If you trigger the same axis twice, once hitting it hard and the second time hitting it softer, you will re-trigger the original note, but at a lower velocity. If you set up the axes to play chords, each new chord will cancel the last one. If you set up an axis to send a *note-off* on a bus, all notes on that bus will stop—so you can get the music to shut up by pointing in the right direction.

Since you can use multiple buses, you can have several musical lines happening simultaneously, with notes on one bus cutting each other off, but leaving notes on the other bus(es) alone. If the buses

are assigned to the same MIDI channel, you can do this on one synthesizer. If you're really obsessive, you can have six musical lines going at once this way.

There's another function attached to the buses, and that's generating MIDI program changes. Within a patch, you can assign a program change number to each bus. Then, the next time you call up that patch—either from the control panel or from an incoming MIDI program change—the assigned program change number will be sent out over the channel to which the bus is assigned. This can be very useful if you want to have certain setups on the Airdrums correspond to particular patches on your synths.

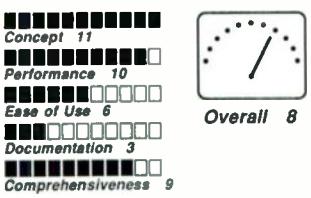
Since you have 12 buses, each assignable to a different channel, and each of which can be assigned a program change, you can actually use the Airdrums as a program-change matrix box, in which each incoming program change generates 12 different program changes on 12 different channels.

## WHAT'S IT ALL FOR

There are more features, but I think you get the idea. If you've followed to this point, you're either helplessly confused or your mind is in overdrive thinking of

## PRODUCT SUMMARY

**Product:**
Airdrums
**Type:**
Gesture response MIDI controller
**Retail price:**
$1,895
**Version reviewed:**
1.10a
**Features:**
Movement of the hands in 12 different directions is translated into MIDI data. Speed of movement is translated into velocity. Comprehensive facilities for assigning different MIDI messages to different movements.
**Manufacturer:**
Palmtree Instruments
5666 La Jolla Blvd. #81
La Jolla, CA 92937
☎ (619) 546-8808 PAN: AIRDRUMS



## . . . And Morton Subotnick on Airdrums

"WHEN WE STARTED OUT, we had to do all our own design and building, but today it seems anything we can think of is out there in some form already. I can say: 'I'm thinking of something, therefore, who's doing it?'" These are the thoughts of composer and electronic music pioneer Morton Subotnick on using the Airdrums as a conductor's controller.

When he started composing with tape and analog electronics in the early '60s, Subotnick would have thought inconceivable a commercial device that applied to his musical ideas. Working with Don Buchla to develop one of the earliest modular synthesis systems, Subotnick helped found the San Francisco Tape Center that later evolved into the Mills College Center for Contemporary Music. He and Buchla worked together into the mid-'80s on Subotnick's "ghost" electronic systems. These were early attempts at improving the man/machine/score interface by giving live players dynamic control over electronic accompaniment—letting them actually change the response of the electronics within the context of the score.

The Airdrums MIDI controllers may not seem related to the first "ghost" in the machine (a tape encoded with ultra high frequency analog control information), but Subotnick is using them in much the same way.

Subotnick first heard of the Airdrums while working at the MIT media lab to develop a "MIDI baton"—a real-time controller that would allow a conductor simultaneously to lead a traditional orchestra and a parallel electronic one. When the Airdrums were introduced, Subotnick and a group from the media lab decided to develop software, prototyped in Macintosh *MidiBasic*, that would turn the Airdrums into the MIDI baton.

Subotnick says he is "trying to make the Airdrums transparent to the conductor, to keep his movements as natural as possible. The baton's commands will be translated to control the sequencers with start and stop commands, tempo, MIDI Velocity, Volume, and Song Pointer information. At certain points, sounds will be triggered directly from the Airdrums. When the conductor speeds up, the computers will follow. The software knows the score; it will recognize mistakes and learn during rehearsal. If at one point in the score, a quarter note is set to 60 beats per minute and the conductor takes it at 90 beats per minute, the software will make a quick adjustment. This will also set a flag in the program so the next time that part is played, the software will give the conductor a choice: *orginal*, or *last time* or somewhere in between. The software gradually accommodates the conductor."

The software interface is necessary because the Airdrums alone are too sensitive, and would limit the conductor's motions. Context-sensitive software can follow the score, and anticipate and interpret the proper movement at the proper time. Furthermore, the range of values created by the Airdrums will be scaled down into one that's more meaningful, dynamically changing as the score progresses. For certain orchestral pieces, a computer operator will assist the conductor.

In March 1989, Subotnick will premier the Airdrums as a baton (in parallel with a Yamaha QX3 sequencer and a bank of TX802 synthesizers) in a piece done with the Cleveland Chamber Orchestra. The software will be tested first with a solo piece (controlled from a Yamaha KX88 controller) in July 1988. In addition to using them as a MIDI baton, Subotnick is developing techniques to allow a singer to use the Airdrums to control her own accompaniment.

After a generation of pioneering work in electronic music, Morton Subotnick continues to forge innovative musical paths with technology. Now, with open-ended commercial products like the Airdrums, he needn't design and build every piece of gear himself.

*—David Julian Gray*

ways to use this thing. The possibilities are indeed staggering. Here are a couple of suggestions, off the top of my head:

1) Set up the left-hand axes so each one generates one note of a scale (you'll have to leave out a note), and put them all on the same bus. Set up the right-hand axes so each one does a different transposition of a Mono message. Now send the MIDI output from the left-hand axes into the MIDI input of the right-hand ones by assigning the global MIDI input of the device to the same channel as the output of the left-hand bus (and run a cable from one of the MIDI Outs to the MIDI In). You can now play melodic lines with the left hand and change keys with the right. Set up a foot pedal or two to change patches.

2) Set all 12 message types to mono, reading the same input channel. Set the transposition intervals to multiples of 12, both positive and negative. Set the trigger types to on/off, and set the delay times to various different values. Send the axes' outputs to different buses, and assign the buses to different MIDI channels. Set up a bunch of synths, using all different kinds of patches, to read the various channels. Send a sequenced melody line, which is also being played by another synth, into the Airdrums' MIDI input. Now by moving the tubes in different directions, you will produce accents to the melody, using whatever the current melody note is, but playing it in different octaves, with different types of sounds, for different lengths of time.

## HELP WANTED

I could easily fill the rest of this magazine with programming examples for the Airdrums. Someone could, and probably should, write a book about them. And they'd best do it soon, because the manual supplied with the instrument is, to be nice about it, awful.

This is one of the most complex MIDI controllers anyone's ever come up with. It's capable of a huge range of expression, and a nearly infinite variety of functions. It's also completely different from anything you've ever seen, and it has a steep learning curve. It screams for a great manual.

The Airdrums have a ridiculous degree of complexity and functionality. You can plug the thing in and make neat noises right away, but to create a complex effect that is both original and *repeatable* takes a great deal of understanding. This is not by any means a criticism of the instrument—anything that gives results this good is worth spending time with—but it means that if it is going to be used in the real world, the manufacturer must make the learning process as fast, smooth, and rewarding as possible.

**The Airdrums are so versatile that any musician, especially anyone who plays live, could benefit from them in some way.**

Palmtree has fallen down in this department. The current manual simply explains, more or less, what each button on the control panel does. Even so, it falls short: although it explains how to set up program changes in a patch, there is no discussion of how to *execute* those program changes. I had to call the company to find out that program changes are only sent out when you recall a patch that happens to contain them.

What's sorely missed is any kind of tutorial, suggestions for how to use the thing, diagrams showing the logic or signal paths, or written programming examples with useful comments.

At this point, the Airdrums are a stable enough product that Palmtree should take a breather from development and get a proper manual done.

## GETTING TO CARNEGIE HALL

Even with good documentation, fluency on the Airdrums is not something that a user can expect to achieve overnight. They demand a type of dexterity that few of us are used to: the ability to make sharp distinctions between wrist motions in the various planes. When you're flicking a tube forward in the pitch direction, it's very easy to cause some movement in the yaw direction; and when you're going for a yaw movement, it's easy to roll a tube slightly. You can clean things up somewhat by muting those axes you don't want, or setting the trigger threshold control to maximum for the axes you use least, but the best solution is the hardest one: lots and lots of practice. This is a serious instrument, and will demand serious time and effort to master.

This is not to say it will be months before you can take the Airdrums out in public. If you're willing to set your sights fairly low at first, you can get them to perform simple functions that will impress even the most jaded crowd. Think what Tina Turner could do with a couple of these things strapped to her hips, or Roger Daltrey by tossing them high in the air. And if you're willing to woodshed the sucker seriously, you can get some amazing effects. A mark of a good creative tool is that the learning curve never stops: the more you study it, the more it can do for you.

In terms of their potential for new modes of musical expression, the Airdrums are one of the most exciting commercially available products to come down the line in many years. Thanks to their extensive MIDI implementation, they are so versatile that I can't think of any musician, especially anyone who plays live, who couldn't benefit from them in some way. However, as with all great innovations, you will need time to get used to them, and like any other real musical instrument, ya gotta practice. If you are willing to invest the time and energy, you will be rewarded. **EM**

***Paul D. Lehrman*** *is a musician, writer, and consultant who often contributes to these pages. His current activities include producing music for visuals, warping the minds of unsuspecting undergraduates at the University of Lowell, and scheming up new ways to add to his collection of bizarre electronic toys.*

# Sampled Grands

## from Roland, Yamaha, and Korg

**EM looks at three grand alternatives. These 88-key wonders offer that 7-foot sound, without straining your backbone or your checkbook.**

Combining a weighted, 88-note keyboard with a variety of realistic piano voicings are (above, top to bottom) the Roland RD-300, Yamaha PF85 and Korg SGX-1D.

BY ALAN GARY CAMPBELL

RECENTLY I'VE SEEN an alarming number of keyboardists suffering from a debilitating, phonic miasma. The symptoms include some bizarre forms of musically aberrant behavior. In the interest of the health of EM readers, I've listed the following symptomological questions, to aid in early detection and diagnosis:

Do you secretly listen to Liszt and Chopin through headphones? Do you disguise yourself and cruise mall piano stores? Are you blown away by Bosendorfers? Bowled over by Baldwins? Do you salivate over Steinways, and yearn for Yamahas? Do you recurrently dream that you're stranded on a desert island with only one instrument, and it's one you don't have to *plug in*?

If you answered "Yes" to any or all of the above, you may be suffering from *asynthetic pianophilia*. This often-chronic malady was previously treatable only by repeated exposure to an expensive acoustic grand piano (though some sufferers sought temporary relief via *electric grands*, and more recently, by expensive *Kurzweil Therapy*), which created all kinds of undesirable side effects: bad miking, hernias, striking roadies, and stratospheric touring costs.

But now, science has found a practical way to control *pianophilia*, through the selected application of the *Sampled Grand*.

### THEY LAUGHED . . .

when I sat down, probably because I was actually *reading* the owner's manual. But how else to find out enough about these things to satisfy the insatiable curiosity of EM readers? (Besides, that's where the MIDI implementation chart is.)

Anyway, the sampled grands reviewed here have many features in common:

# "Your song sounds great, but . . .

I'd like you to change a few things. The bass needs to be doubled or thickened up a bit, and repeat the horn-fill on guitar in bar sixty-eight. You went a little overboard with the pitch-bend in the middle of the solo, but I think it'll sound fine if you bring up the velocity on each chorus. Oh and by the way, I need it three seconds shorter, but don't cut anything. . . and I'd like to hear the changes by morning."

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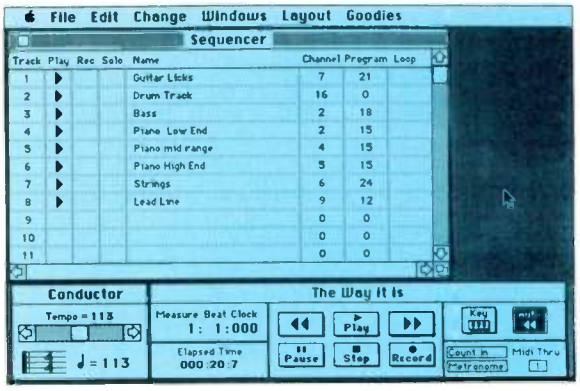


**Multi-Track Sequencer**

- Record or play from any point in the song
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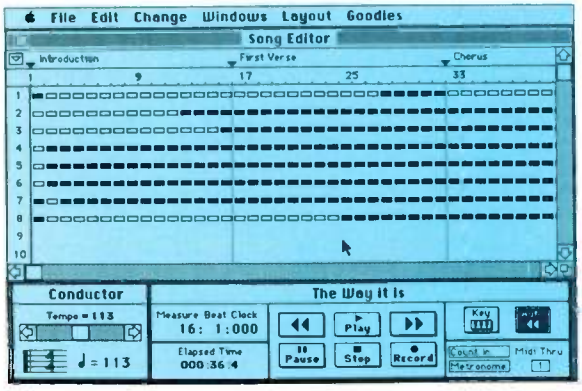
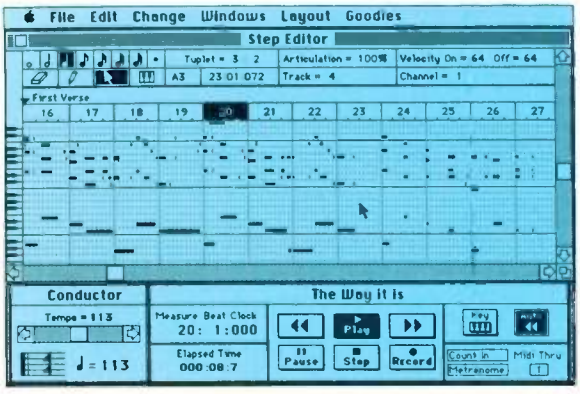


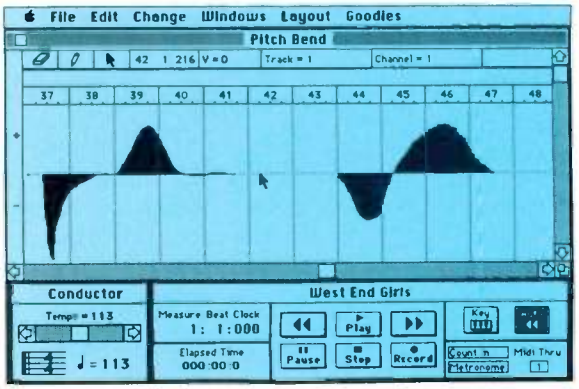

**Song Editor**

- See the structure of your song over time
- Select meter, tempo and beat for each measure
- Use cut, copy, paste and mix editing to build songs




**Step Editor**

- See and edit tracks of MIDI data
- Step input notes using mouse or MIDI controller
- Edit individual events or entire phrases




**MIDI Data Editor**

- Plot Pitch Bend, Aftertouch, Modulation MIDI data
- Zoom in and out on individual events
- Draw changes on screen to edit MIDI data

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- Complete implementation of all standard sequencer features
- Extensive control over all MIDI events
- Visually display MIDI events over time
- 240 clocks per quarter-note resolution
- SMPTE sync via MIDI song pointer
- Independent track looping
- Data filtering on input or while editing
- Select areas to edit using mouse
- Change duration, velocity, channel, continuous, transpose
- Cut, copy, clear, paste and mix editing of all data
- Insert or remove time anywhere in a piece
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- Rebar any section to any meter
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Requirements.
Macintosh 512, Plus or SE, or Atari 520 ST or 1040 ST, MIDI interface and MIDI instruments.



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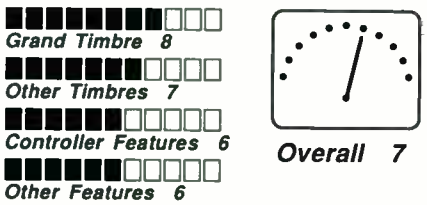
*The Speed of Sound.™*

| Model | Action | Action stiffness | Number of voices | Number of sounds | Sound types |
|---|---|---|---|---|---|
| **Roland RD-300** | 88-key weighted | Light | 16 (1) | 8 | P1, P2, P3, EP1, EP2, H, C, V |
| **Yamaha PF85** | 88-key weighted | Moderate | 16 | 5 | P1, P2, EP, H, V |
| **Korg SGX-1D** | 88-key weighted w/aftertouch | Moderate | 12 | 4 (2) | P1, P2, EP1, EP2 |

they all use some variant of sampling technology as the basis of their sound-producing circuitry. They all have 88-note, velocity-sensing keyboards; multiple preset sounds; stereo chorus; stereo headphone jacks; MIDI In, Out and Thru jacks; piano-like sustain pedals; transpose functions (except the Korg SGX-1D); and fine-tune controls. They all send MIDI Program Change and Sustain Pedal commands and have various transmit/receive channel, Omni on/off, and Local on/off functions.

But beyond these functional similarities, they're as different as can be. And evaluating a sampled grand is every bit as subjective and personal as evaluating an acoustic instrument. I hope I've managed to provide some objective information, but if you're in the market for one of these things, you owe it to yourself to check them out *first hand*, before you lay down your hard-earned cash.

## ROLAND RD-300




The RD-300, like the MKS-20 and RD-1000, uses Roland's *Structured Adaptive* (SA) synthesis technology, which is perhaps closer to resynthesis than sampling—though the acoustical results are comparable. The 300 is a 16-voice instrument (though the Harpsichord, Clavi, and Electric Piano 2 sounds provide only ten voices), with eight preset sounds: *Piano 1*, an acoustic grand timbre; *Piano 2*, a brighter, less full-bodied sound; *Piano 3*, an electric grand sound; *Harpsichord*, a useful simulation, if unrealistic in the lower register; *Clavi*, a nice sound, but more like a clavichord than a clavinette, especially in the upper register; *Vibraphone*, a superb sound with a mallet-like "thunk" and great clarity; *Electric Piano 1*, a beautiful Rhodes sound; and *Electric Piano 2*, a more "electronic" timbre. When you select a new sound, it isn't enabled until all the notes held or pedaled with the current sound are released—a nice feature for live performance.

The grand piano sound of the RD-300 is a little less accurate than that of its sampled competitors (play low A on one of these things, and you'll hear what I mean), but the timbral uniformity from note to note is much greater and the overall clarity is phenomenal. Every note of a left-hand chord rings clear, even under a busy solo line. In an ensemble, this thing really cuts through (maybe that's why MKS-20 modules are so popular with rock and roll players). The Vibraphone sound is very convincing and the Electric Piano 1 sound, fantastic.

Signal processing consists of a front-panel brilliance control (which affects all sounds equally), a stereo tremolo with front-panel sliders to adjust the rate and depth, and a stereo chorus with fixed rate and depth. When you enable tremolo or chorus for a given sound, the RD-300 remembers the setting if you call up the sound again (until you turn the instrument off). The stereo tremolo is great (suitcase Rhodes, anyone?), but the chorus pitch-modulation seems excessive when monitored in stereo, and you can't adjust it.

The RD-300 keyboard has the lightest action of the three instruments reviewed, which facilitates fast'n'flashy, two-fisted frolics, even if you haven't practiced for a week (synth players will love it); but pro-

## Piano Pedals Demystified

**PIANO PEDAL TERMINOLOGY** can be downright confusing. An acoustic grand piano normally has three pedals. The rightmost pedal is called the *damper* pedal (commonly referred to as the "sustain" pedal). It raises all the dampers off the strings, allowing each to continue to sound until its output decays to inaudibility, or until the pedal is released. But the damper pedal is not limited to simple on/off operation. It can be used to raise the dampers partially above the strings; hence the reference, in more advanced piano music, to "half pedal," "quarter pedal," and so on, though the ultimate pedal resolution is determined by the quality and regulation of the pedal mechanism and the skill of the performer. Partial-pedal technique is critical to modern classical piano music, but is less widely practiced in jazz and rock performance. To my knowledge, the only electronic musical instruments that incorporate partial-pedal functions are the Yamaha PF70 and PF80 electronic pianos and the Kurzweil 250.

The middle pedal is called the *sostenuto* pedal. When engaged, it "grabs" the dampers of any notes that are currently held, and allows those notes to continue to sound until they decay, or until the pedal is released. This is useful since it allows the performer to sustain a bass note or chord while playing simultaneous stacatto passages "on top." These days, quite a few electronic musical instruments incorporate a sostenuto-pedal function.

The leftmost pedal is called the *soft* pedal (sometimes referred to as the *mute*, *una corda*, *sordino*, *practice*, or even *piano* pedal). It reduces the overall volume and timbre range of the instrument, normally by shifting the keybed so the hammers strike only one or two of the strings per key-group. This pedal function is found on some electronic instruments; but even when it is not provided, it can often be mimicked by selecting an alternate velocity curve for a controller or module, or by adjusting patch envelope-parameters.

—AGC

| Signal processing | Performance controls | MIDI functions | Pedal functions | Size | Weight | List price |
|---|---|---|---|---|---|---|
| T, C, BR (3) | MV (4) | SP, ST, PG, O, L, PC | D, SOFT, S (7) | 55 15/16 × 18 1/8 × 5 1/4 inches | 60 lbs. | $2,595 |
| C (3) | None | PG, O, L (6) | D, SOFT, S | 52 3/8 × 15 3/8 × 5 3/8 inches | 68 lbs. | $1,995 |
| C, BR, EQ | PW, MW, AT (4) | SP, PG, O, L, PC (5) | D, SOFT, S (8) | 54 × 15 3/4 × 4 7/8 inches | 74 lbs. | N/A (9) |

**Key:**

**P** = Piano
**EP** = Electric Piano
**H** = Harpsichord
**C** = Clavinet
**V** = Vibraphone
**T** = Tremolo
**C** = Chorus

**BR** = Brilliance
**EQ** = Equalization
**PW** = Pitch wheel
**MW** = Mod wheel
**AT** = Aftertouch
**MV** = MIDI volume
**SP** = Split

**ST** = Stack
**PG** = Program change
**O** = Omni On/Off
**L** = Local On/Off
**PC** = Performance controls
**D** = Damper
**S** = Sostenuto

**Footnotes:**

(1) Ten voices on EP2, H, & C
(2) Additional sounds via ROM card
(3) Chorus is not adjustable
(4) Affects MIDI output only
(5) Splits between MIDI and internal only
(6) Sends program change numbers 1-5 only
(7) Soft-pedal function is programmable
(8) Soft- & sostenuto-pedal functions via MIDI only
(9) Korg does not publish suggested list prices.

**Manufacturer's addresses**

**RolandCorp US**
7200 Dominion Circle
Los Angeles, CA 90040

**Yamaha Music Corporation**
PO Box 6600
Buena Park, CA 90622

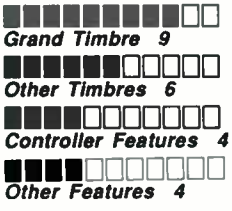
**Korg USA**
89 Frost Street
Westbury, NY 11590

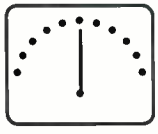
vides somewhat less subtlety of control than a heavier action. *(Since this article was written, Roland has replaced the RD-300 with a new model, the RD-300S, featuring an SK-6 weighted-action keyboard that provides a more piano-like feel.—Ed.)*

The output MIDI velocity curve seems at home with synths and modules from various manufacturers. You can split the keyboard and have the 300 send the upper and lower sections on different MIDI channels (or have the whole keyboard send on two channels at once); and you can turn Local control off for the upper and/or lower sections, but you can play only one *internal* sound at a time.

There are no pitch-bend and mod wheels, and no aftertouch. The only performance controls are two External Volume sliders that send MIDI volume data for the upper and lower sections. You send MIDI program change numbers by pressing a switch, or switches, for the lower and/or upper sections, then pressing a key to select the appropriate bank, another key to select the first program-change digit, and still another key to select the second digit. Setting the split point and transpose functions involves similar button-pushing and key-pressing —which is cumbersome, to say the least. Thankfully, the parameters are silk-screened on the front panel, and the "Soft/Remote" footswitch can serve as a soft pedal, sostenuto pedal, *or* remote footswitch for the transpose, split, program change, MIDI channel, tremolo, and chorus functions (but only one at a time). You can also set the instrument to send program change messages 1 through 8 when you select sounds from the front panel.

## YAMAHA PF85




The PF85 employs Yamaha's *Advanced Wave Memory* (AWM) technology, a derivative of sampling. It's a 16-voice instrument, with five preset sounds: *Piano 1*, a round, mellow, grand piano timbre; *Piano 2*, a brighter grand timbre with a more pronounced attack; *Electric Piano*, a disappointing, "synthy" sound; *Harpsichord*, a DX-like sound, best in the middle register; and *Vibes*, a great sound with a wonderful "thunk," and pronounced harmonics in the lower register.

The grand piano timbres are very realistic from the middle register on down. Low notes are *thunderous*; the bottom octaves sound uncannily like a *BIG* acoustic piano. The Piano 2 preset really knocked me out—it's great for rock and aggressive jazz (I kept coming back to play it when I was supposed to be reviewing). Timbral uniformity from note to note is also very good. The only sonic shortcoming of the grand timbres is that the high notes decay too quickly compared to a real piano. Though to be fair, a little reverb during recording makes the 85's truncated envelopes hard to detect. In fact, of the instruments reviewed, the PF85 sounded the most realistic on tape. But while the grand piano and vibes presets are great, and the Harpsichord is about what you'd expect, the Electric Piano preset is not even as good as some of the lesser DX patches. What's a nice instrument like this doing with a sound like that? *(Note from the* EM *insider tips department: when the PF85 is powered up while the lowest and* second-*to-highest keys are depressed, the unit's digital filtering system is bypassed. We passed this information on to the author, who tried this technique and reported an improvement in the vibes and electric piano sounds.—Ed.)*

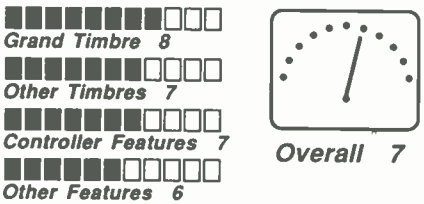
Signal processing consists solely of a stereo chorus. It sounds good, but you can only turn it on or off; there are no rate or depth adjustments. The PF85 does have a built-in stereo amplifier and two speakers mounted at each end of the top

panel (and you thought those were heat-sink vents) which you can turn off with a switch on the back. This is definitely handy for songwriting and practicing in hotel rooms and dorms, and doesn't really sound too bad. To boot, the 85 comes with an attractive acrylic music rack. The 85 has a moderately stiff, very piano-like action that feels good and provides excellent, subtle control over the preset sounds. The soft pedal can be set to function as a sostenuto pedal; but absent are the partial-damper-pedal functions of the PF85's predecessor, the PF80.

The 85's MIDI implementation is very basic. You can transmit on any one channel, receive on any channel (or in Omni mode), and turn off Local control. The PF85 sends Program Change numbers 1 through 5 only, and doesn't send MIDI volume. There are no performance controls, and no split or stack capability. You set the transmit/receive channels by holding down the *MIDI/Transpose* button on the front panel, and pressing certain keys. The transpose and fine-tune parameters are accessed similarly. This is reminiscent of the Roland scheme, but on the PF85, none of this info is silkscreened on the panel, which seems a needless inconvenience (though the button- and key-press sequences are simpler than on the Roland).

Still, the PF85 might make a respectable basic controller, if not for the fact that its MIDI output velocity curve seems incompatible with many synths and modules. For example, when driving a DX7, DX7S, or DX7II from it, light to moderate playing force yields velocity values that sound as if they're somewhere in the mid range, and you have to really bang it to trigger the higher values. A Yamaha service representative assured me the output curve is, in fact, no better or worse than that of many instruments—Yamaha's and others—and that this is not a bug. That may be true, but I found it unmusical, at best. (I tried two PF85s, one from a dealer, and one graciously supplied by Yamaha, to make sure this problem was not caused by a defective unit; unfortunately, both instruments responded similarly.)

## KORG SGX-1D




The SGX-1D, an upgraded version of Korg's popular SG-1D, uses sampling technology but contains nearly five times as much sample memory as before (older units can be upgraded by Korg service centers). It's a 12-voice instrument, with four preset sounds: *Piano 1*, a dark grand piano timbre; *Piano 2*, a brighter grand timbre; *Electric Piano 1*, a down and dirty Rhodes sample; and *Electric Piano 2*, a DW-8000-type sound. Four presets may seem scant, but the SGX-1D can read new sounds from ROM cards (not included), and Korg offers an extensive card library: harpsichord, vibes, bass, guitar, etc.

The new samples are definitely worth Korg's trouble. The grand sounds have punchy, hammer-like attacks, and the high notes have long, natural-sounding decays. The Rhodes sound is great (a little dirty for some tastes, but I like it).

Nonetheless, on our review unit, the sample pitches went slightly flat as notes decayed (this happened only with the grand samples, not the electric piano samples). Korg vice-president of product development Kim Holland reports that there have been no complaints from the field, and that we may have received a defective unit. To be fair, our SGX-1D was an early production model and might be expected to have a few bugs; I wasn't able to try a second unit, so be sure to check for this if you're shopping.

Signal processing consists of bass, mid, and treble EQ sliders, a brilliance slider and a stereo chorus with rate and depth sliders. The brilliance control may seem redundant, but it's quite useful to be able to quickly adjust the brightness of the various presets and ROM card sounds after the basic EQ has been set to taste. The chorus sounds good, too.

The SGX-1D action is very piano-like, similar to that of the Yamaha PF85 (the Korg is perhaps slightly stiffer, the Yamaha slightly springier). Performance controls consists of pitch-bend and mod wheels, aftertouch and damper pedal. MIDI volume is not sent. The wheels and aftertouch affect only the MIDI Out, not the onboard sounds. The wheels appear at first to be inconveniently placed, but are easy to get used to. The mod wheel is a dual-function, center-off type that sends both modulation and breath controller data. The aftertouch is very controllable, with a reasonably uniform response, even at the upper and lower extremes of the keyboard. Oddly, there is no input jack for a soft/sostenuto pedal, though onboard soft- and sostenuto-pedal functions can be accessed via MIDI.

As a MIDI controller, the SGX-1D stacks up very well. The output velocity curve is compatible with synths and modules from various manufacturers, and is the best I've ever tried for driving Yamaha DX and TX gear: some patches that sound synthetic when played from a DX7 keyboard take on an almost "acoustic" quality under the subtle control of the SG. It's very impressive. One rear-panel control scales the overall velocity range, and two others set the MIDI transmit and receive channels independently.

The keyboard can be split (between MIDI and an internal sound—the SG can transmit on only a single channel) at any point, and Local control can be turned off for the upper or lower sections or both. Like the Roland RD-300, the SGX-1D sends MIDI Program Change commands, and sets split points, via multiple button- and key-presses, but like the Yamaha PF85, none of the info is silkscreened on the panel. Unless you're

## Real Piano Technology

**IF ALL THIS** piano talk has piqued your curiosity about the real thing, you might want to check out these books and magazine articles:

*Theory and Practice of Piano Construction*, William B. White, Dover Publications, Inc., 1975. This is a thorough, concise, technical reference.

*The Piano Book: A Guide to Buying a New or Used Piano*, Larry Fine, Brookside Press, 1987. A great book for pianophiles.

"The Physics of the Piano," E. Donnell Blackham, *Scientific American*, December, 1965. One of the reprints contained in the Scientific American book *The Physics of Music*. A good semi-technical introduction.

"The Coupled Motions of Piano Strings," Gabriel Weinreich, *Scientific American*, January, 1979—intriguing (but technical) article that explains the physical reason for the piano's "singing" tone. **—AGC**

## Grand Alternatives

**IF YOU WANT** that *grand* sound, without spending a couple of grand, here are some surrogate-piano ideas:

The lowest of the low-priced piano samples are contained in Casio's SK-1 budget sampler (and the newer SK models). You can get one at K-Mart for 79 bucks. You can even add MIDI to it (see "Build a MIDI Input for your Casio SK-1," in the August '87 issue of *Keyboard* magazine), though it helps if you're handy with a soldering iron.

360 Systems sells a piano chip for the MIDIbass and newer Professional MIDIbass. No, I don't know why anyone would want a monophonic bass piano sample, but you can buy it, anyway.

Speaking of samples, there's hardly a decent sampler around that doesn't have a good piano-sample disk available for it. (I have a feeling the Mirage piano sample is buried in more garage mixes than anyone would care to own up to.)

Believe it or not, the little preset Keytek CTS-400 and its rack-mount cousin have pretty decent piano and electric piano samples. They're eight-voice polyphonic and cheap, too.

Speaking of cheap, how about some new piano patches for those synths you already own: the ESQ-1 or DX7? They're definitely cheaper than a new axe. There are some interesting DX7-compatible piano patches in both the DX7's factory cartridge, and in the Bo Tomlyn cartridge series. Check 'em out.

If you *do* want to spend a little, don't forget Ensoniq's Sampled Piano. It has a 76-key weighted action, stereo outputs, ten voices, and 12 sounds, including piano, electric piano, clav, marimba, vibes and bass (acoustic and electric). The keyboard can be split, with bass on the bottom or set so the bass —which has its own audio output—can be controlled from a separate MIDI channel. All this for $1,295!

If you've got the bucks, but need more than just piano sounds, check out the Kurzweil K1000 (or the rack-mount 1000 PX), reviewed in the April '88 **EM**. It has a 76-note, weighted action, 24 voices, full multi-timbral capability, and great piano, acoustic bass, string, choir, vibes, brass, and clarinet sounds.

**—AGC**

adept at memorizing program change numbers as two-handed intervals (and at converting from "octal" in your head), you may find this to be a drag; also, the SG sends only numbers 1 through 64, there's no "Bank B" or the like to access numbers 65 through 128.

### HOPE THROUGH RESEARCH

Let's face it, pianophilia can be a serious problem. None of these second-generation electronic marvels represents a cure; for severe cases of complex piano music (e.g., classical and jazz pieces), you'll need the real thing, with its 88 voices and true damper pedal.

Still, each of these instruments has its therapeutic niche. The Korg SGX-1D is by far the most versatile of the three, with lots of features, great internal sounds (I'm assuming the intonation problem we noticed was a fluke), and alternate sounds on ROM cards. It also makes the best MIDI controller. Perhaps its only limitation is that it has 12 voices, while the others offer 16. The Roland RD-300 provides piano timbres that really cut through in an ensemble, and has a really beautiful Rhodes sound. It's a fair controller too, with a comparatively light action. No doubt it will be a favorite with rock and rollers. But the Yamaha PF85, in my opinion, makes the best sit-down-and-play-it piano replacement. I had so much fun with it that I'd almost forget it wasn't a real acoustic grand. True, it's rather basic as a controller. But if Yamaha would fix the output velocity curve problem, and perhaps improve the electric piano sound, it would be great for the price.

Piano panacea? No. But until science finds a cure, try sampled grand therapy. I feel better already.

*(Thanks to Al Miller Music, Chattanooga, TN, for providing the Roland RD-300 for this review.)* **EM**

---

***Alan Gary Campbell** is the owner of Musitech™, where he regularly nurses sick keyboards back to health.*

# Introducing Kawai's Maximum music.

You'll be amazed at the natural sound, expressive power and easy-to-use functions of Kawai's remarkable K1 keyboard and K1m tone module.

The Kawai K1 is an exciting new class of digital synthesizer giving you an inspiring range of dynamic sound at an unbelievable low price.

**Amazing sound that inspires the imagination.**

Kawai's new Sampled Digital Waveform technology results in a rich multi-timbral sound that you've got to hear to believe!

The K1 features 32 sound sources that generate 256 different digital waveforms. Kawai's advanced digital circuitry creates a clean, well-defined sound which resonates with surprising depth and character.

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Unlock the creative genius in you with the K1's programming versatility.

With a single patch, you can program up to 8 sounds into a combination that includes splits, layers, multiple MIDI channels and independent keyboard control.

*The K1m low-profile design is ideal for desktop use.*

## Grand Alternatives

**IF YOU WANT** that *grand* sound, without spending a couple of grand, here are some surrogate-piano ideas:

The lowest of the low-priced piano samples are contained in Casio's SK-1 budget sampler (and the newer SK models). You can get one at K-Mart for 79 bucks. You can even add MIDI to it (see "Build a MIDI Input for your Casio SK-1," in the August '87 issue of *Keyboard* magazine), though it helps if you're handy with a soldering iron.

360 Systems sells a piano chip for the MIDIbass and newer Professional MIDIbass. No, I don't know why anyone would want a monophonic bass piano sample, but you can buy it, anyway.

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# new K1 synthesizer. Minimum moola.

Dynamic note assignment and velocity zone functions further enhance the K1's multi-timbral capability. Strike a key softly and one note will play. Hit it a little harder and you'll hear another sound—a tonal variation or a completely different timbre. Create a simple duet, complex orchestral passage or monster solo unison, then save it for instant recall.

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The 61-note K1 keyboard features Velocity, After-touch and weighted keys for excellent responsiveness. The LCD display and direct access buttons easily summon any of the K1's 64 internal single sounds or 32 multi-combinations. Optional memory cards expand the library of sounds available.

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**The bottom line: You need to hear this synthesizer.**

The K1 is the epitome of intelligent engineering at a very affordable price. But don't take our word for it. Visit your nearest Kawai dealer today and find out how you can achieve maximum music for minimum moola.

# KAWAI

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Kawai Canada Music Ltd., 6400 Shawson Dr., Unit #1, Mississauga, Ontario, Canada L5T1L8

BY ROBERT CARLBERG

Reviewers' favorites tend to be bizarre, out-of-the-way backwaters, simply because they catch our attention in the flood of new releases. It doesn't matter how professional the 27th album of sax-and-synthesizer new age music is if you've just heard 26 others. It's terrible to say it, but being good isn't enough anymore. To get noticed, you have to be different too.

The irony is that the record companies aren't really looking for anything different. The really innovative artists, the ones who blaze their own trails and have something unique to offer, are by-and-large locked out of the airplay and distribution networks they need to gain wide exposure. I doubt that anything as diabolical as payola or boycotts is involved; more likely it is simply the blinders of what is, at heart, a very conservative industry.

Every once in a while something innovative sneaks through, becomes a huge hit nationwide, and then for years afterward the cigar-chomping record execs try to duplicate the success. What they don't seem to understand, or fail to acknowledge, is that the very act of repeating the formula keeps it from becoming a hit again. The public wants something new.

The record companies want assured hits. They're looking for the gold, platinum, double-platinum, uranium successors to *Thriller* where fortunes are made overnight. To an extent this is true not only of the music industry, but of the film industry, the book industry, the TV industry, the auto industry—the economics of scale make mega-popularity very attractive.

Not all labels are motivated by greed, of course. Many of the stalwart cornerstones of the industry, labels such as Blue Note or Nonesuch or Ryko, are perfectly happy to sell 2,000 copies and make an adequate profit. Their economics are to have a lot of 2,000-sellers in their catalog so that overall the company remains comfortably profitable, while providing an outlet for a lot of music. Sometimes they stumble onto a release which takes off and propels them into the "big time." Rounder had George Thorogood, Windham Hill had George Winston and Ryko has Zappa. But if they're smart they go back to what they were doing before, providing a service to the public, an outlet for the musicians and a small profit for themselves.

Other labels, primarily independent, single-artist "vanity press" labels are content to break even just to get their music out. They may dream of wearing one white glove on stage, but they won't sing "Beat It" to get there.

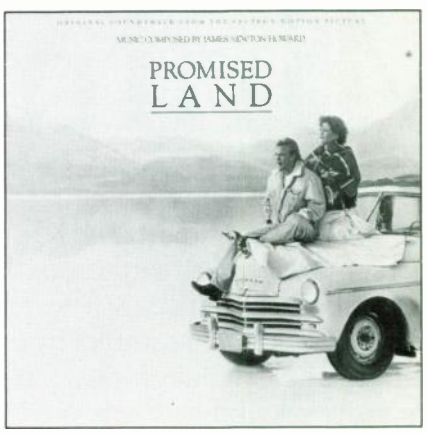
All this is by way of introduction to one of the backwaters furthest from the mainstream. **The Mnemonists** are a combination rock band/tape studio/artist co-op who are now on their seventh LP, *Bellowing Room* (Recommended Records C27, 387 Wandsworth Road, London SW8 or contact Bill Sharp, 910 West Mulberry, Fort Collins, CO 80521 ☎ 303 / 221-1576). Their music defies description which is a fancy way of saying I'll try, but not very successfully. Diverse instruments (everything from guitars to psalteries) are set to moaning (or bellowing if you like), small items are bashed together, obscure texts are read at the limit of audibility, and electronics provide a constant throbbing. It is as if Frank Zappa were to record George Crumb's "Night of the Electric Insects" inside the engine room of a large ship. If it all sounds a bit anarchistic, it is—but within such strict limitations that the pieces are consistent, coherent and hover right at zero


on the VU meters. It may well be bizarre "noise music," but so finely tuned and well performed that *Bellowing Room* is no less a work of intention than a classical symphony. Elaborate packaging with reams of dadaist/surrealist artwork also accompany each Mnemonist release. The effect is a powerful blast from an alternative universe which, though it will probably never impact the mainstream, is nevertheless essential for perspective.

What happens when an "underground" composer gets a contract with a nominally "national" record company? In this case, the composer is **Steve Fisk** (607 West Third, Ellensburg, WA 98926), the label is SST Records (PO Box 1, Lawndale, CA 90260) and the record is *448 Deathless Days* (SST 159). The result is passionately uncommercial—twisted pop songs thoroughly mixed up with found tapes, backwards vocals, cheesy processing and enough studio tricks to gag a normal producer. There are just enough hooks and real musical tidbits to fool the casual listener into thinking this may be a serious effort, but closer examination will reveal, certainly, that Fisk is shy a few bricks. If you've ever worried about the dangers of prolonged immersion in the studio, one listen to *448 Deathless Days* should help you pull the plug and go fishing. Or maybe not.

Rykodisc, the eclectic CD-only label currently struggling to keep up with orders for Zappa, has released another disc which should be easier to keep in stock. The 72-minute compilation from the group **Birdsongs of the Mesozoic** is called *Sonic Geology* (RCD 20073). Culled from their three albums released 1981-5, the liner notes on *Sonic Geology* go to great lengths to attempt to explain Birdsongs of the Mesozoic. At various times they are described as "The World's Hardest Rocking Chamber Music Quartet," "an unlikely mix of punk, minimalism and freeform improvisational sounds," "multi-layered cacaphony" and "a realm where sounds and sensibilities are on a constant collision course." I'd take the easy way out and just describe them as determinedly weird. The guitarist and pianist are ex-Mission of Burma; the other two synthesists, who double on horns, tapes, bass and percussion, are probably also from Boston. Their music consists of fairly frenetic patterns on piano, distorted guitar and synthesizers, relying less on tunes than the textures thus produced. Sort of an electric Penguin Cafe Orchestra at 45 rpm. Two tracks are covers: "Theme from Rocky and Bullwinkle" and "The Rite of Spring"—like I said, weird.

**Charles Ditto** ("32 years old, married, father of one"—I wonder what he named the kid) has released his debut LP *In Human Terms* (DIT 0101, PO Box 49124, Austin, TX 78765). On it he programs some electronics (DX7, MKS-20, MKS-80, Prophet 2000, ME30P, KX88, SPK-90) using other electronics (Macin-




tosh SE with MIDI-DJ and *Performer*) to perform his music. Now Charles, who has undoubtedly heard every joke associated with his name, sounds unlike anybody else. The music, which he categorizes as officially uncategorizable, consists of medium-to-slow tempo compositions on low-register synthesizer voices which bridge the gap between popular music and contemporary classical. They are rhythmic, using great percussion sounds, but fairly abstract melodically, occurring within a narrow range of notes (generally about a fifth) and hitting nearly every note within that range. The music isn't really in a key therefore, sounding almost microtonal. It doesn't strike

you as computer-programmed either, with lots of rhythmic and dynamic variety to keep it "in human terms." Ditto's choices of synthesizer sounds are at once both organic and unique. *In Human Terms* isn't weird in the sense of *Sonic Geology* or *448 Deathless Days*, or from another universe like *Bellowing Room*, just something very different from a man named Ditto.

Back in the early '80s, **Robert Rich** (PO Box 8891, Stanford, CA 94309) put out some trance music cassettes and performed concerts in which the audience was encouraged to fall asleep. His debut long-player, *Numena* (Multimood 005), still maintains a dreamlike development but includes sound effects, light percussion and a greater variety of sound sources than just the voice of his Prophet. Connections to Kitaro, Edgar Froese or even Jon Hassell make *Numena* a soundtrack for travellers in space and time. Another new album, *Geometry*, and an upcoming collaboration with Steve Roach, *Dreamtime Return*, mean Robert will have a fairly high profile in the near future. You'd better stay awake for it.

Another group known for dreamlike improvisations has been **The Nightcrawlers**, made up of Dave Lunt, Tom Gulch and Pete Gulch (1493 Greenwood Avenue, Camden, NJ 08103). Like Robert Rich, they've been at it for almost a decade, getting incrementally more complex and sophisticated with each release. Their latest, *Shadows of Light* (Synkronos 202, $8 postpaid), continues the slow steady climb, utilizing a roomful of synthesizers and a bagful of ideas. They're finally crawling out from beneath the shadow of Tangerine Dream (where all synthesizer trios are inevitably born) to emerge into their own light, developing a slow, ponderous, almost grandiose style all their own. It's a light that should spark a burst of new growth—that is, if nightcrawlers produce chlorophyl.

Despite a goofy title (*Roy Rogers Meets Albert Einstein*), an amateurish sleeve photo (bad imitations of Rogers and Einstein), and a ludicrous "story line" (a truck driver crisscrosses the country with two aliens on the day of JFK's assassination), the music on **Sigmund Snopek III**'s fourth release on Dali Records (Dali 20013) almost redeems the concept. Snopek's curriculum vita includes both symphonies and rock bands, and he's described as an "underground hero in his hometown of Milwaukee" (one wonders if that's worth a cup of coffee on a rainy night). *R.R. Meets A.E.* is a concept album, a progressive jazz/rock/classical fusion of two long suites which owe equal debts to Mike Oldfield, Zappa, Genesis and maybe early Steve Tibbitts. The tableaus within each set pass quickly from one to the next, and some of them are genuinely memorable. Guitars, flute, sax, violins, varied percussion, bass and short vocal moments are all tied together with Snopek's piano and analog

synthesizers. The scope and range of the works, not to mention their subject matter, make them appear more than a little disjointed, but this is partly because he tries to do so much. He still hits more often than he misses. The promo blurb claims "this record should be in everyone's record collection"; I wouldn't go that far, but it ain't cowflop either.

After all of my moaning recently about the state of progressive music (in general) and the slide of Bill Bruford (in particular), I was gratified to run across a fairly new record which shows off both to full advantage. *The Spice of Life* by guitarist **Kazumi Watanabe** (Gramavision 18-8706-1) features rock's hippest rhythm section, drummer Bruford and bassist Jeff Berlin, both playing their ever-loving hearts out. In fact, listening to them bulldoze this music into submission, it's hard to imagine them ever taking the easy way out. Watanabe, to his credit, hangs on for dear life.

I'm not charged with doing film reviews, but if I was, I'd say Michael Hoffman's *Promised Land* is a promising concept, filled with explosive talent and photography of aching beauty. Unfortunately, it fizzles away its potential, like safe and sane fireworks. Not so with the


soundtrack album by **James Newton Howard** (Private Music 2035-1). Howard, veteran of stage (Elton John, Barbra Streisand, Chaka Khan) and screen (*Nobody's Fool*, *Wildcats*, *Eight Million Ways to Die*, *Five Corners*) expands on a couple of the cues from the film to make his soundtrack album (the first for Private) a self-contained autonomous production. A lot of soundtrack music is hack work, innocuous backgrounds slaved to the scenery and unable to survive without visual excuse. James Newton Howard's music is just the opposite; only outside the theater can you appreciate the rare beauty and stunning production of his contribution. Howard wrote and orchestrated (on Synclavier and piano) a series of suites which rank with the best of the "new electronic music" that Private Music has come to define.

**Peter Rudolfi** (862C De Haro Street, San Francisco, CA 94107 ☎ 415/550-1872) was last reviewed in EM in the July 1986 issue for a tape of solo piano compositions. His new tape, *Cellos* ($9.98 postpaid) is quite different. It features (surprise!) the instrument of the title, with DX7 and Roland TR-505 drum accompaniment. The cello, with its long, drawn-out bowstrokes, tends toward a David Darling ECM mournful jazz, while the drum programs and synthesizer add elements of an uptempo new age fusion. Rudolfi keeps varying the textures all the way from neo-classical overdubbed cello ensembles to straight new age synthesizer, so even though the tape doesn't break any new ground, it doesn't run the music into the old ground either. And it's not sax-and-synthesizer, which is an advantage right from the starting blocks.

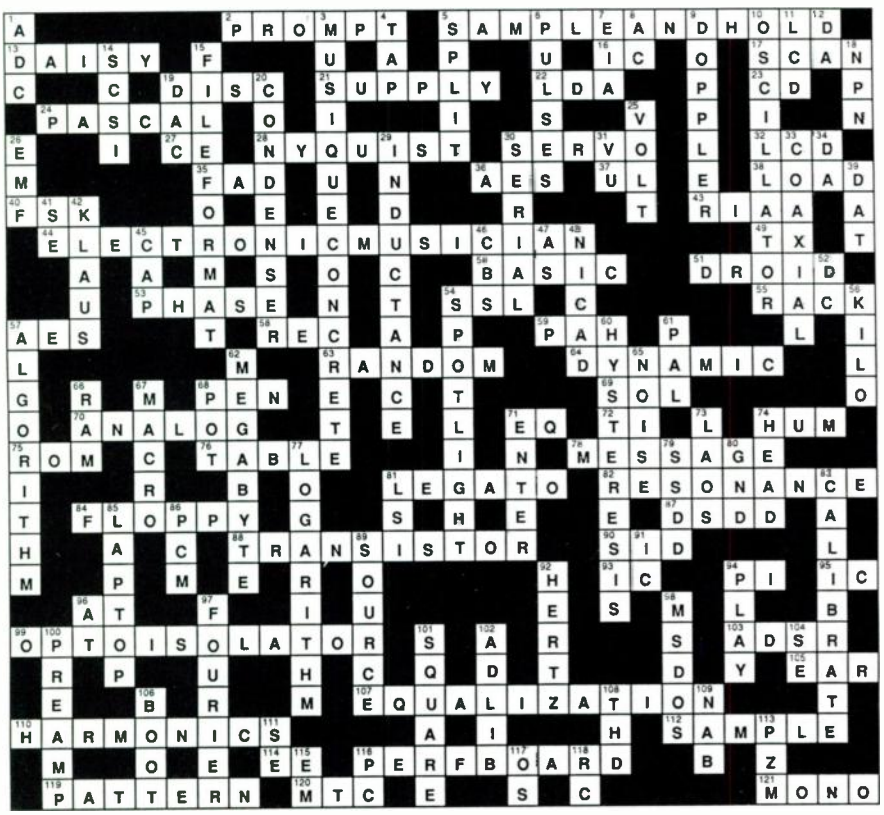
Last today is another album from Private Music, although this one falls more into the "guilty pleasures" than the outside music of the other end of this text-stream. **Jerry Goodman**'s history includes leading The Flock, a seriously rocking '60s band, as well as providing some incendiary violin in the '70s John McLaughlin's Mahavishnu Orchestra. His first two solos for Private Music, *On the Future of Aviation* (1985) and *Ariel* (1986) were therefore somewhat surprisingly new age. With *It's Alive* (Private Music 2026-1) he closes the circle, playing songs from *The Future of Aviation* and *Ariel* but goosing them up with driving instrumentals that aren't likely to be mistaken for meditation music. Four new tunes also cement this contention that the violin isn't for sissies. When pushed to the wailing overdriven limit, electric violin does sound quite similar to post-Hendrix guitar, and the excitement of this live concert, taped in one night in Chicago, is infectious. The band that plays with him, the same quintet that shared *Ariel*, does a remarkable job of re-creating all of the intricacies and subtleties of the original material while giving it a new momentum, showing that new age music doesn't have to slumber.

Just the thing for clearing the air after 27 drowsy albums of sax-and-synthesizer. Gimme some guitars!!! **EM**

*Robert Carlberg really doesn't hate new age sax-and-synthesizer music. He's just cranky from lack of sleep. Send all of your sax-and-synthesizer new age albums to PO Box 16211, Seattle, WA 98116 and make Robert happy. We want Robert to be happy, don't we?*

**From page 75**

# Answers to Mystery Word Matrix



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**BOSE** Acoustimass Pro Powered loudspeaker system now available—The first large-format self-contained amplifier/loudspeaker system. Honored at NAMM as best new sound technology. Full frequency response and high-power output in a portable enclosure. Call for further details. Green Dolphin Sound (213) 258-4744.

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**Cozmosynth 1:2** is a publication devoted to increasing the musical value of the Casio CZ series synthesizers. In its 48 pages you will find designs for a D.I.Y. MIDI Snake and an expressive modulation controller option for the CZ-101, the complete CZ system exclusive MIDI codes, with tips and software applications, including CZ Librarian and CZ Patch Print programs for the C-64 (disk available), and 16 great CZ lead and bass patches. All this for only $5.95 postpaid. Also available, **CZ Patch Book:** 70 professional data sheets for all CZ synthesizers, beautifully bound in a silk-screened cover, only $6.95 postpaid. Foreign orders, please include $2 postage for each publication. **Dream Machines,** PO Box 1033, Grover City, CA 93433.

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**Tell me what you gonna do, what you gonna do, Samantha!** ...Cellarful of Noise's smash hit from *Magnificent Obsession*, the CBS album that was sequenced and recorded in a basement 8-track studio. Guitars and vocals recorded on tape. All other instruments are virtual live tracks, sequenced and synced to 8-track. Mark Avsec wrote, arranged, produced and engineered Cellarful of Noise in his house and also wrote a book on MIDI recording. So study the pros and cons of MIDI sequencing versus tape from somebody who makes a living doing it, not somebody who just writes about it. **You must take your fate into your own hands and do it yourself!** Order **Your Basement: It's Not Just For Demos Anymore. The Advent of the MIDI Recording Studio.** 170 pages. $19.95 plus $2 P&H. (OH res. add 7%). Send check or money order to: Revere Press, 1075 E. 61st Street, Cleveland, OH 44103.

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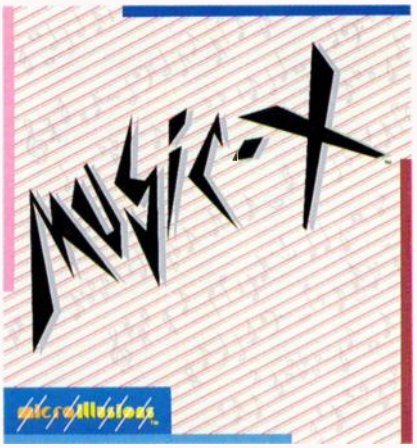


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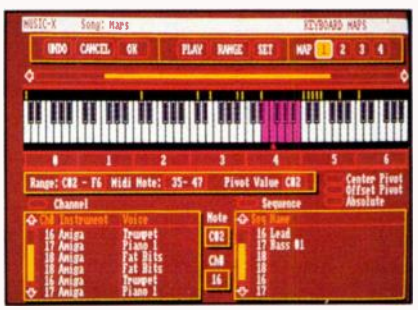


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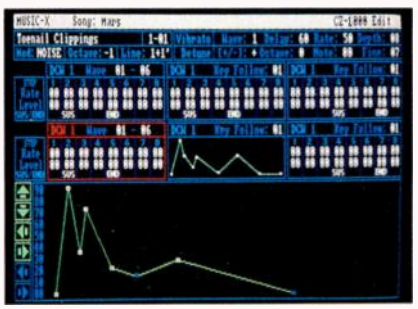


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Noise, distortion and crosstalk are effectively inaudible and there's more headroom than any comparable desk.

At last, a compact console that's as crisp as the new digital keyboards and 16 bit samplers.

While the famous Soundcraft equalization gives you a distinct edge on less advanced designs.

Repatching is something you'll be doing a lot less of with 16 equalized monitor channels.

Add two 4-channel return modules, and you've a full 24-track console.

There are optional stereo input modules, which can be used as stereo returns for effects like the remarkable new digital reverbs.

And even the option of an integral professional patchbay.

You'll also find Series 600 as intelligently designed as it is good to listen to. (Confusion being something else we design out.)

Yet such quality, and the reliability that goes with it, can actually cost you less than an ordinary desk.

Because with advanced production techniques we're able to offer the Series 600 at very competitive prices.

So there's no reason to accept half measures. Especially in your music.

Call your nearest Soundcraft dealer for a demonstration.

FRAME SIZES: 16, 24, 32 & 40 CHANNEL ● OPERATING LEVELS SWITCHABLE +4dBu OR -10dBv ● OUTPUTS: ELECTRONICALLY BALANCED +26dBu INTO 600Ω ● NOISE: MIC INPUT EIN: -128dBu (150Ω SOURCE) ● DISTORTION: LINE IN TO GROUP OUT @ 1kHz: <0.005% (+20dBu) ● CROSSTALK: UNROUTED INPUT TO GROUP -85dB @ 1kHz

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