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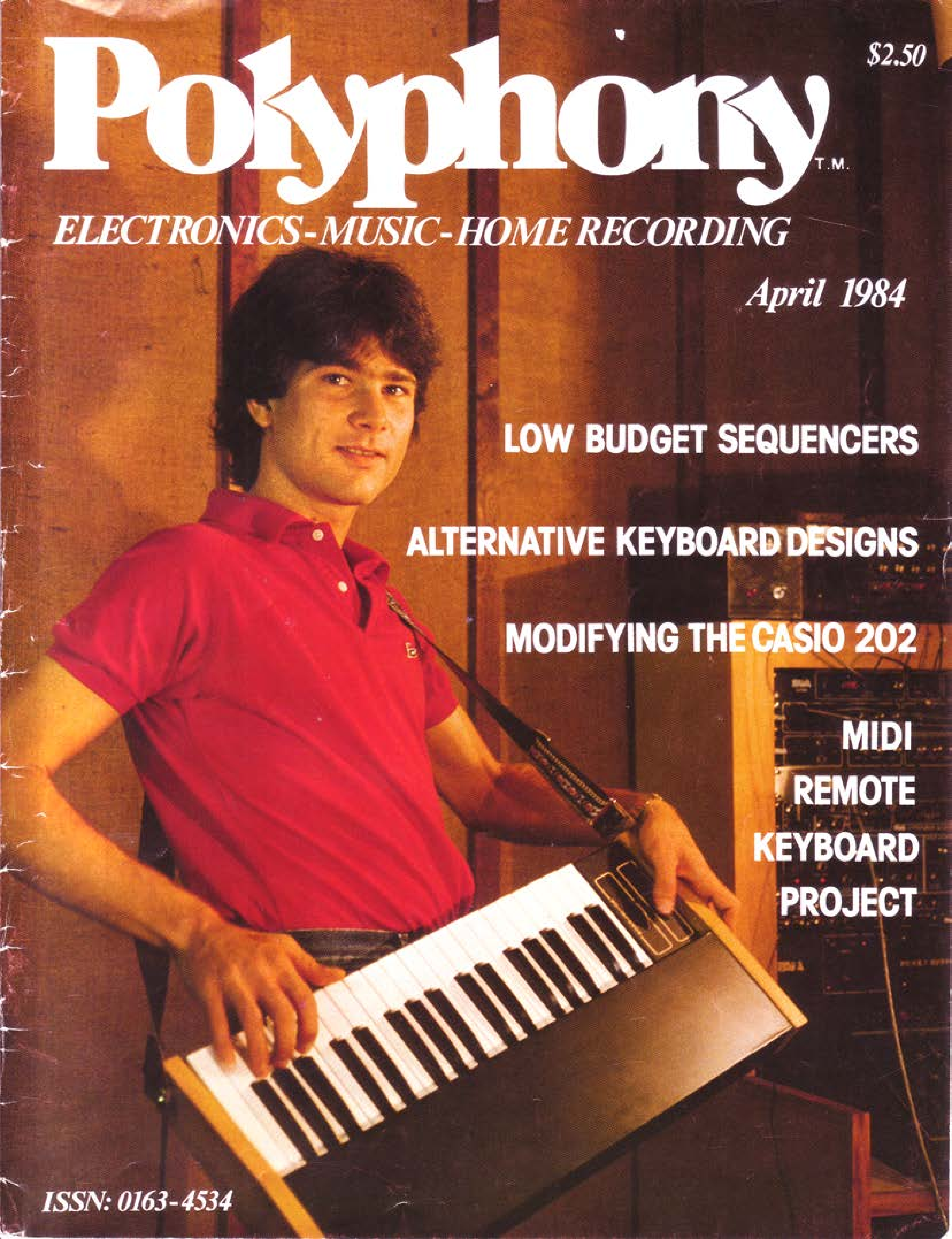

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APRIL, 1984

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ON THE COVER: Scott Lee PAIA Tech. Service Director tries out Remote MIDI Keyboard Project in the PAIA Demo Studio.
PHOTOGRAPH BY: Linda Kay Brumfield

Editor's Notes

If you're a Polyphony reader, you probably value your ears. I certainly do; without a good set of ears, I would be out of a job! Unfortunately, some people feel that tolerating loud sounds is some kind of badge of honor, like seeing if you can down 20 shots of Tequila and survive. If people want to blast their ears, I won't stand in the way...but if you care about your hearing, I strongly suggest bringing some kind of ear protection whenever you go to a club or concert. While I don't want to start a debate on whether music is generally too loud or not -- that's something that cannot be resolved -- I do want to stress to Polyphony readers that it's important to treat your ears with the same kind of care with which you treat your tape recorders, synthesizers, or lab equipment. If you find yourself in a club where the music is too loud, don't subject yourself to the din because you don't want to make waves. Stuff some cotton in your ears; if cotton isn't available, paper napkins can also do the job in a pinch. Now, many people will say that using cotton is not as good as using hearing protectors designed for that specific purpose, and that's probably true...but I feel that something is certainly better than nothing.

Also remember that there are many other noises that attack your ears every day (even a hammer or drill can be pretty loud). Your ears can stand a remarkable amount of abuse and come back for more, which is why many people take them for granted. But past some point (which usually occurs as you get older), the ears can no longer heal themselves as well, and your hearing starts going downhill from there. Take care of your hearing; it's worth it.

* * * * *

There sure are a lot of MIDI compatible devices being manufactured -- just check out this month's Current Events. When MIDI interfaces first started to appear, many people told me that MIDI didn't mean much since the equipment wasn't there. Wait, I said. Well, the wait is over -- we now have drum machines, several keyboards, and even a computer (the Commodore 64) that can all talk to each other over the MIDI bus. And remember, this is the beginning; I'm sure that musicians will take to MIDI with ever-increasing enthusiasm as the necessary hardware and software becomes more and more common.

MIDI required a lot of work and a lot of talk, a little bit of pressure, some ego sublimation, and a remarkable degree of co-operation from all the members of an intensely competitive and individualistic industry. Sure, everyone knew that MIDI wasn't perfect; but it was workable and economical, and virtually everyone agreed that it held the promise for musicians of much more capable instruments at very little extra cost. I really think we owe much thanks to the people who started MIDI and the companies who continue to keep MIDI alive and well. MIDI represents more than just a better deal for musicians: it shows what happens when an industry works together for the good of its customers.

* * * * *

This month, you'll notice a new feature we're trying out in the magazine called **Databank.** Why Databank? Because while going through the magazine, we noticed that a couple of articles referenced the same chips -- so why draw the pinouts twice? Instead, we put the IC pinouts on their own page to serve as a convenient reference. What do you think? Do you appreciate having pinouts available, or do you think this isn't really necessary? Let us know what you think.

* * * * *

Speaking of letting us know what you think, we're currently at work on a reader survey for publication in the next issue or so. The last time we presented a survey, the response was incredible -- and it helped shape the magazine in a particular direction. So, keep an eye out for the survey; it's your chance to tell us a little bit about yourself as well as what you like, and what you don't like, about the magazine. Incidentally, we will be publishing the results of the survey, and if the last survey was any indication, this will make for pretty good reading.

* * * * *

Finally, thanks to Kirk Austin for helping make Polyphony the first magazine to publish a do-it-yourself MIDI project...we think that you're really going to like the results of his work. Polyphony is extremely interested in any articles relating to MIDI -- applications, software, experiences using MIDI equipment, whatever might be helpful or interesting to musicians who want to get involved with MIDI (and don't forget we pay pretty well for good articles).

Craig Anderton

Robert Carlberg's

re-view

Andreas Vollenweider **...Behind the Gardens - Behind the Wall - Under the Tree** (CBS 37793); **"Caverna Magica" (...Under the Trees - In the Cave)** (CBS 37827). Electric harp records, augmented by guitars, percussion, synthesizers, and some nature recordings. They might broadly fall in the category of jazz, except they come with no baggage. Sort of like New Age meets Mike Oldfield.

John Wiggins **Anagenic** (cassette). John writes that he spent 14 months on this tape, but it sounds like it could have been 14 years. An incredible cornucopia of sounds, treatments, taped excerpts, jokes and pokes (of fun) comes tumbling out, held together by the finest of musical threads. This Musique Concrete is as far from "Variations for a Door and a Sigh" as Peter Gabriel is from Chuck Berry. $5.00 from 15 Reservoir Avenue, Northport, NY 11763.

Ian Anderson **Walk Into Light** (Chrysalis 41443). For whatever reasons, Anderson has chosen more challenging material for his solo debut than recent Jethro Tull releases. It's not UNcommercial, it just shows some thought. He backs himself with Linn drums and programmable synthesizers, which also helps.

Steve Roach **Traveler** (Domino 101). Roach has several things going for him: 1) fine sounding synthesizers, 2) comfortable sequencer patterns, 3) frequent key changes, 4) judicious use of electronic and acoustic percussion, 5) variety, 6) dynamics, 7) taste...-need I go on? Domino Records, 2708 Via Mar, Venice, CA 90291.

Lila **Illuminatus/Zeitfenster** (7F668630) (single). Lila is a synthesizer duo of Rike Casper & Herman Lipinski. Although a 3340 recording, this is over 12 minutes of very professional music, full of changes, breaks and variations. $4.00 postpaid from Helmholtzstr. 12, D-4000 Dusseldorf 1, W. Germany.

Bernie Krause **Citadels of Mystery** (Takoma 100 j-8). This was an unusual album when it was recorded 9 years ago -- it is less so today. It's essentially jazz with torrential ethnic undercurrents, not unlike M. W. Gilbert or Jon Hassell.

The Penguin Cafe Orchestra **Mini Album** (Editions EG MLP2). Six tracks from Simon Jeffes' eclectic (violin, bongos, ukelele, penny whistle, etc.) ensemble: two old, two new, two live. A good place to start and not a bad place to rest.

The The **Soul Mining** (Some Bizzare 25525). Matt Johnson has gradually slipped from "remarkably accomplished" (April) to "not as catchy but still brilliant" (June) to "attractive but cynical" (August). This album continues the trend, as state-of-the-art engineering and synthesizer work are offset by despondent lyrics about moral decay, pain, and suicidal moods. Not a record for weak constitutions, if you speak English.

Thomas Dolby **The Flat Earth** (Parlophone 2400341). Last year, Dolby's mastery of the Studio earned him "Best Engineering" award for **Wireless.** Since then his songwriting has matured remarkably, and his engineering has lost nothing in the process. Be forewarned: here's a likely candidate for "Best Album" of '84.

ai/ia/af **First Deployment** (cassette). Murky unfriendly tunes lurking in Throbbing Gristle masks. $7 Canadian plus $1 post from Chimik Productions, P.O. Box 1415 Station H, Montreal, Canada H3G 2W4.

Tara Cross **Concocting Chaos** (cassette). A slightly unsettling collection of unadorned ideas, at once both amateurish and showing signs of sophistication. I don't know if that's her real name. Contact 350 65th Street, Brooklyn, NY 11220.

Weather Report **Domino Theory** (CBS 39147). Buy this record for its synthesizer sounds or to maintain a collection. You needn't buy it for any other reason.

re-view

Everfriend **Shoot to Kill** (Jazzical 83034). A musical portrait by Bill Rhodes of the downing of Flight 007 over Soviet airspace. The back cover shows a dove (with olive branch) going down in flames. Flanged white noise is used for the "jet sounds". $6.98 from Jazzical, 1 Wyndmere Road, Piscataway, NJ 08854.

John Lennon/Yoko Ono **Milk and Honey** (Polydor 422-817 160-1 Y-1). From the same sessions as **Double Fantasy**, and equally strong. John was feeling optimistic just before his death, which makes it all the sadder. Yoko is to be commended for releasing John's songs exactly as he left them, not quite polished.

Thomas Dolby **Hyperactive!** (Parlophone 6065) (12" Single). Two tracks from the album (see above) plus a manic remix. Like Eno, Dolby is never satisfied to let his songs sit.

Philip Perkins **King of the World** (Fun 1003). A difficult album to review -- it has that hollow sound of The Residents' **Eskimo**, yet it is certainly more entertaining than that disc (or anything Perkins has done previously). Someone should unplug his reverb though. Synthesizer, nature recordings, and Residential percussion.

Steven Miller **Singing Whale Songs in a Low Voice** (Hip Pocket 102). Steel-string and electric guitar jazz. Mark Isham's synthesizer work is a modest addition. Not to be confused with the rock guitarist or the British keyboardist of the same name.

Caravan **Back to Front** (Kingdom 5011). A 1982 reunion disc. All the elements are there, but somehow the magic of this seminal Canterbury group isn't. Music is so fickle.

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ON LOCATION: WINTER 1984 NAMM SHOW

By: Craig Anderton

I really enjoy going to NAMM shows: Under one roof, you get to see all of the latest musical goodies demonstrated by interesting and intelligent people. However, even more intriguing than any individual products are the trends which become evident as you stroll down the aisles. This "On Location", then, will spotlight individual products -- but we'll also mention what I see as the important trends that will affect electronically-oriented music in the years ahead.

Sampling devices. Digital sampling technology finally came into its own at this NAMM show, and it seems that everybody is storing sounds in RAM and ROM these days. Leading the pack, both in terms of price and performance, was the Kurzweil 250 piano and E-mu's new Emulator II. The Kurzweil has already been described in the August 1984 issue of Polyphony, as has the 360 Systems sampling keyboard, so we won't go into them here. What was new was E-mu's Emulator II (called the E-2 for short). E-mu certainly knows their sampling; they introduced the first Emulator in 1981, and the Drumulator (which many people regard as the most cost-effective digital drum machine on the market) has been extremely well received. The E-2, while beyond the financial reach of most musicians (list is around $6,500), delivers a tremendous amount of versatility for the price. It uses a floppy disk based memory storage, lets you do your own sampling, features a touch-sensitive keyboard, and even includes some of the more popular analog synthesis components (such as a lowpass filter for those sounds that only an analog lowpass filter can create). The E-2 gives an extremely realistic acoustic piano sound, and also plays a host of other sounds with excellent fidelity. Some people who saw the E-2 remarked that once you had one, you didn't really need to buy another keyboard instrument...while I'm not sure I'd go that far, if any keyboard can make that claim the E-2 certainly comes close.

Sampling was not just present in keyboards; another "hit" of the show was little sound effects/-percussion boxes. MXR showed their "Junior", a relatively low-cost sampled sound effects generator. You can choose up to four sounds per Junior, but the best part is that these sounds are on replaceable ROMs so that you can easily change sounds. MXR also showed a bunch of new sound ROMs for their drum computer, and appears heavily committed to the concept of user-replaceable retrofits to existing instruments. E-mu showed the "E-Drum", which seemed like a spin-off of Drumulator technology. This is a practice-pad sized box which includes four drum sounds; the trigger pad features limited dynamic capabilities (thankfully, one very positive sign at

Ray Kurzweil with his newest "toy".

The E-Mu booth was buzzing. No, it was not a ground problem.

Where else but a NAMM show could you find a mannequin in a DEVO energy dome pointing at a 10 foot long mock-up of an Omnichord?

Like most synthesizer manufacturers, the Moog booth displayed an abundance of keyboards that could "talk" to one another.

the show was that companies now seem to recognize that dynamics and touch sensitivity are very important in electronic musical instruments). Boss got into the act with the HC-2, a miniature handclap box which didn't use sampled technology but instead used the analog clap sound from one of their rhythm boxes.

Electro-Harmonix demonstrated their new "Super Replay", an improved (studio-quality) version of the "Instant Replay" sampling device. This is an entirely RAM-based box, so if you sample a sound and pull the plug, you lose the sample. But in the E-H tradition, the Super Replay is relatively inexpensive, lots of fun to play with, and easy to use. It also features a touch-sensitive trigger pad.

Sampling devices seem so universal, so interesting, and so laden with possibilities I think that we can expect to see more such devices, with ever-lowering price tags, in the near future. However, the legal, ethical, and copyright ramifications of sampling devices remain somewhat murky -- and I don't expect these complex issues to be easily resolved. If you sample Jimi Hendrix' guitar sound from one of his albums and store that in the instrument, do you owe his estate a royalty? Or only if you play it on a record that becomes a hit? If you sample that sound, but then modify it beyond recognition, does it then become your sound? Will these devices give more power to composers at the expense of playing musicians? I don't have any answers, but sampling devices do raise interesting questions which will eventually have to be confronted.

Computers were everywhere; Yamaha slaved a bunch of DX series keyboards together with an IBM PC.

Analog drum sounds strike back. Another obvious trend at the show was the upswing in analog drum sounds. Yes, the "Simmons sound" is everywhere, to the point where digital drum machines now offer analog drum sounds stored in ROM! (Actually, I think it would be far simpler and cheaper to just build up a bunch of Thomas Henry's "Snare +" circuits if you want some good analog drum sounds...) Unlike sampling devices, though, this particular trend is probably more ephemeral; some people are already complaining that they're getting tired of hearing the same analog drum sounds over and over. Still, I have always felt that analog drum sounds offer more possibilities for imaginative percussion than simply recording an acoustic drum into a ROM, and perhaps we will see a new wave of research into electronic percussion that combines the best of both digital and analog devices.

The Peavey booth resembled something out of a Van Halen concert.

MIDI. But the biggest trend, and perhaps the one with the greatest impact for working musicians, was the emergence of MIDI as a bona fide, accepted specification. MIDI was everywhere -- it seemed that every keyboard, sequencer, and even most drum machines now include MIDI interfaces. It is extremely heartening to see the music industry cooperate on such an important matter, and we all stand to benefit. Before too long, there should also be substantial software support for MIDI devices, and that's when things will really start getting interesting. (This situation reminds me of the early days of home computers, when the computers existed and the software didn't. As more software became developed, computers started taking off. MIDI will no doubt exhibit a similar growth curve as more and more software becomes available for MIDI-based systems.) I won't even attempt to list the MIDI-compatible products at the show because they are literally too numerous to mention. Make no mistake: MIDI is real, and MIDI is here to stay. Support it in any way you can, even if it's just a fan letter to a manufacturer involved in MIDI saying that you think the idea is hot.

SMPL Sync System. Of course, there was more than MIDI, sampling, and little drum boxes. In fact, one of the products that got a big response at the show was the SMPL System, designed by none other than Polyphony publisher John Simonton. Simply stated, SMPL automates many tape recorder transport functions and serves as a kind of "robot tape operator". Features include SMPTE time code generation for recording on one track of a multitrack tape recorder, automatic punch-in, automatic punch-out, search to programmable cue point, programmable metronome, 24 pulses-per-quarter note sync track, eight programmable "events" which initiate individual gate outputs (these gate outputs occur at various programmable times), and several other computer-controlled features. I was fortunate enough to get an early prototype for testing purposes, and I must say SMPL is the greatest thing that has happened to my studio since going from four to eight track -- no more losing sync on electronic drum/sequencer overdubs, no more tedious rewinding to the beginning of a tape to obtain sync with a standard click track, and no more missed punches! I could go on and on (and on) about SMPL, but those who want more information can refer to my review of SMPL in an upcoming issue of Modern Recording & Music.

John Simonton demonstrating a fern (actually, there's a SMPL System behind the fern).

What else was there? Lots. While I didn't get a chance to play it, I did manage to see and hear Roland's new GR-700 guitar synthesizer. What I did hear was impressive, although it sounded as if it may have lost some of the GR-300's more endearing characteristics along the way. I'm eagerly awaiting a chance to check it out further and see what this particular machine is all about.

And then there was the Korg Poly 800, which is a really cost-effective polyphonic synthesizer. And a bunch of new products from Yamaha. Peavey's new digital amp. Extremely low price delays from Delta-Lab. More MIDI compatible instruments from Sequential Circuits. Guitars made out of magnesium. And, and, and, and...

As always, there was lots to see and lots to do. I'm already looking forward to the Summer show in Chicago to see what surprises it holds for us.

NEXT

A Synthesizer Delay Line

Commodore 64 Programs

Wendy Carlos Interview

Guitar Switching Techniques

DSX Modification

in Polyphony

DECILLIONIX DX-1: "DIGITAL RECORDER"

A Review

by: Allen Campbell

Have you ever wanted to pound on a 32-piece studio drum kit via your computer keyboard? Or sequence dogs barking "Pictures at an Exhibition"? Or slow down an insect sound several hundred times to create intense, modulated "African" rhythms? The Decillionix DX-1 is a microcomputer accessory that will let you do all this, and more.

The hardware. The DX-1 is a hardware card that turns your Apple-compatible computer into a digital audio recorder and processor. The DX-1 card can be inserted into any empty slot, even slot zero. One precaution: when installing the DX-1, make sure that its open-frame RCA output jack doesn't short out to a card plugged into a right-adjacent slot (place a piece of paper between cards, if necessary). The card construction is excellent, and features a G-series double-sided epoxy board loaded with premium components; all ICs are socketed.

The board includes several jacks and CIS (commercial interconnection system) connectors for input/output and accessory functions. An unbalanced, low-impedance, line-level output is available at the previously mentioned RCA jack, and an RCA cable is included for connecting this output to the AUX input of your stereo or other amplification system. The output stage uses an LM380 Audio Amplifier IC, and is capable of directly driving an efficient speaker to surprising volume levels. A CIS connector is paralleled with the RCA jack to facilitate attachment of speaker cables incorporating this type of connector.

A microphone input is provided via a 1/8" miniature phone jack (a 1/4" to 1/8" female to male adapter is included). A solderless jumper selects mic- or line-level input gain, and a thumbwheel-adjustable trimpot sets the optimum signal levels for recording.

A second solderless jumper turns on or off a low-pass filter in series with the output, and a second CIS connector allows attachment of the "Echo" feedback potentiometer (an optional accessory).

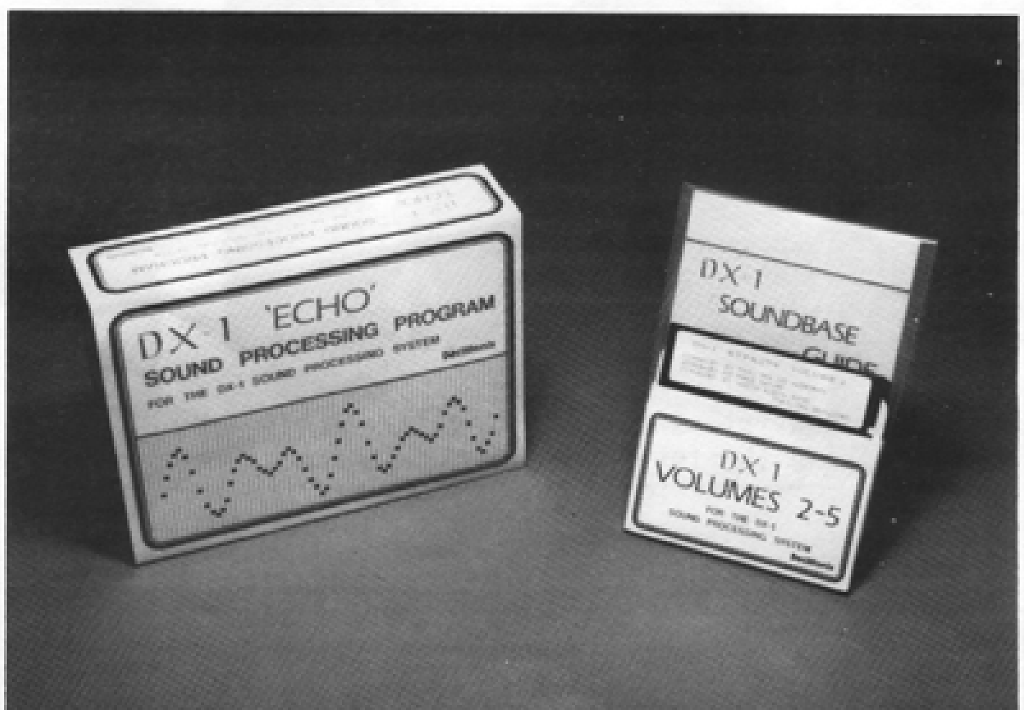
The software. There are five available diskettes of DX-1 software. Each diskette contains a master program called "DX-1 Effects", and three different groups of pre-recorded sounds called "Soundbases." The basic DX-1 System includes Volume 1 of the five diskettes; the other diskettes are available separately as a set, as described later under "Accessories".

Once the DX-1 card is in place inside the computer and a speaker or amplifier connected, you boot the system using the "DX-1 Effects Vol. 1" diskette. To play the DX-1 drum set, select "3" and bang on the ASDFGHJK and ZXCVBNM keys. Wow! How did Carl Palmer get inside the computer?

From any DX-1 Submenu, select "1" to return to the Main Menu selections, including: 1) Sound Samples, 2) Preset Rhythms, 3) Real Time Rec/Play, 4) Autosequence, 5) Record Unformatted, 6) Load/Save Base, 7) Board Slot (=3).

"Sound Samples" plays Soundbase recordings in various patterns. For example, you can cycle through the Soundbase recordings, playing an ascending scale on each in sequence; or play the recordings at random, fast or slow; or play one recording at random pitches, weighted fast or slow. You can also impart a "Roller Coaster" or "Falling Object" effect to recordings.

"Preset Rhythms" is designed to drive a Soundbase of percussive sounds in traditional rhythm patterns, turning the DX-1 into a pseudo-drum machine. You can vary the playback pitch as well as the tempo, play the sounds in reverse, even use non-percussive sounds with preset rhythms. Have you ever heard a Samba of car horns and breaking glass? There's no provision for recording percussion sequences in real-time, however, and there are other limitations of the DX-1 as a "drum machine." You can't play two sounds simultaneously, and changing the pitch also affects the tempo and rhythm. You see, when playing a DX-1 sound, a finite digital recording is converted to audio through a single output channel; and when the pitch (playback rate) is altered, so is



Note: If you would like to hear a pre-recorded demo of the DX-1, call 408/735-0410 (24 hour demo line).

the period of the sound. Some of the preset rhythms are a little weak, but you can program your own using "Autosequence" (see below).

"Real Time Rec/Play" lets you trigger and play the Soundbase recording from the computer keyboard, or record your own soundbase. When played from the keyboard, each sound or chain of sounds is triggered by a pair of adjacent keys (AS, DF, GH, etc.) to facilitate playing drum rolls or other forms of rapid articulation. (The recording process is described later in this review.)

"Autosequence" allows you to sequence recorded sounds. For each event you can control: which sounds are sequenced, the portion of each digital recording that is reproduced, the playback rate (pitch), the "rest" duration before the next event, the playback direction (forward/reverse), and the relative volume. You can program a maximum of four sequences of up to eight events each. A separate subroutine allows you to loop the sequences and play them in programmed order.

Programming an Autosequence can get pretty involved, since the pitch of each sound affects the period, and there's no global tempo control for the sequence. If the tempo is not correct you must reprogram the Autosequence tables -- a significant limitation of the otherwise-excellent software.

"Load/Save Base" will load a new Soundbase from diskette into the machine, or save to disk a Soundbase that you've created. "Board Slot (=3)" allows you to tell the software where to look for the DX-1 card, if the card is in a slot other three.

Recording your own sounds. With the "Real Time Rec/Play" submenu, you can record your own sounds and create your own Soundbase. Seven recording modes determine how the available memory space is to be divided between sounds. There is even a special mode for optimum recording of groups of percussion instruments. This divides half of the memory evenly between six sounds, and the other half between only two, thus allowing recording of six rapidly-decaying percussive sounds and two longer cymbal or bell sounds. If a sound is recorded in one mode and played back in another (via the "Sound Sample", "Preset Rhythms", or "Real Time Play" routines), then each trigger will play multiple or partial sounds.

To record a sound, simply plug in your microphone or instrument, set the appropriate gain, press "R" for "record", and then press the key assigned to the required recording mode. The DX-1 automatically starts recording when the signal reaches a level set by the TRIG LEVEL command. Recording with the DX-1 is not difficult; in fact, it is so easy for the DX-1 to turn normal, everyday sounds into film-quality sound effects that it's bound to make professional sound effects engineers take notice. For highest fidelity, however, you will want to experiment with the REC RATE, TRIG LEVEL, and gain trimpot settings.

You can also record using the "Record Unformatted" submenu. In this case the record modes are totally defined by the user. For example, it is possible to create a single recording occupying an entire soundbase. Of course, your recordings can be saved to disk, regardless of the record mode you use.

DX-1 accessories. The Volume 1 soundbases included with "DX-1 Effects Vol. 1" are: a complete drum kit, some electronic sounds, and some miscellaneous sounds. Four additional diskettes of pre-recorded sounds, "DX-1 Effects Vols. 2, 3, 4, and 5", are available as a set. These would seem to be a must for deriving maximum value from the DX-1. One volume consists entirely of percussion sounds (24 different sounds), and includes some of the best percussion recordings that this reviewer has heard. Another includes music sounds such as piano, sax, harmonica, guitar and bass (both notes and chords), as well as string, bell and horn riffs. Other volumes contain more electronic sounds, "Sounds in Life", "Party Sounds", and my favorite, "Sounds Around the House." This Soundbase causes adult music technologists to roll on the floor in hysterical laughter. It's probably worth the price of the entire system.

The DX-1 "ECHO" hardware/software set is also available as an accessory. The hardware consists of a handheld potentiometer assembly; this corresponds to an echo unit's feedback control, and lets you impart multiple echo repeats and other real-time processing effects. The software is a special diskette that turns the DX-1 into a real-time audio processor. The "Echo" software does not work in conjunction with other DX-1 software, or pre-recorded soundbases. Neither will it allow you to record sounds to disk; "Echo" is strictly a real-time processor.

This accessory has great potential for really bizarre sound manipulation -- it's more than an Apple-ized Echoplex. Although Decillionix disclaims its use as a "studio quality...system", making common sense compromises between the recording rate, signal levels, and filtering can yield "recordable" results. In fact, the main limitation of the "Echo" system is not the hardware or the software, but the owner's manual, which is very cryptic, occasionally erroneous, and generally an example of extremely bad technical writing. In all fairness, the Preface implies that only the basics were intended to be covered, leaving the user to explore the system independently; but the manual fails to accomplish this. With its existing documentation, it would be hard to recommend the "Echo" accessory to the average user.

Conclusions. The DX-1 is a novel, well-designed sound recording and processing device. It seems that the output jack should be insulated on future units -- a minor complaint. The pre-recorded sounds are excellent, and all of the diskettes are directly copyable, thereby allowing the user to make back-up diskettes. Unlike the "Echo" accessory manual, the owner's manual for the DX-1 System is very good, and includes information regarding the theory of operation, tips for writing your own software, and tables of technical data and programming aids.

With a suggested retail of $239.00, the DX-1 is the first microcomputer-based audio recorder/processor with a consumer price tag. The "DX-1 Effects Vols. 2-5" set lists for $79.00, and the DX-1 "Echo" for $149.00. If the DX-1 is as successful as it promises to be, no doubt Decillionix will develop new and more powerful software for the system in the future.

ELECTRONIC SOUND TOY

Bibliography & Final Statement

by: Andrew Gelt

(Editor's Note: Andrew Gelt has reviewed several sound toys in the past for Polyphony.)

At the A.S.U.C. Region IV Conference on November 3 - 5, 1983, at the University of Miami, an audience had the opportunity to hear the premiere of my "Electronic Toy Symphony Op. 39 'Batteries Not Included'" (for tape). The reviews from my peers as well as the newspapers said that among other things, it was "ear-splitting." (Thank you. I wanted it very much to be "ear-splitting.") In fact, it was everything that I wanted it to be, and this is all we can hope for as composers. The selection utilized eight different electronic sound toys (average price, $15.00) and, along with this essay, culminates my exploration into an area which obviously shows my continual reluctance to enter adulthood.

Such devices and their extremely low prices are made possible by the new integrated technology, which has allowed a capacity for memory (as well as miniaturization) previously thought to be impossible. Yet to some of us, it has been available for not yet a decade.

I can't help think that such toys, along with video games, have enabled our children to cope with the frightening phenomenon of future shock. Acceptance of the new is healthy, and hopefully, this will be a perpetual trend as it will truly be our main key to success.

Children now improve on their own computer programs while in their bedrooms, and during leisure hours play games on machines which teach and display the latest software. Computer Science is becoming common at lower educational levels, and universities experience little difficulty with enrollment in this field (don't we wish that this were the case with Music?).

So this is my farewell to the study and examination of these small devices. Perhaps those who have been touched by such machines as "Simon," "Super Simon," "Merlin," and "Milton" have already set them aside for Casios and even more advanced devices -- but this certainly does not diminish the earlier toys' importance.

Our new technology has made the distinction between toys, games, musical instruments, and computers a difficult one. Let us just hope, as we continue to enter this accelerating age, that our children are not so rapidly accelerated into adulthood that they totally lose their childhood.

"Men deal with life as children with their play,
Who first misuse, then cast their toys away."

Cowper, Hope

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Practical Circuitry

EASY FIRING ADSR

by: Thomas Henry

You'll probably think that I have a one track mind, but we're going to look at ADSRs again! Recall that back in the March/-April 1982 issue and again in the June 1983 issue of Polyphony we looked at two distinct approaches to building ADSRs for your home-brew synthesizer. By now you might think that the topic has been exhausted, but I hope that after you see this new circuit you'll agree with me that electronic music design is nowhere near being a finished subject. There are always new circuits out there just waiting to be discovered!

Since the publication of the two aforementioned articles, I've come to discover more and more uses for ADSRs (especially in the area of electronic percussion). Due to this new emphasis in my music, I spend about equal time with my keyboard synthesizer and drum unit, so it's important to me that an ADSR be useable with both systems. Thus, this issue's circuit is called the "Easy Firing ADSR" since anything from synthesizers to drum boxes to computers can fire it. Best of all, besides being a most versatile unit, it is also extremely easy to build.

Figure 1 shows the complete schematic for the circuit. Simple, isn't it? Like many of the circuits described in "Practical Circuitry", the simplicity comes about because we exploit some of the new integrated circuits developed especially for electronic music. The heart of this circuit is the Curtis CEM3310 ADSR chip (see below for availability). This IC contains all of the logic needed for a complete ADSR and requires a minimum of external circuitry. A few pots, a handful of resistors and capacitors, and a few hours of construction time will reward you with a very professional envelope generator.

How it works. Scanning the schematic, note that pins 15, 12 and 13 are the inputs for the Attack, Decay and Release voltages, respectively. By varying the voltages at these pins from 0 Volts to about -240 mV, we can modulate these three parameters over a 2 millisecond to 20 second range. Three identical potentiometer and voltage divider sections provide this control voltage. For example, consider the Attack section consisting of R8, R5 and R1. R8 is a potentiometer which allows you to pick off a voltage between 0 and 15V. Then, divider R5 and R1 attenuate this voltage to an absolute maximum of -240 mV. The sections for Decay and Release work similarly.

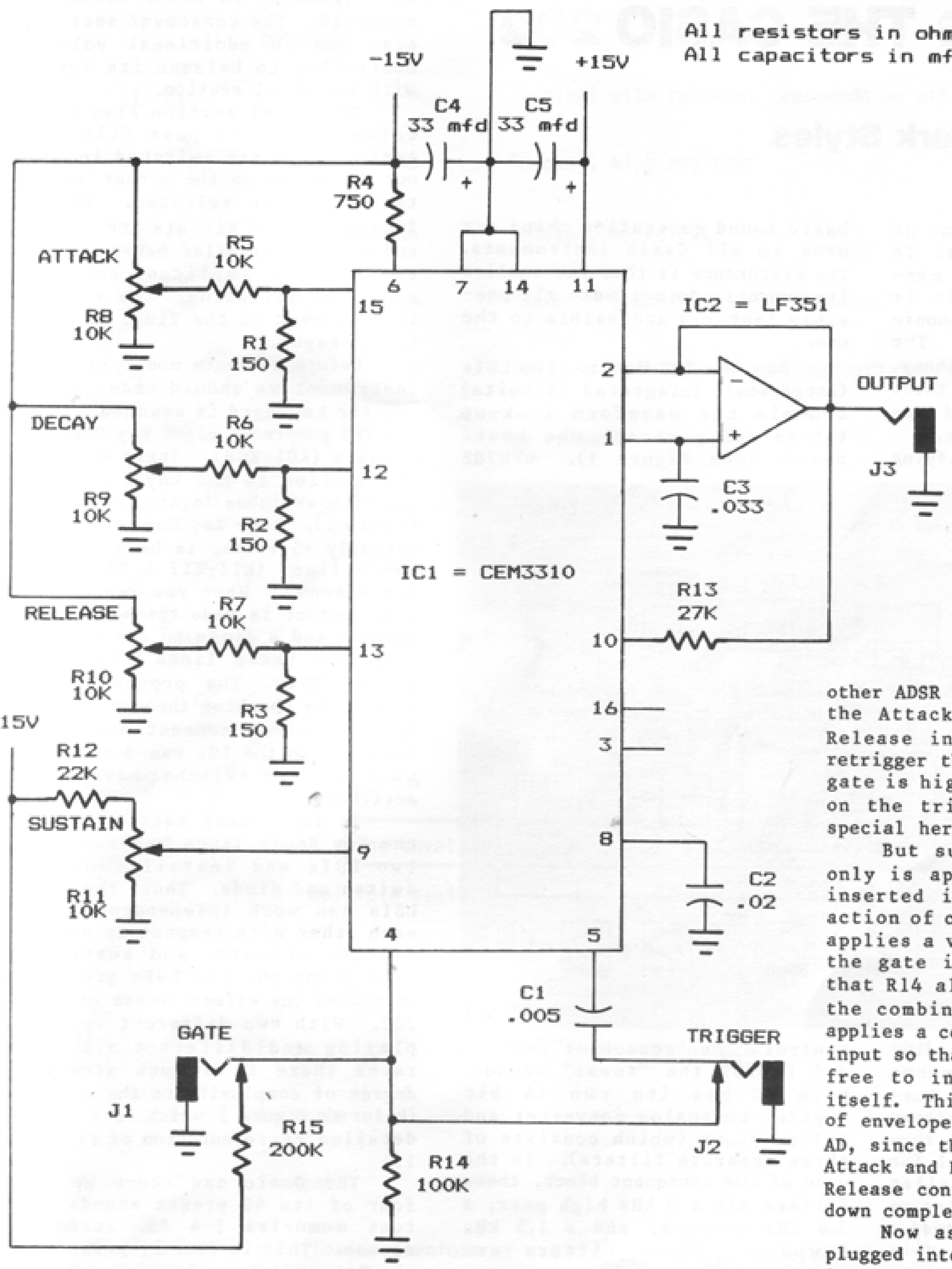
The Sustain control operates in a slightly different fashion. Pin 9 expects to see a positive voltage ranging from 0V to +5V; this voltage is mirrored to the output and sets the output sustain level. R12 drops about 10V from the positive supply, leaving approximately +5V across potentiometer R11.

However, one subtle point that may be of some concern to purists in the crowd is that if the Sustain voltage is greater than the Attack peak voltage, the output waveform will exhibit a "pip" (i.e. the waveform rises to the Attack peak level and then jumps suddenly to the higher Sustain level). Although this "pip" can be quite small (100mV or so), in some applications the resulting distortion might be unacceptable. The spec sheet and application note for the CEM3310* show two ways to correct this problem, but for our purposes a simpler solution is to select R12 so that the maximum voltage across R11 is less than the Attack peak level. According to the spec sheet, the CEM3310 is guaranteed to have an Attack peak voltage between 4.7V and 5.3V. By selecting R12 as 22K, R11 creates a voltage drop of about 4.7V, which is low enough to meet worst-case conditions. This is a quick-and-dirty way to solve the problem, but works quite well and only costs the price of a resistor. Of course this implies that the envelope will only go from 0V to +4.7V (instead of +5V), but for most applications this hardly matters.

Having covered the four input parameters (Attack, Decay, Sustain, and Release), let's take a look at the output. Since the internal buffer of the CEM3310 has a fairly high output impedance, I felt it would be necessary to provide additional buffering through an external op amp. Using the method suggested in the application note, IC2 provides this extra buffering. Notice the unusual configuration in the schematic. The timing capacitor, C3, connects to pin 1 of the CEM3310 and the non-inverting input of IC2. Also, part of the output is tapped off via R13 and heads for pin 10 of IC1. (C3 and R13 are the two principal time constant devices for this circuit and may be experimented with if desired).

Although the main output at J3 is shown as a single jack, I wired five jacks in parallel. Thanks to IC2, we have plenty of drive current available now and it makes sense to provide additional output jacks.

And now is a good time to mention that IC2 must be a FET type op amp. According to the spec sheet, whatever op amp is used here should have a positive current flowing into the input pin and op amps like the LF351 or TL071 meet this condition. Just for the sake of experiment, I tried a 741 op amp and observed that the ADSR locked up on long time settings. So, stick with an LF351 or something similar if you want reliable operation for any setting of the controls.



C2 is not a timing capacitor, but instead compensates an amplifier internal to the CEM3310. Likewise, resistor R4 has nothing to do with the time constant, but is instead a dropping resistor for the internal Zener diode. A value of 750 ohms is recommended for safe operation with a ±15V supply.

How "easy firing" works. Finally, let's examine the input structure and see just what makes this an "easy firing ADSR." J1 and J2 are the gate and trigger inputs, respectively. When both gate and triggers are used, the circuit performs just like any other ADSR would: you can adjust the Attack, Decay, Sustain and Release independently and also retrigger the unit (as long as the gate is high) with another burst on the trigger input. Nothing special here!

But suppose that a trigger only is applied and no jack is inserted in J1. The switching action of closed-circuit jack J1 applies a voltage through R15 to the gate input at pin 4. Note that R14 also ties to pin 4, and the combination of R14 and R15 applies a constant +5V to the gate input so that the trigger input is free to initiate events all by itself. This "trigger-only" type of envelope is commonly called an AD, since the trigger initiates an Attack and Decay. The Sustain and Release controls should be turned down completely.

Now assume that nothing is plugged into J2, and a gate signal is patched through to J1. R15 is now disconnected from the circuit and R14 simply acts as a tie-down resistor; therefore, the input gate signal coupled directly through to pin 4 exactly as it comes from the keyboard or drum box (or whatever!).

Since no jack is inserted, the gate signal is allowed to pass through J2, where it is then differentiated by C1 before hitting

..........continued on page 18

MODIFYING THE CASIO 202

By: Mark Styles

The Casiotone 202 is one of Casio's more exotic products. It is not Casio's usual low end market product, yet at $400 it is cheap compared to other polyphonic instruments on the market. The 202 features eight note polyphony, 49 different preset sounds, three vibratos, sustain and hold options, and a built-in speaker.

The inspiraton for modifying this instrument came after reading an article by Polyphony author Robin Whittle of Melbourne, Australia. He has printed a fourteen page bulletin which explains recommended procedures in detail for modifying several of the smaller Casio instruments. If you plan on doing any Casio modifications, I strongly urge that you get this bulletin. Write Robin for current pricing and availability at 42 Yeneda St., Nth Balwyn 3104, Melbourne, Australia.

I also ordered a service manual from Casio's New Jersey plant. Armed with these two documents, I performed a series of minor operations which have greatly enhanced the value of the 202. Robin's suggestions for the 201-202 and 301-302 were speculation because he had not actually worked on any of these instruments at the time of writing, however, the same basic sound generation chips are used in all Casio instruments. The difference is that the smaller instruments do not make all possible features accessible to the user.

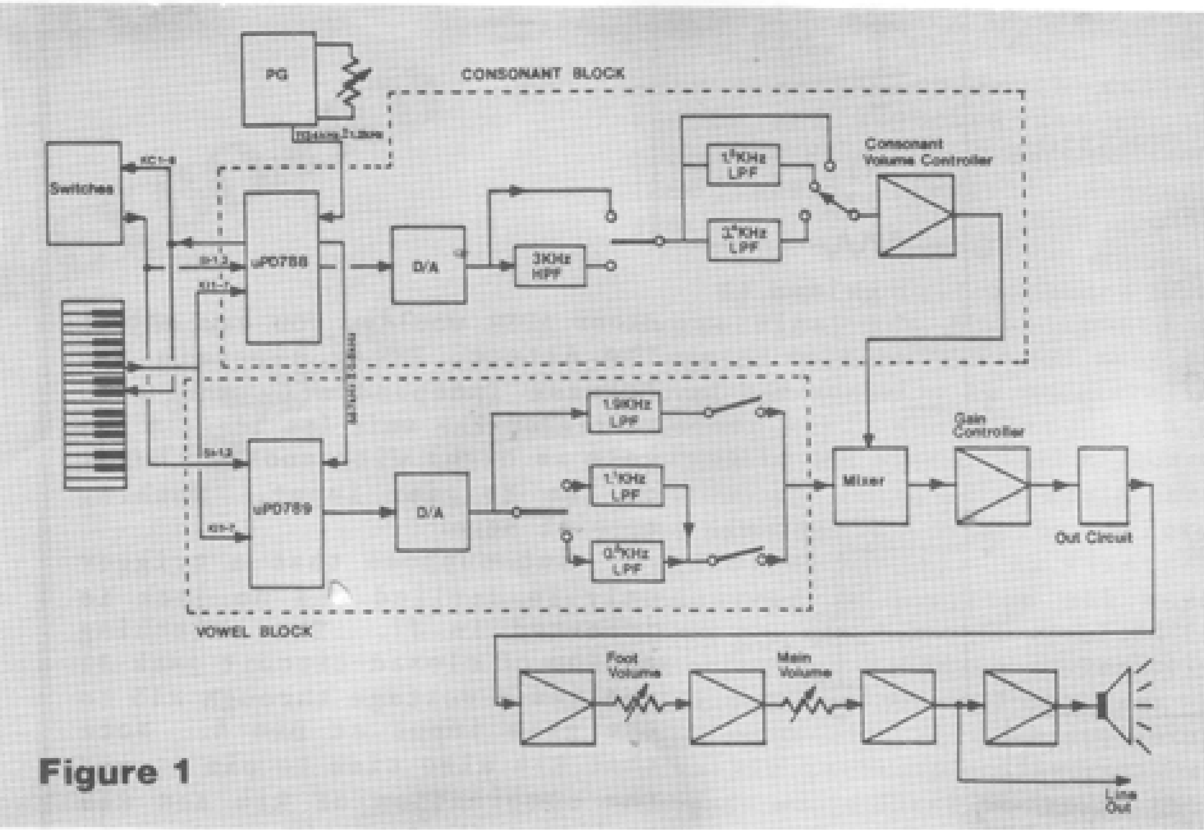


Figure 1

How the 202 Works. Two LSIs (large-scale integrated circuits) contain the waveform look-up tables and generate the basic sounds (see Figure 1). uPD788 controls the "consonant" sounds and UPD789 the "vowel" sounds. Each IC has its own 14 bit digital-to-analog converter and filter block (which consists of three separate filters). In the case of the consonant block, these filters are a 3 kHz high pass, a 3.4 kHz lowpass, and a 1.5 kHz lowpass. These filters are switched in and out by the processor depending on which voice is selected. The consonant section also has an additional volume controller to balance its level with the vowel section.

The vowel section also contains three low pass filters. Again, these are switched in and out depending on the preset sound that has been selected. After filtering, the signals are mixed and a gain controller makes up for the various amplitude changes caused by filtering. The signal is then sent to the final amplifying stages.

Before we begin modifying the instrument we should understand how the keyboard is scanned. LSI uPD 788 generates eight Key Common signals (KC1-KC8). These signals are applied to the keyboard and function switches (again, refer to Figure 1). Each Key Common line, normally +5 volts, is brought low Sense lines (KI1-KI7 & SI1-SI2) are scanned. When you depress a key, contact is made through a Key Common and a diode to one of the nine Key Sense lines which is pulled low. The processor is constantly checking through seventy-two switch connections. In this manner the LSI can determine what notes or switches have been activated.

It is an easy matter to cut the Key Sense lines between the two LSIs and install another switch and diode. Thus, the two LSIs can work independently of each other with respect to voice select, vibrato, and sustain. Separating the two LSIs greatly increases the effectiveness of the 202. With two different voices playing and different vibrato rates there is a much greater degree of complexity to the sound. (Refer to Figure 2 which is a more detailed representation of Figure 1.)

The Casio can store up to four of its 49 preset sounds in tone memories 1-4 for instant access. This is done by pressing the Set switch, selecting a tone

	KI-1	KI-2	KI-3	KI-4	KI-5	KI-6	KI-7	SI-1	SI-2
KC1	C1	C#1	D1	D#1	E1	F1	C5		
KC2		G1	G#1	A1	A#1	B1	F#1		L-SUS
KC3		C#2	D2	D#2	E2	F2	C2	SET	
KC4		G2	G#2	A2	A#2	B2	F#2	M1	M2
KC5		C#3	D3	D#3	E3	F3	C3	M3	M4
KC6		G3	G#3	A3	A#3	B3	F#3	F/D	F/S
KC7		C#4	D4	D#4	E4	F4	C4	S/D	S-SUS
KC8		G4	G#4	A4	A#4	B4	F#4	DROP	

M1-M4 = TONE MEMORY SET SWITCHES
F/D = FAST DEEP VIBRATO
F/S = FAST SHALLOW VIBRATO
S/D = SLOW DEEP VIBRATO
S-SUS = SHORT SUSTAIN SWITCH
L-SUS = LONG SUSTAIN (HOLD)
DROP = SOFTWARE OCTAVE DROP

Table 1

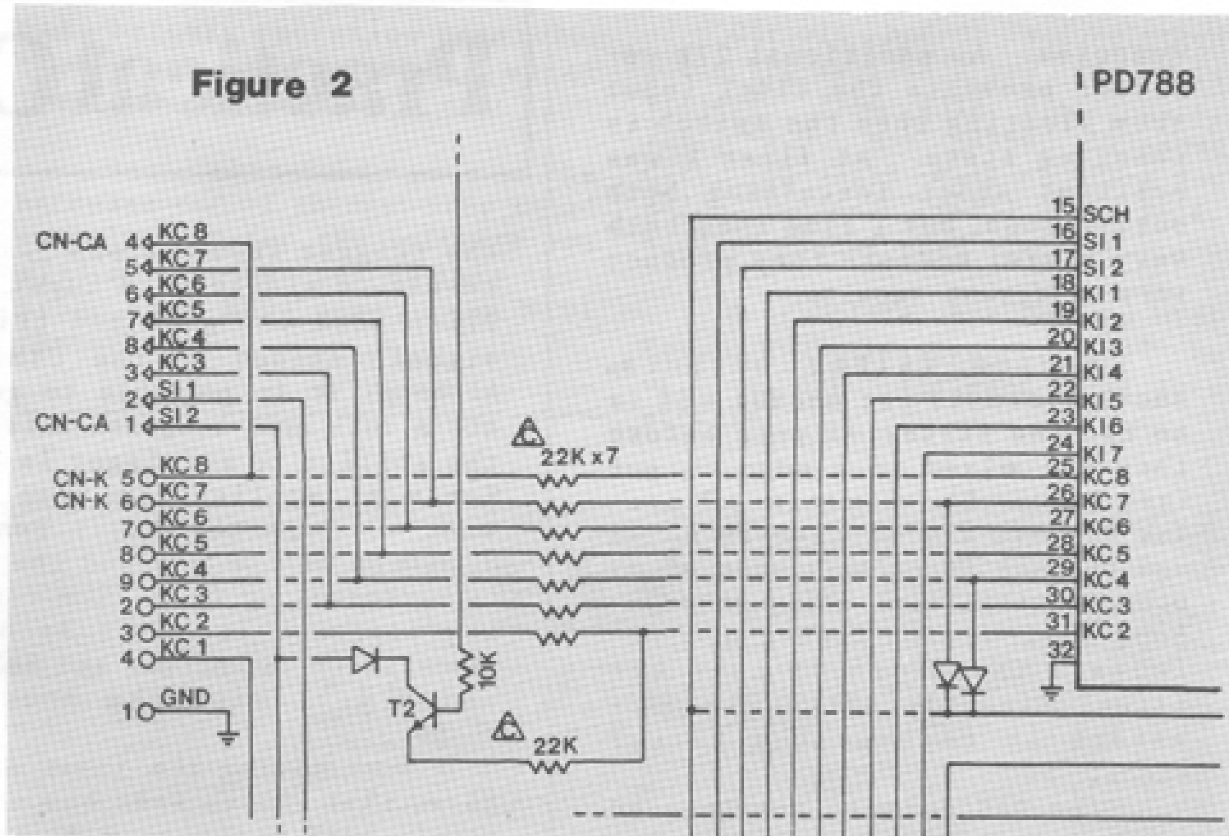
memory, and hitting one of the 49 AGO keynotes. When the Set switch is on all keyboard notes will play middle A to let you hear the sound. Upon returning the Set switch to Play, the keyboard functions normally. Selecting a Tone Memory will instantly give the selected sound when you play the keyboard.

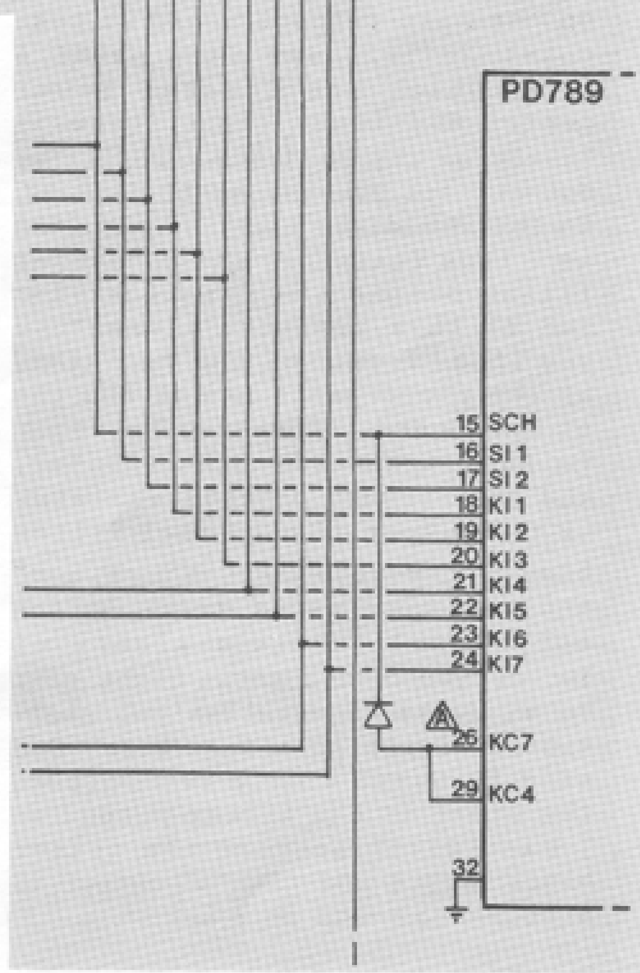
Most of these switches are simple on/off types, however, the tone memory switches are different from the other switches since only one of these four switches can be 'on' at one time (this is similar to car radio tuning pushbuttons). I wanted to add a few new functions and a complete set of duplicate switches beside the originals on the control panel. So, I bought a switch panel which consisted of twenty pushbuttons at an electronics surplus house. I modified this to six switches which now serve as voice select, tone memories 1-4 select, and unison/dual mode option. The unison/dual mode lets the Casio function as it was originally desgned, or with the two LSIs running independently.

As an added bonus, I discovered an additional vibrato function. Referring to the Casio Service manual, I realized that they used a double-pole four throw switch for the vibrato. Since on the LSIs the speed and depth are independent of each other, by using four single throw switches I gained an extra function: a slow, shallow vibrato which is useful when the instrument is running in the dual mode. This is accomplished by shorting KC-6 to SI-2 and KC-7 to SI-1 simultaneously.

To implement a particular function, all you need to do is insert an on/off switch and a diode in series (1N914 or 1N4148) between the Key Common signal and the Key Sense lines. Figure 3 shows a wiring example; realize, though, that you will want to connect the leads to different places according to the function you wish to control. Table 1 shows the 202's key matrix table.

Figure 2





Octave drops. Another option is software octave drop; while different preset sounds use this function, it is not normally accessible so that you can octave drop any sound. To make this possible, add a switch and diode in series between LSI pin 25 (KC8) and pin 16 (SI-1; see Figure 3).

Robin has provided an octave drop by dividing the LSI clock in half using a CMOS 4013 (Dual D Flip-Flop). The hardware drop Robin suggested is particularly interesting because not only does it drop the pitch an octave but the vibrato rate and envelope length take twice as long! It's great for making a big heavy sound. And, because I separated the two LSIs I can drop either voice an octave using the software switch, and drop yet another octave if desired by using the hardware switch.

Figure 4 illustrates the hardware octave drop switch. Affix a CMOS 4013 to the component side of the PC board with double-sided tape and connect the positive supply and ground lines (pins 14 and 7 respectively). The octave drop switch selects between normal and half-speed clock fre-

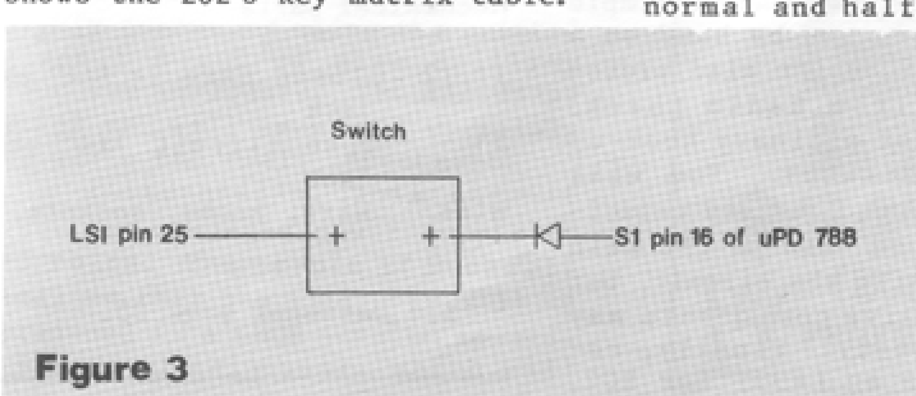


Figure 3

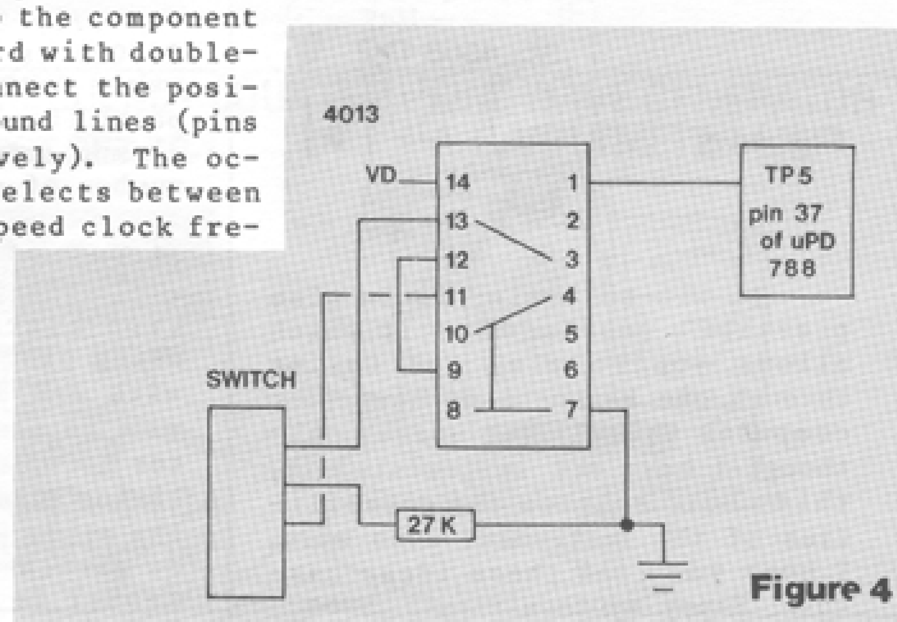


Figure 4

quencies. An additional 27k resistor prevents the clock input from floating when the switch is changing state. At first I was hesitant about installing both octave mods, but I find them both very useful because they produce very different results.

Tapped filter outputs. Another simple yet useful mod is to tap the filter outputs before they are mixed to a mono output (see Figure 5). Sometimes I prefer to take the unfiltered sound and process it through some of my other synthesizers using an envelope follower to create new effects. Therefore, I take the signal directly after the DACs before it reaches the filter block.

The DAC outputs are located on the main circuit board at test point 2 (TP2) and test point 4 (TP4) which are located lower center and lower right, respectively on the pc board. The filter outputs are present at IC 4558-17. To the immediate right of the 4558 is a 100k resistor; the Consonant filter output is present at the end of this resistor closest to you (the "front" of the resistor) if the phone jacks are at the top of the board. The next resistor to the right is a 47k resistor, and the "front" of this resistor is the output of the Vowel Filter block. By attaching wires here and mounting extra jacks on the back panel (there's plenty of room), you're all set. Right next to my jacks I installed two additional single pole switches. One side is wired to the DAC output, the other to the filter output so I can switch between the filter block output and raw DAC output in stereo.

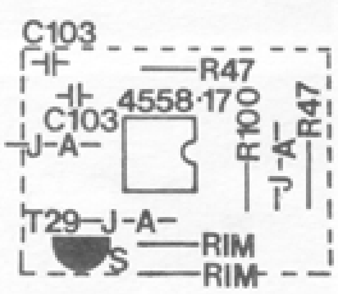


Figure 5

In his bulletin, Robin also presents a coupler circuit which allows you to play two Casios through one keyboard or have your computer trigger the notes. Although I have not implemented it, this would enhance the capabilities of the instrument even more. I hope you find these ideas useful. Happy synthesizing!

Practical Circuitry

....continued from page 15

the trigger input at pin 5. As a result, a single gate input supplies both the gate and trigger signals needed by the CEM3310. Although it is possible to generate a full ADSR response this way, the ability to retrigger is lost. For most applications you will want to turn the Decay control down all of the way and the Sustain control up full. The resulting response is known as an AR since it is the Attack and Release which determine the envelope shape.

Summarizing the input structure, then, we've seen how to get a full ADSR response with both a gate and trigger, an AD response with just a trigger, and an AR response with just a gate. With these three options at your disposal you should be able to interface this envelope generator with just about anything including synthesizer keyboards, the Super-Controller, Micro-Drums and many types of computers.

As a quick review of voltage levels, let's note that the power supply is a bipolar 15V, the gate and trigger inputs should be 0V to +5V level and the output is a nominal +5V maximum. Thus, the "Easy Firing ADSR" is compatible with all of the other circuits described in "Practical Circuitry."

Finding parts for this project is easy. PAIA electronics (1020 W. Wilshire, Oklahoma City, OK 73116) stocks the CEM3310 and they'll throw in a spec sheet/application note when you buy one as well. The LF351 can be obtained from DIGI-Key Corporation (P.O. Box 677, Thief River Falls, MN 56701) as well as from several other dealers. All of the other parts listed in the parts list are common and may be obtained from a number of sources.

Since this was such a simple circuit, I built it by hand on a small piece of copper clad prototype board (from Radio Shack) using pieces of ordinary hook-up wire and flea clips. You will want to use a good quality capacitor for C3 since this is the main timing element in the circuit, but the other passive components may be garden variety. Finally, remember to use an LF351 for IC2, and by all means use sockets for both ICs.

I mounted my ADSR behind a standard 1-3/4" by 19" rack panel and used epoxy paint and dry transfer letters to complete the project. Since I had a little extra panel space left over, I added an uncommitted 100K pot with an input and output jack. You might want to add this too, since a spare attenuator can come in handy from time to time.

And that's it! While a very easy project to build, there is no doubt that this is a fine ADSR. Due to advances in integrated circuit technology, small circuits often yield very professional results and this circuit is no exception. Give it a try and see if you don't agree that the Easy Firing ADSR is a great add-on to any system!

Parts List

Resistors

R1-R3	150
R4	750
R5-R7	10K
R8-R11	10K potentiometer
R12	22K
R13	27K
R14	100K
R15	200K

Capacitors

C1	0.005 uF
C2	0.02 uF
C3	0.033 uF poly or mylar
C4,C5	33 uF 16V electrolytic

Semiconductors

IC1	CEM3310 ADSR IC
IC2	LF351 Bifet op amp

Mechanical parts

J1,J2	Closed circuit 1/4" phone jack
J3	Open circuit 1/4" phone jack
Misc.	Wire, knobs, sockets, etc.

* See **Databank** page 23.

LOW BUDGET SEQUENCERS

by: Bill St. Pierre

Mention the word "sequencer" and most of us immediately think of those slick little digital versions, with their 250 note memories and calculator displays, merrily outputting stored bass lines on through the night. They never tire and they never miss a beat, although for this reason they are sometimes criticized for being too cold and mechanical sounding. Detractors aside, this particular type of controller is extremely versatile and very useful in filling out the sound of a small band. Not only that, it's downright fun to play with sequencers!

With the magic of the microprocessor at its disposal, the digital sequencer is usually capable of remembering long event sequences, loading notes directly from the AGO keyboard, automatic transposition, and other such nifty tricks. Unfortunately, a complete digital sequencer set-up is not cheap; but hold on. Before digital, there were analog sequencers which are invariably cheaper to buy than full-blown computer systems. Computers are wonderful -- I've had one hooked into my synthesizer set-up for a while but when I first started out I couldn't afford it. So, as the title has indicated, we'll be discussing low-cost sequencers -- how to build them, and what performance compromises you may expect.

The basic analog sequencer definitely has some limitations. One problem is rhythm. Let's say you'd like to lengthen a note, or put a rest somewhere in the sequence. Since most analog units output a trigger pulse with each step, even if you set two adjacent stages to the same note voltage, a longer note won't be the result. Instead, it will fire its associated ADSR twice in that time. What about rests? If a particular sequencer stage is set at zero volts, then its associated VCO will produce no sound at that point. Unfortunately, even though the VCO is silent, a trigger pulse still fires the ADSR, which in turn activates a VCA and a VCF, which means that your ears are greeted with residual noise from the filter being gated though the VCA...so much for syncopation.

How about transposition? One common sequencer application is repeating bass line effects. Unlike the human bass player, however, a sequencer keeps repeating the line over and over again, in the same key! This, as you would imagine, has a tendency to be less than interesting.

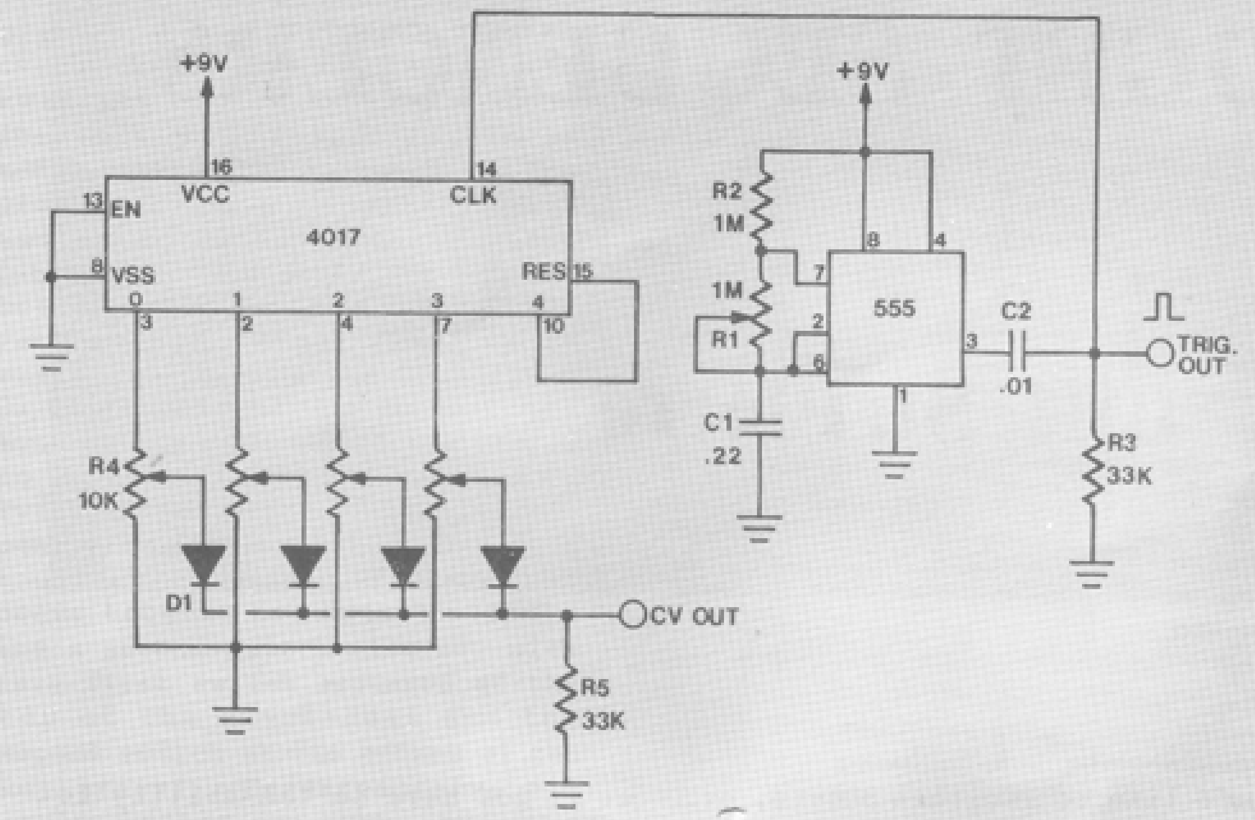
There are ways around these problems, of course, but these solutions involve multiple sequencers and special features. In other words, more bucks!

The syncopation problem can be alleviated with two sequencers synchronized to each other. One puts out the normal VCO control voltage and the other feeds the input of a voltage controlled clock module which, in turn, clocks the two sequencers. What we've got here is the ability to adjust the amount of time spent at each stage before proceeding to the next; however, the syncopation is not accurate to an external metronome reference, and you need two sequencers and a special clock module.

The transposition trick can also be tackled with two sequencers if you have an exponential response system. This time, instead of being hooked in parallel, the second sequencer is clocked by the last stage of the first sequencer. Summing both voltage outputs together equals the absolute control voltage output. Every time sequencer #1 completes a run of the sequenced melody, it clocks #2 to a new output voltage which "transposes" the sequence by a certain amount. However, this only works with exponential response equipment in which summing in 1/12th of a Volt will transpose a bass or melody line by one half-step. Linear systems such as PAIA'S 4700 series don't take to this practice well, and they let you know by sounding out of tune.

Both of the above solutions will work but are limited. Most importantly, they involve extra equipment which means extra cost. However, with a little work it's possible to build an analog sequencer which is both versatile and low in cost. What we're going to do is take a look at some sample circuits, starting simply and then adding in some special features.

FIG. 1



The circuits. Figure 1 shows a four-stage model that uses only two ICs, and could easily be expanded to 10 stages with the addition of a few more pots and diodes. Of course, it is missing a few features which would make it easier to set up and adjust, but for a simple starting point it works just fine.

On the right we see that jack-of-all-trades, the 555 timer, set up as an astable multivibrator (refer to **Databank**, p.23, for IC pinouts.) C2 and R3 form a differentiator that gives us both the sequencer clock pulse and a trigger pulse to fire external ADSRs. C1, R2 and trim pot R1 control the clock tempo. This clock pulse line feeds the clock input of the 4017 divide-by-10 counter.

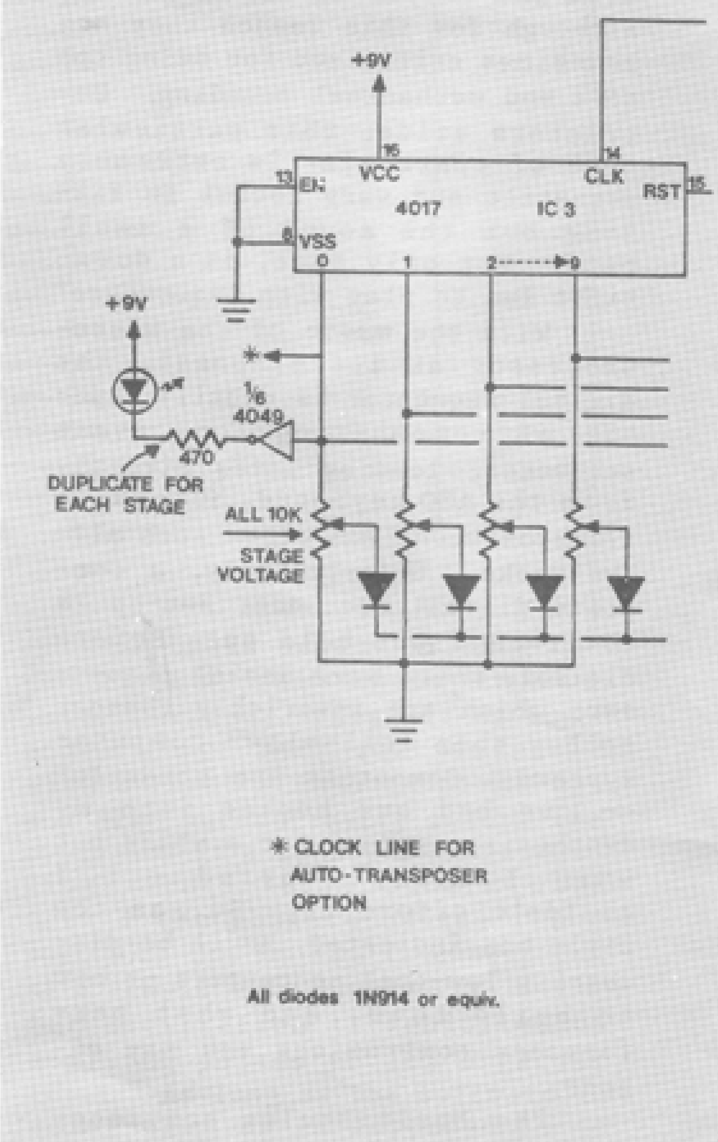
The 4017 has 10 output lines, 9 of which are low at any given time while one of them is high. With its enable input held low, each input clock pulse advances the high voltage from output #0 to #1, from #1 to #2, etc. After the output pulse on line #9 occurs, the 4017 recycles back to output line #0 and repeats the cycle for as long as the clock is going. For a four-stage sequencer, connect the line from output #4(pin 10) to the reset input (pin 15). As long as reset is low, everything will operate normally but as soon as pin 15 goes high the 4017 resets, which begins the sequence again with a high voltage pulse at the #0 output. The reset line, then, enables us to select the number of stages for the sequence from one to ten.

I hope you're still with me here -- the 4017 counter is the heart of our sequencer, so it's important to understand how it works. Now let's consider how to derive control voltages. Consider 10K trimmer R4; with output #0 High, there's about 9V sitting across this resistor. We're using R4 as a voltage divider with its wiper picking off different voltages ranging roughly from 0 to 9V. Diode D1 provides a blocking function to prevent interaction with the other stages. The voltage from R4 passes through and is summed onto a common buss, ground referenced by R5 and finally presented for your use as CV_{out} (Control Voltage Out). As the counter's outputs are sequentially clocked, each trim pot is successively activated, emitting the selected voltage onto the control voltage buss.

Now, if you were to wire up a sequencer as shown, it would work but not very elegantly. There's no single stepping feature to allow holding one stage active, tuning it and leisurely proceeding to the next. What makes it even worse is that there aren't any indicator lights to tell which stage is active at a certain point in time. Obviously improvement is needed, so on to Figure 2.

This circuit incorporates the basics of Figure 1 and also adds some of the needed features I just mentioned, along with glide and syncopation. An automatic transposer will be discussed later in this article.

The 4017 counter (IC3) is laid out similarly to our first circuit, but look at the output #0 line and note that there are two new connections. One is part of the Auto Transpose feature and can be ignored at this time. The other goes to a 4049 CMOS buffer/-inverter. When output #0 goes high, the 4049 inverts this to a low and proceeds to sink current though an LED by way of a limiting resistor. By duplicating this circuit at each stage, every time that stage is active, its associated LED will light up. This not only shows which stage is on, but also looks really great when the sequencer is running. (It sort of resembles a miniature



theater marquee.) Anyway, the 4049 inverters come six to a package, so there's no problem with using a bunch of them.

Next, notice that all of the output lines have connections that split off and run to the right, and which then go to the Recycle switch. This switch connects to IC3's reset input and selects the number of stages in your sequence. Now, go back to where we just split off and continue to the right. (Please note that not every output line is shown. This is to reduce clutter and to save me, and you, a lot of eye strain.) This leads to clock generator IC1, which is still an astable 555 timer but this time, the upper timing resistor has been replaced by a bunch of 1M trimmers and diodes. This converts the 555 into a crude voltage controlled clock: instead of the timer charging its capacitor, C1, with V_{cc}, it now gets its charging current from IC3 through the 1M trimmers labeled "Stage Duration." Whenever a stage becomes active, IC1 gets its timing current through that stage's respective Duration trimmer. The greater the resistance, the longer the amount of time that particular stage is active, thus giving us syncopation. Now you are no longer tied to a monotonous beat, but are free to set all kinds of unusual rhythm patterns. (Note also that trimmer R1 sets the overall rate of the clock although there is some interaction between it and the Duration trimmers.)

The output of the clock generator feeds one side of a center off, SPDT switch (S1). One side is labeled Run, and like its name, lets the sequencer free run through its stages. The center off position is selected when you want to use an external clock. Note that the external clock input and trigger output are shown matched for PAIA'S signal conventions. Those of you needing Moog Type S compatibility can use the modifications shown along side. These will accept and generate active ground triggers.

The other side of S1 (Step) connects to IC2, another 555 timer. This serves as a debouncer for the Single Step pushbutton (S2) by swallowing any noise spikes generated by the button and delivering nice, clean logic levels. When you press S2, pin 3 jumps to 9 volts. When it's released, pin 3 drops back to 0 volts. Speaking of noise spikes, it's good practice to connect a 0.1 uF capacitor across the 555's power pins (1 and 8), as close to the chip as possible. This helps inhibit the 555's tendency to generate pulses back into the power supply line.

The last Figure 2 detail we will examine is the control voltage output. R2 and R3 form a voltage divider to keep the output between 0 and 5 volts, which PAIA modules need. By shorting out R2, the voltage swing will approach 9 volts, a range that's useful for some brands of equipment. IC4 is a 741 op amp that merely buffers the control voltage. At its output is the straight, unmodified CV_{out}.

IC5, a lag amp, optionally adds glide effects by permitting

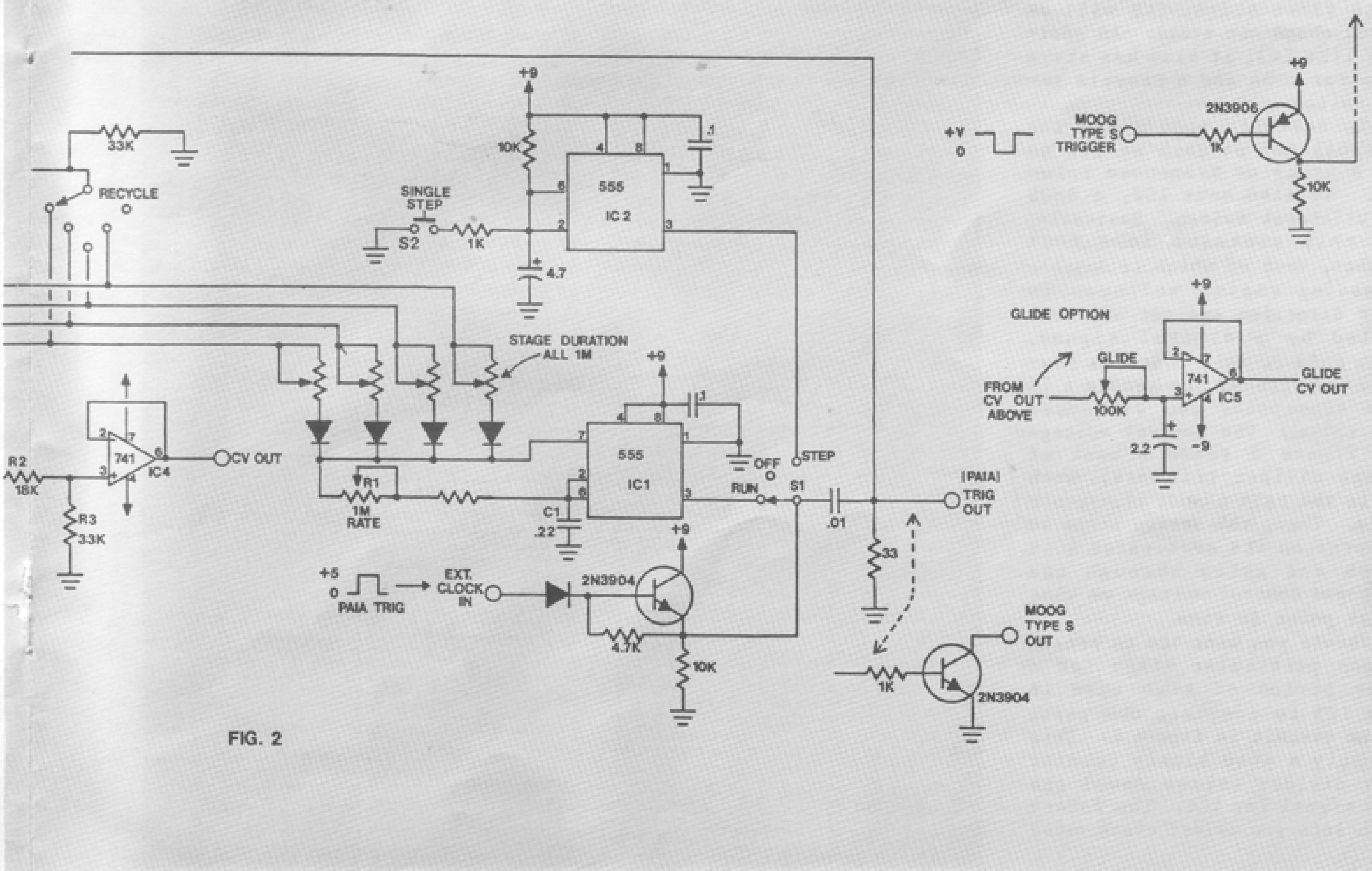


FIG. 2

one to variably increase the amount of time it takes for the control voltage to settle to a new level. This circuit is identical to that which PAIA uses in their Glide Retro-Fit kit.

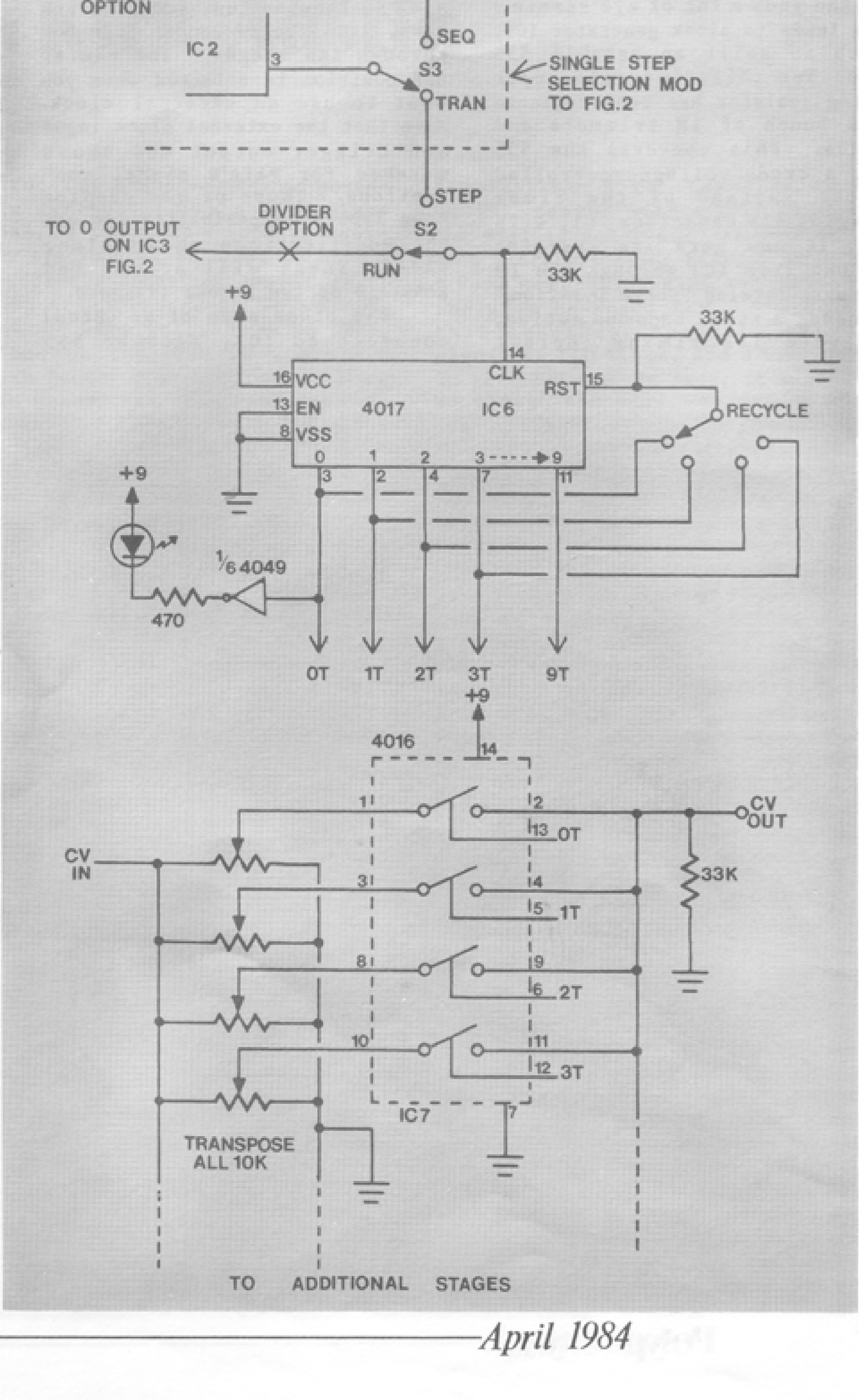
That takes care of Figure 2. At this point we have a functional sequencer circuit that incorporates such features as stage indicator lights, a single stepper, glide output, and built-in syncopation capability. You could stop right here, build it as described, and end up with a very useful addition to your module complement. However, remember the optional Auto Transposer mentioned earlier? Take a peek at Figure 3 and let's see how it works. Again, we are using a 4017 counter as a type of sequencer, only this time we'll be stepping through stages of transposition instead of note voltages. Our clock comes from S2, a SPDT switch, which is installed at IC2's output. This way we can use the same single step pushbutton for either the sequencer or the transposer. The other side of S2, called Run, connects to the output #0 pin of IC3. Now, whenever IC3 steps through its sequence and recycles to its first stage, IC6 will be clocked ahead one stage. In addition, like IC3, it also has stage indicator LEDs and a Recycle select switch.

To actually accomplish the transposition at each stage, we have a group of Transpose trimmers. We also have IC7, a CMOS quad bilateral switch. Basically, this chip contains four SPST switches, each of which is capable of passing analog voltages in either direction and yet are controlled by a digital signal. (Since this IC only contains four of these switches, to handle a 10 stage transposer you will need three chips.) The control voltage from Figure 2 feeds a bank of voltage divider trimmers, much like in the PAIA manual transposer module. Then, the active stage in IC6 turns on its associated 4016 switch and gates through the transposed control voltage we want at that point in time.

Should you want IC6 to remain at each particular stage for a longer period of time than it takes IC3 to complete one pass, add the circuit in Figure 4. This is simply a 4040 binary counter which divides (slows down) the clock signal for IC6. The rotary switch lets you select clock rates from straight all the way to divided by 32, which is probably more than enough range for anybody.

Construction. There is nothing particularly touchy or critical about these circuits, nor is any calibration necessary. The CMOS ICs are pretty hardy and not very noise sensitive -- just be sure to keep them in their conductive foam until it's time to install them, since CMOS is susceptible to damage from static electricity. Sockets are recommended, if only for peace of mind should problems crop up at a later date. Sprinkle a few 0.1uF disc capacitors around your board, hooked across V_{CC} and ground. This will help eliminate possible noise spikes. All the parts are available at your local Radio Shack.

FIG. 3
AUTO-TRANSPOSER OPTION



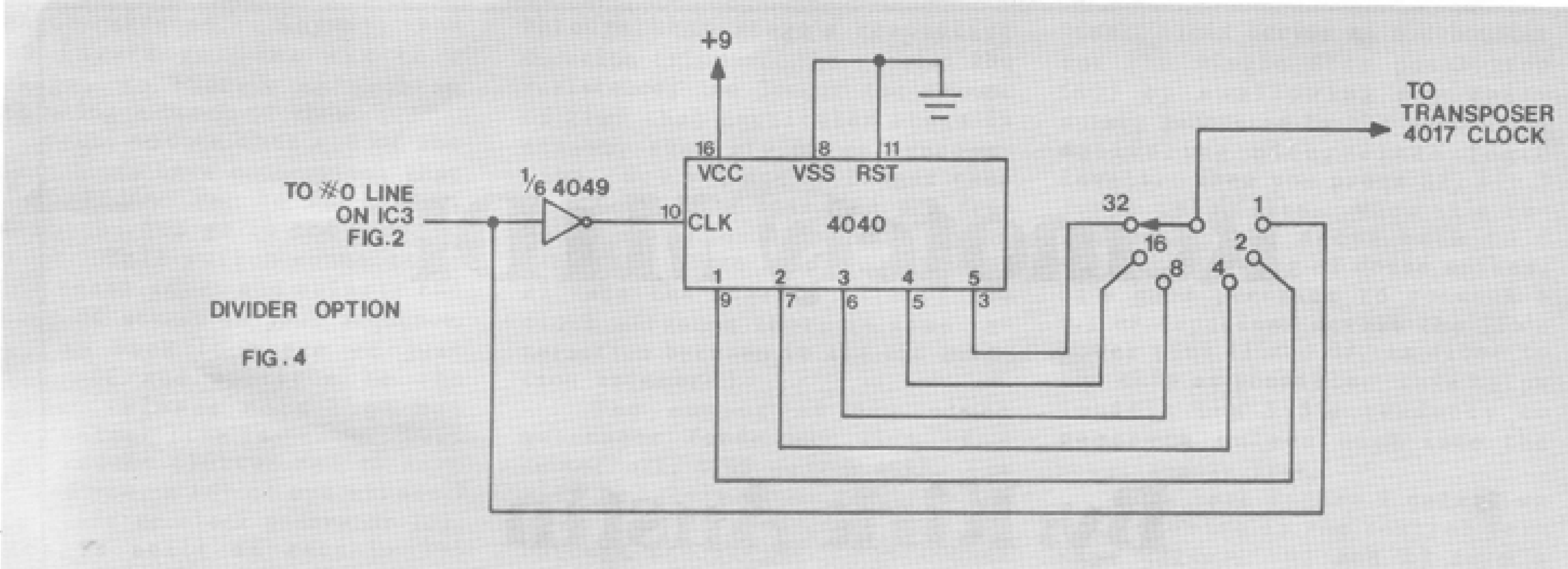
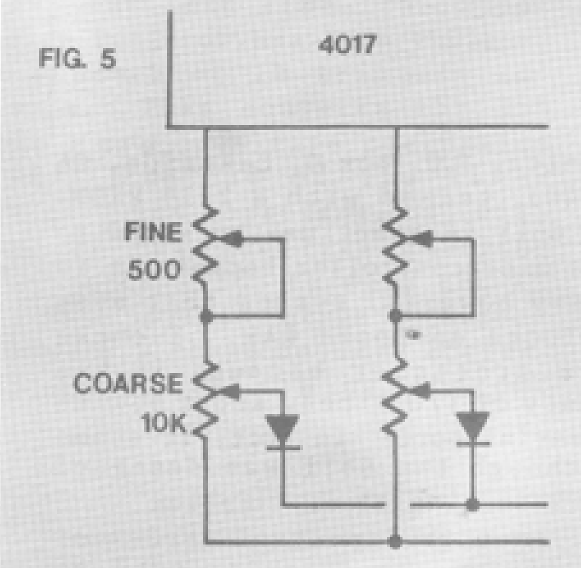


FIG. 4

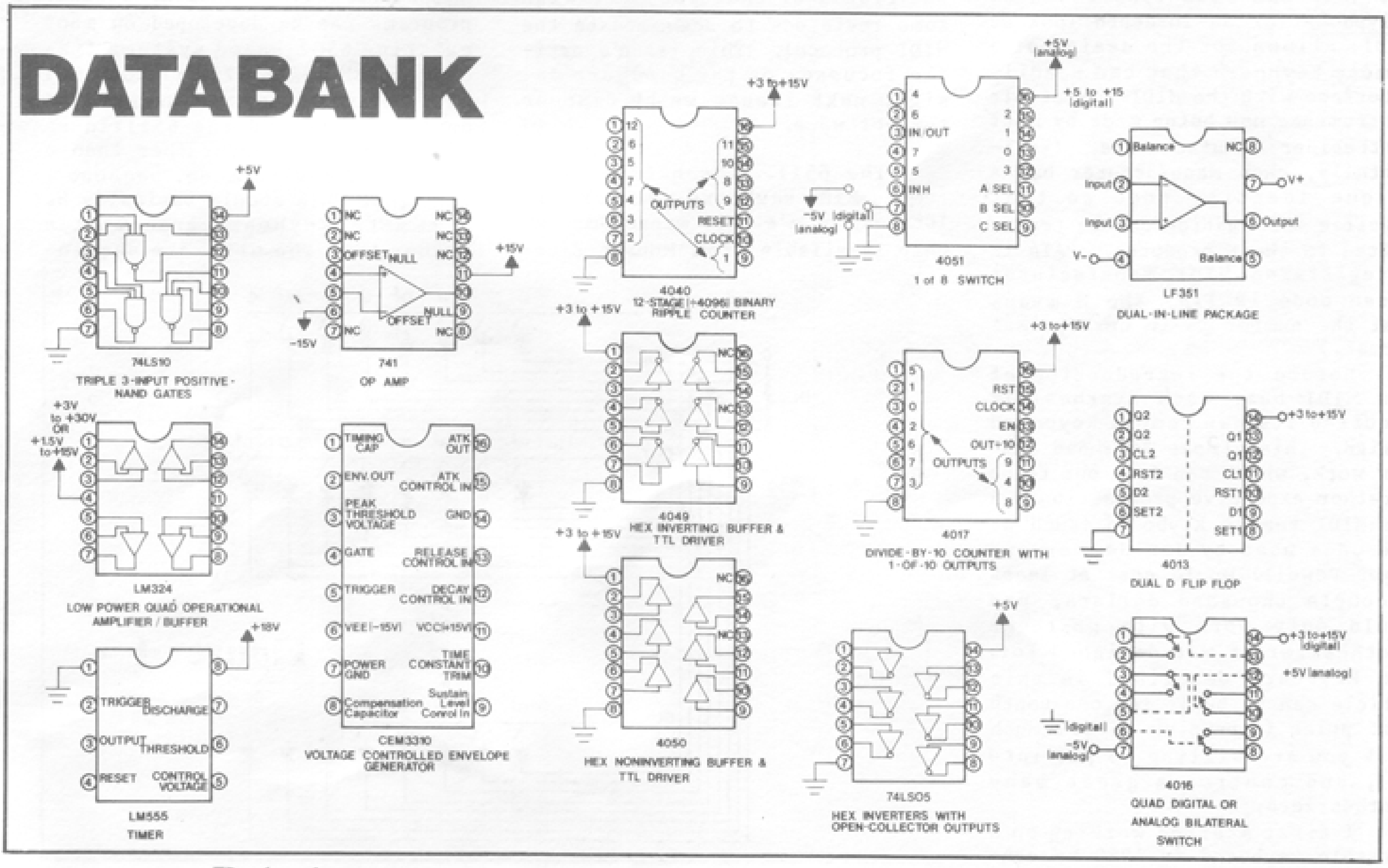
FIG. 5



If you find tuning each stage a bit tricky, wiring a 1K trimmer in series with the 10K trimmer gives you the equivalent of a coarse and fine control as in Figure 5. As always, this increases the price. And speaking of money, instead of using potentiometers and knobs, you might consider using trim pots. These do have to be adjusted with a small screwdriver, which could be a nuisance, but they cost about a third of what you'll pay for the pots and knobs. In a live performance situation there might be several of these sequencers preset and waiting to be activated. In a home studio, time isn't so critical compared with saving a few bucks, right?

Well, there you have it: a low budget, high performance, do-it-yourself analog sequencer. The built-in Syncopator and Auto Transposer are features that would be hard to find on most commercial models. To repeat myself, sequencers are extremely handy to have around and can be fun as well...-and in my opinion, that's a good enough reason to build something.

DATABANK



Remotely MIDI

By: Kirk Austin

Would you like to control complex synthesizers from a lightweight, portable keyboard? Or even control drum machines from this same keyboard? While the idea of a portable keyboard instrument is certainly not new, it is only now possible to build one for a reasonable price that will work with a variety of synthesizers. What makes this all possible is, in a word, MIDI. This standardized communications protocol (see the June 1983 issue of Polyphony for an in-depth look at MIDI) allows for the design of a remote keyboard that can readily interface with the MIDI-compatible instruments now being made by most synthesizer manufacturers. (Incidentally, each manufacturer has a unique identity code so that specific information can be transmitted to their products. PAIA is a registered MIDI manufacturer whose code is 11H; the H means that the number is in hexadecimal format.)

Before the introduction of the MIDI bus, each synthesizer required its own remote keyboard design. This almost demanded custom work, which can turn out to be a rather expensive proposition. A pre-MIDI remote keyboard (such as the ones used by Jan Hammer and Roger Powell) would cost at least a couple thousand dollars, and would only work with whatever synthesizer it was designed for. The keyboard described in this article can be built for one tenth that price (depending on how much work you are willing to put into it), and control a great many synthesizers.

I first started working on a portable keyboard in 1980 by constructing a self-contained portable synthesizer in a fiberglass case. I included a cordless guitar transmitter in order to have a cordless synthesizer that I could hang around my neck; it worked, but not very well. Then in 1982, I became involved in a project with former Polyphony editor Marvin Jones that required a remote keyboard interface using a serial communications scheme. The keyboard covered in this article is the result of that project, with some revisions to accommodate the MIDI protocol. This issue's article focusses on the hardware design; next issue, we'll discuss the software.

The 6511. The heart of the remote MIDI keyboard is Rockwell International's 6511 microcomputer chip (available from Mouser Electronics, P.O. Box C, Lakeside, CA 92040), teamed with a 2716 PROM. The 6511 is sometimes referred to as a microcontroller because it is a very powerful system that even includes on-board RAM. I chose this processor because it has plenty of I/O lines, and a built-in serial port. In fact, it seems as though the 6511 was designed for this kind of application.

Another important aspect of the 6511 is that it is software compatible with the 6502, so that programs can be developed on many existing 6502-based systems (including the PAIA 8700 if you happen to have a PROM burner). I have implemented the 6511 in an I/O intensive mode, rather than a memory intensive mode, because I feel that this should basically be a remote keyboard transmitter rather than the ultimate sequen-

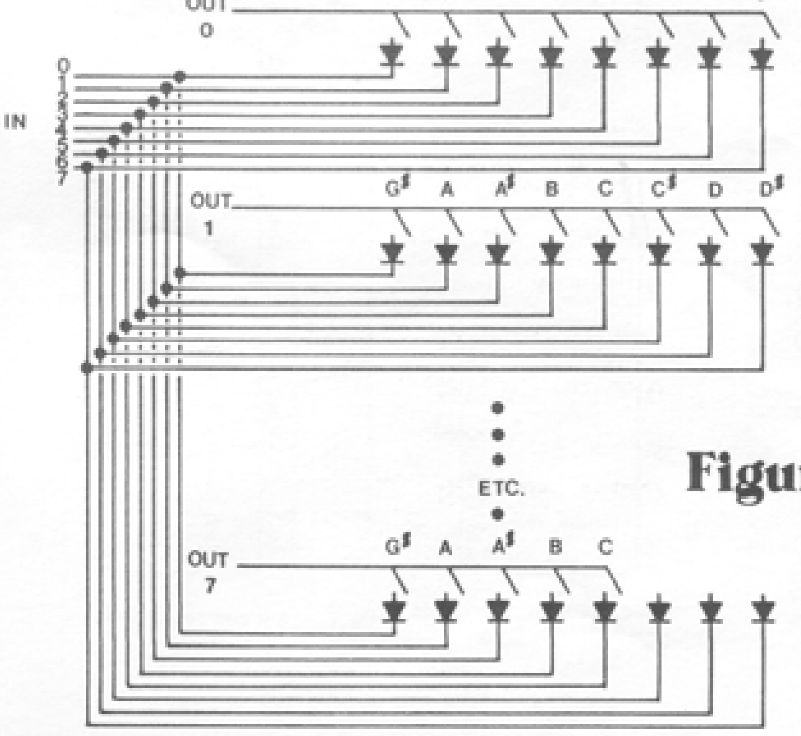
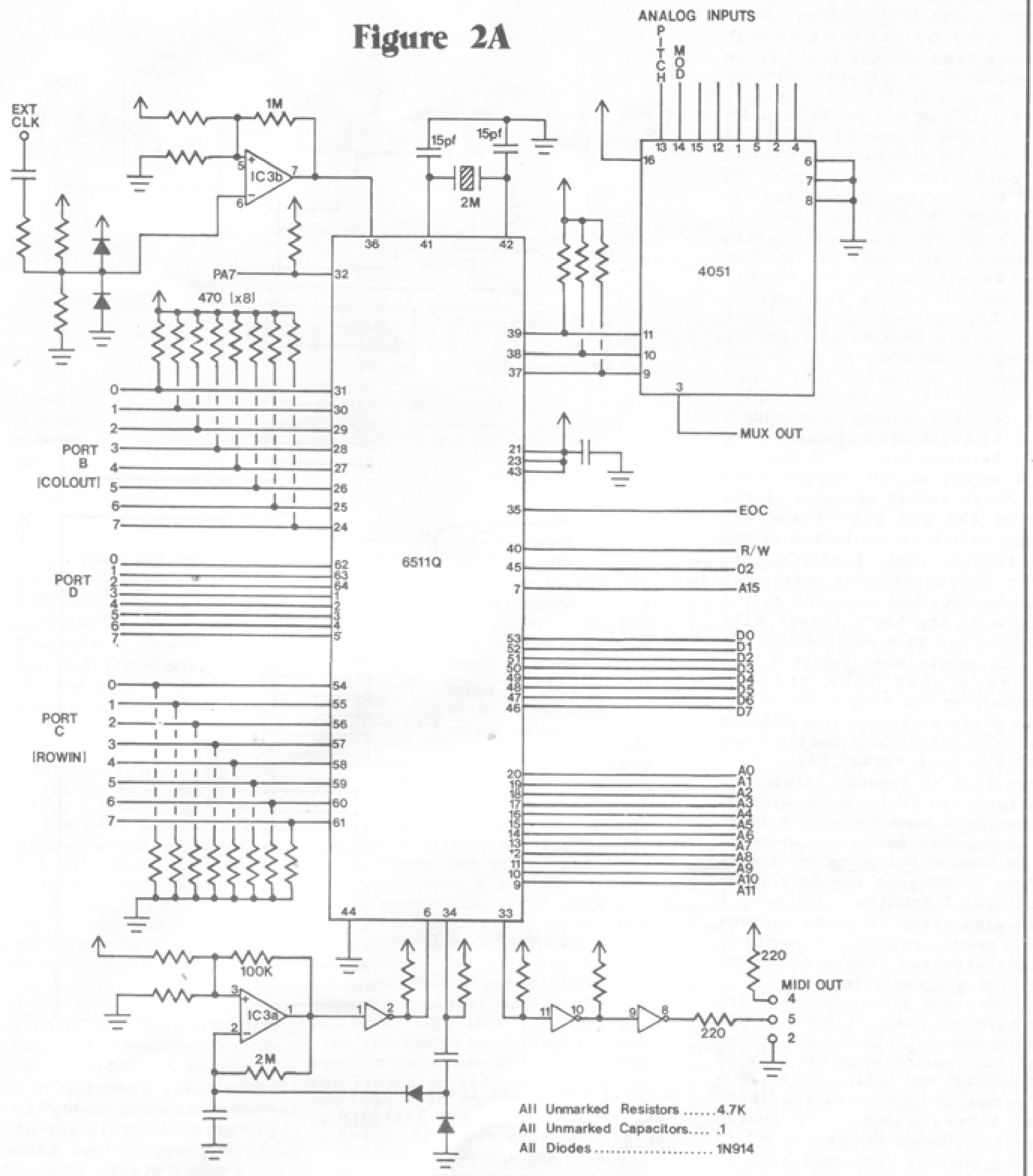


Figure 1

Figure 2A



cer. (In my opinion, a sequencer project should be a stand-alone module based on a processor with vast memory resources such as the Motorola 68000.) With this philosophy in mind, the remote keyboard circuit is purposely limited to scanning many inputs and transmitting that information over a MIDI cable. However, it is still a pretty powerful device, and even includes special function keys that give the ability to control a MIDI sequencer from the remote keyboard.

How it works. Although the design itself appears straightforward, it took a rather long route to get there. Basically, the 6511 processor and 2716 PROM transmitter handle everything except the pitch and mod wheels. The keyboard is arranged as a bunch of SPST switches and appears to the processor as eight input lines and eight output lines (see Figure 1). This is called a matrix configuration, and allows the processor to check the status of each switch on a five octave keyboard without having to use 61 I/O lines. Each of the output lines is taken high one at a time and the input lines are examined by the processor, so even though the 6511 only looks at eight lines at a time it ends up checking the status of all of the switches by the time it's done. The only part that needs to be added between the keyboard and the processor is a diode for each switch to decouple the signals (otherwise, you would get phantom notes resulting from sneaky current paths). Since there is an extra I/O port on the 6511 (port D) it is possible to do velocity sensing for each key if you happen to have a keyboard with two switches per key. You can implement velocity sensing by keeping a count of the number of scans that occur between one switch closure and a second switch closure, with this first switch actuated at the top of the key travel and the second switch at the bottom of the key travel. Unfortunately, old style keyboards that have two switches per key actuated at the bottom of the key's travel will not work for this application.

To create some function keys (to do tricks like program changes), we can wire eight calculator style keys into the existing keyboard matrix and enable them with the line marked PA7. What these keys do depends totally on the software running the system. If you have some particular ideas as to possible functions, write to me in care of Polyphony and I will try to incorporate the most popular ideas I receive. For now, I have used three of these buttons for remote sequencer control (start,stop,and continue) and the rest for program selection.

When the processor completes the keyboard scan, it looks at the analog controllers and digitizes that information with the help of the ADC0804 and 4051. The ADC0804 is an analog-to-digital converter that likes to see a low source impedance (hence the op amp buffer on the input). Its operation is pretty straightforward -- writing to it starts the conversion, and when the EOC line goes low the data is ready. The 4051 switches between the pitch wheel and the mod wheel on the standard interface, but this same circuitry could possibly be used to develop a polyphonic pressure sensitive keyboard. Although I have not tried this as yet, it seems to me that a bunch of pressure transducers could be built using conductive foam, and their outputs matrixed just like the keyboard except that they could be routed to the 4051 and scanned to provide a separate pressure value for each key. This would take an unbearably long time if you had to do a conversion on each key, but all you really need is to do a conversion on each key that is depressed. Since there are usually no more than eight keys down at the most, this process would take less than 1 millisecond.

The 6511 is really a great chip, but even great chips can use a good supporting staff. The circuit built around IC3A is referred to as a "watchdog" in computer circles. This set of components provides the processor with a reset signal on power-up, and also automatically resets the processor if a faulty power condition occurs (8700 owners will notice the absence of the reset button). The op amp is configured as a simple square wave oscillator but oscillation is inhibited by applying pulses to the negative input. As long as the software is doing what it is supposed to do there will be a stream of pulses to the op amp. However, if the

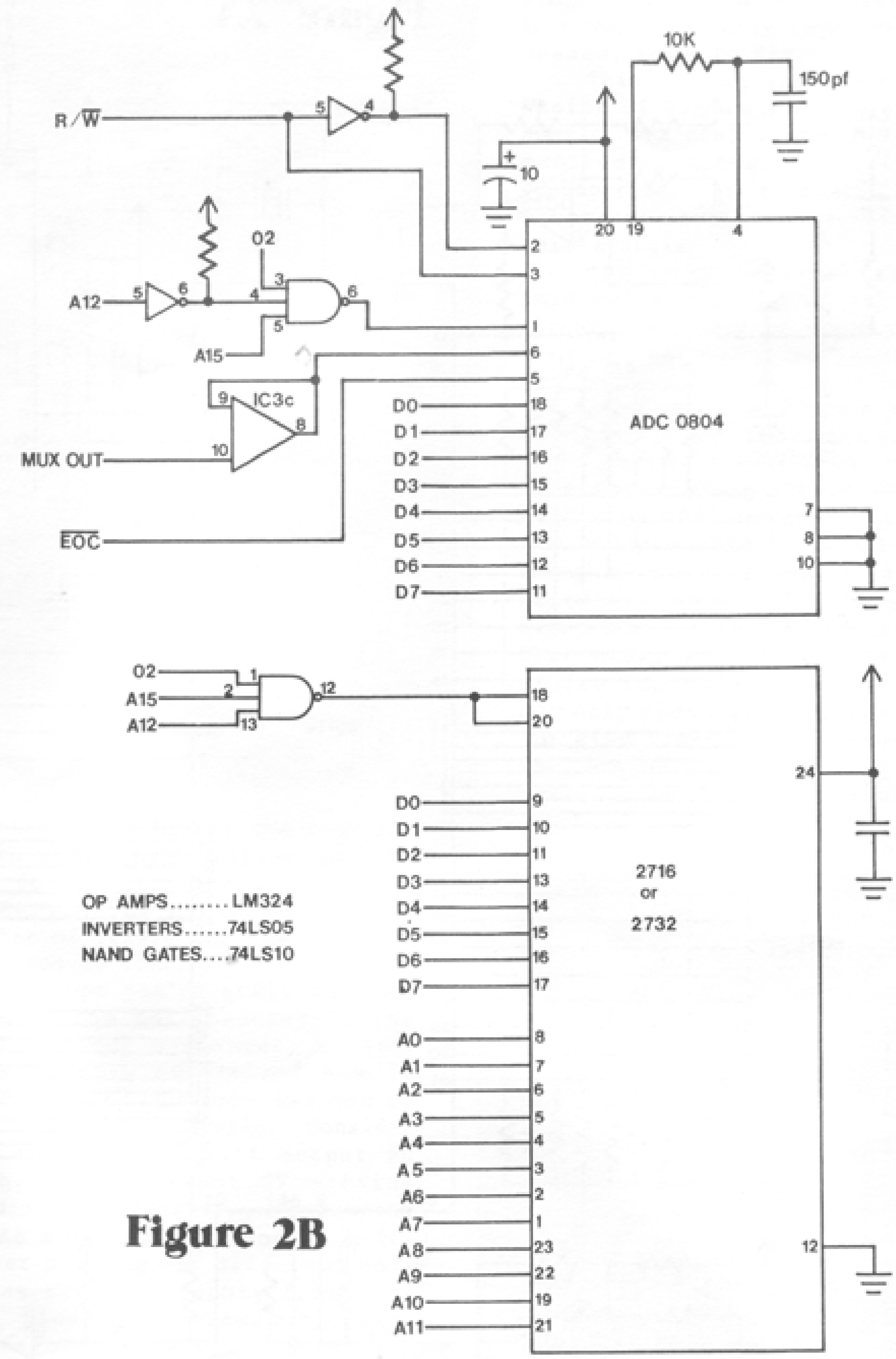


Figure 2B

program crashes the pulse stream will stop, and the subsequent oscillation of IC3A will reset the processor. The software is also designed to allow for a graceful recovery from failure, should that ever occur. More important than any of these facts is that the circuit becomes much more reliable in daily use. If you are on stage playing a portable remote keyboard you certainly don't want it to conk out on you in the middle of a great solo (or any other time, for that matter).

IC3B is a zero-crossing detector circuit for reading a click track from an external source. This will allow us to take a 24 pulses-per-quarter-note click track and translate it into MIDI timing code. (One application would be to sync a drum machine that just puts out clicks to a polyphonic synthesizer that just reads MIDI timing code. One day all of this timing stuff will have to come together, but it still seems like this is quite a ways off.)

The only other chip left is the 74LS05. It's just there for buffering the serial port, and providing a few inversions where appropriate for address decoding and such. That's about all there is to it, since part of the high reliability design philosophy dictates a minimum parts count -- after all, the fewer parts there are, the fewer can break down. So, since there are very few chips involved do yourself a favor and use sockets for every one. Then, troubleshooting usually amounts to nothing more than a simple chip swap.

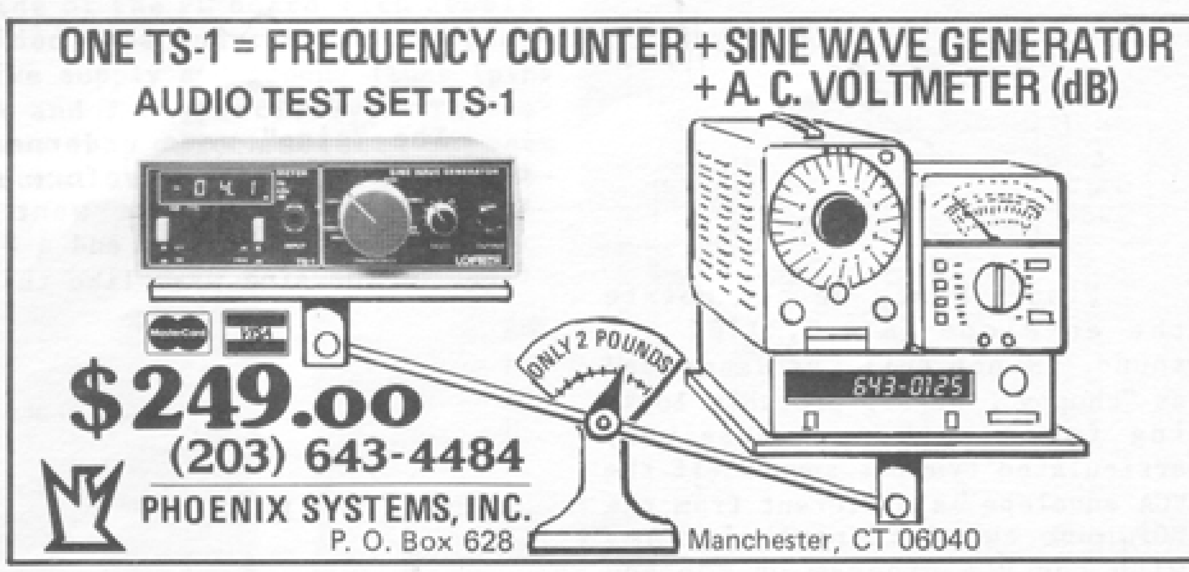
Construction. Since there are so few parts involved, almost any construction technique can be used -- with one possible exception. The 6511 has a pinout that rests on 0.05" centers, which means that it won't fit into a standard piece of perfboard. I built my prototype with wirewrap techniques, but I wouldn't want to try it again! For this reason I highly recommend using the printed circuit board or else drilling your own perfboard. The amount of grief you will save will certainly be worth the small investment.

Incidentally, this circuit requires a single power supply of +5 volts. The people at Rockwell tell me that the 6511 chip will be produced in a CMOS version towards the end of this year, which will make battery operation possible. Then if we could just add a wireless transmitter...

Well, that takes care of the hardware end of things; stay tuned to Polyphony for the software you will need to get all of this running...same MIDI time, same MIDI channel.

Circuit boards and selected parts are available now for this project from PAIA Electronics, Inc., P.O. Box 14359, Oklahoma City, OK 73113 Call or write for price quotes. (405) 843-9626. Visa or master card accepted.

A complete kit for the Midi Remote Keyboard project will be offered with the Part II of this article.

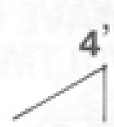


Applied Synthesis: NOTATION

By Bill Rhodes

So you want to synthesize or imitate a sound; you experiment and fiddle, and finally you arrive at that sound you want. Now how do you explain this sound to another musician in a logical manner? You can say this hypothetical sound is: "Sort of a brassy, ah, choppy, ah warbly sound, you know, ah, it has some vibrato, it is rather high registered, ah..." Wow! A lot of words for one sound. You may or may not be accurate or understood, so we need a better way to describe that sound. If you know basic musical electronics and can apply a reasonable amount of logic, you can notate a sound so others can understand what you're describing.

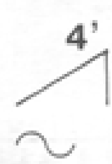
First, specify the waveform. Let's return to our hypothetical sound mentioned in the beginning. "Sort of brassy"...draw a sawtooth waveform with a 4' notation on top to indicate the high register. We can write this as:



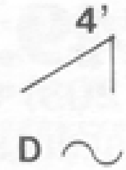
Fine. Next, we can notate the envelope (A,D,S,R) of the sound. Since this was described as "choppy", we are probably looking for a rather percussively articulated trumpet sound. If the VCA envelope is different from the VCF, use two different diagrams with the VCA diagram on top and the VCF on the bottom. We'll assume that the attack is quick, the decay almost non-existent, the sustain full, and little or no release. A quick way to notate is to just look at your synthesizer's envelope settings, and draw up the diagram according to the dial settings. Here is the envelope:

Notice that the VCF envelope has a slightly longer attack and release time, and is therefore notated separately from the VCA diagram.

The description "warbly" probably means the sound includes vibrato. Notate this as such:



The "sine" wave underneath the audio sawtooth waveform notates vibrato. If we want to indicate vibrato delay, add a D in front of the sine wave like this:

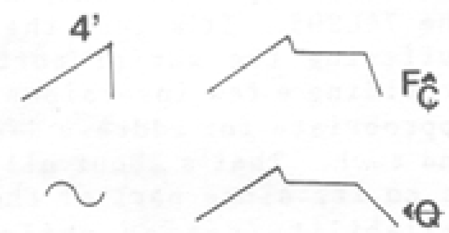


Now, notate the proper filter cutoff and resonant frequencies; look at the controls on the synthesizer and notate as follows:

This indicates a 12:00 filter cutoff position. If a brighter sound is needed, move the arrow further clockwise.

Indicate resonance (Q) similarly, as shown below:

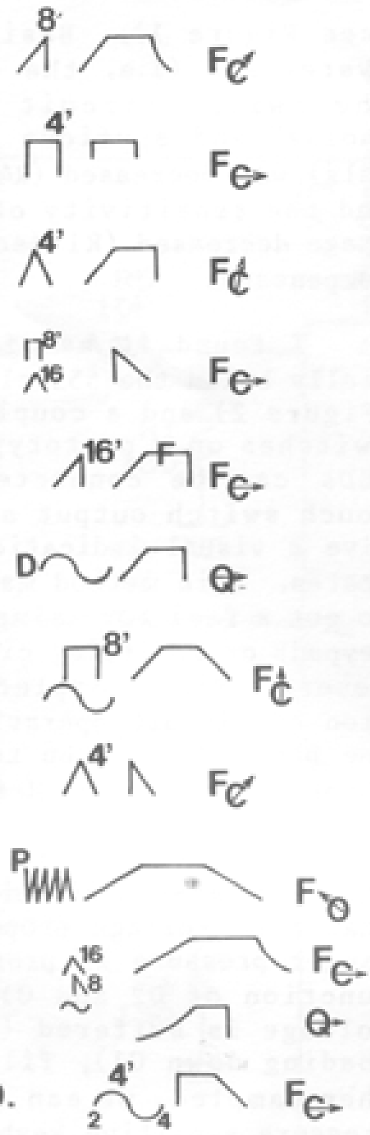
So far, we have this notation for our hypothetical synthesizer patch:



To recap, this means a sawtooth wave (with vibrato) played in a high register with a fast attack, no release, with a bright "non-wow" type filter setting -- probably a trumpet-like sound. If we wanted to notate the exact depth and rate of the vibrato, we could write the settings in parenthesis to the left and right of the sine wave.

This notation standard has worked well for me, although different individuals will probably want to develop different standards. Granted, complex sounds might have complex symbols but these will be no harder to understand (once the vocabulary is learned), than standard musical notation. While certain settings might vary with different synthesizers, we still have an accurate way to find a sound we are trying to create or a way to notate such. See the examples below to see how this system works with other types of sounds, and I hope that this article makes it easier for you to remember those "hot" patches in the future.

SUGGESTED USEFUL NOTATION FOR SYNTHESIS APPLICATION



	Symbol	Results
1.		= "String" with release, crescendo on attack
2.		= "Organ", high register
3.		= "Flute", no release
4.		= "Harpsi" (combination of footages)
5.		= Delayed vib. open filter sawtooth "wave"
		= No release
6.		= Vibrato clarinet with release, no delay
7.		= "Banjo"
8.		= "Thunder", growing then decrescendo
9.		= Crescendoed resonant sweep, open filter, vibratoed sawtooth in 16' and 8' registrations, release on VCA, no release AFTER filter cutoff peaks.
10.		= "Bell"

The envelope diagram on top is VCA, bottom is VCF

If multiple oscillators and/or waveforms are used, notate as such.

- Square
- X % – Pulse
- Triangle
- Sawtooth
- Trem or Vib – LFO (beside waveform of audio osc.) D~ Delayed
- P – Noise (pink)
- W – Noise (white)
- F_{CM} – Filter modulation

- F_C – Filter Cut-off (Intensity 0-10)
- Q – Resonance

This is a generalized notation and can be used with any synthisizer.
New symbols and representations are at the musician's descretion.

ALTERNATIVE KEYBOARD DESIGN

by: Richard Wixner

I have long been interested in experimenting with music synthesizers; however, due to my background as a guitarist, I have tended to shy away from keyboard instruments. Although the linear layout of the keyboard pitches is an effective aid in visualizing music theory, for me the physical arrangement of the keys adds unnecessary complications. (For example, barre chords and moveable finger patterns which are practical with guitar do not translate to keyboard technique.) Also, the standard (or "C-major") keyboard favors the key of C and is fixed at 12 notes per octave, which complicates playing in other keys or tunings. Therefore, armed with articles on touch switch theory and keyboard design, I proceeded to design a personalized (and fairly eclectic) keyboard system.

By basing this keyboard on a symmetrical key arrangement, a fingered note pattern need only be moved horizontally to modulate to another key. Therefore, with a chromatic and symmetrical keyboard system, all scale modes would have the same basic fingering pattern regardless of key. At first, I attempted to position all keys along one row but this resulted in an octave's span being excessively wide for comfortable playing. I then spent alot of time designing possible keyboard configurations; keypads would first be drawn, then cut out and arranged. This proved to be a good method for personally optimizing the keys with respect to size, shape, and spacing. I also learned rather quickly that I didnothave the tools or patience to build a purely mechanical keyboard, but instead needed an experimental keyboard that could be easily modified.

Touch Switches. Touch switches provide a means of constructing an easily modified nonmechanical keyboard, since the "keys" are simply touch pads at the end of a piece of wire. The basic touch switch circuitry I used was described in "Touch Switches Revisited" (see References), with some slight modifications to allow for my particular keyboard and playing style (see Figure 1). Basically, the hysteresis (i.e. the ability of the switch circuit to reject "noise" and spurious touch signals) was decreased (R4 increased) and the sensitivity of the input stage decreased (R1 decreased) to compensate.

I found it helpful to initially build the 555 clock circuit (Figure 2) and a couple of touch switches on a prototyping board. LEDs can be connected to each touch switch output as shown to give a visual indication of their states. This method makes it easy to get a feel for using different keypads or modifying circuit parameters. For a complete description of circuit operation, review the past articles on touch switch theory listed under References.

Interestingly, in prototyping the touch switch circuitry I found that a DC voltage proportional to finger pressure is present at the junction of D2 and C1. If this voltage is buffered (to prevent loading down C1), filtered, and then sampled, we can even have a pressure sensitive keyboard!

Construction. Fabricate the keypads using single-sided copper clad circuit board; an entire key array can be built from one piece of circuit board, etched to leave only the pad areas. Then a hole can be drilled in each pad for its connecting wire. The wire is passed thru the pad and soldered in place on the top of the copper clad surface. The resulting solder blob provides the player with tactile feedback on an otherwise flat keyboard surface, but make sure that you smooth the soldered areas with sandpaper to avoid injury.

Although using a single copper clad board is very efficient, it has some drawbacks (such as difficulty in getting a uniform solder blob, and making the keys cosmetically appealing). After some experimenting, I decided to cut out the pads individually and space them 1/4" apart, thus enabling tactile input via the pad edges. If you can obtain brass strips of the desired width, only one cut per pad need be made.

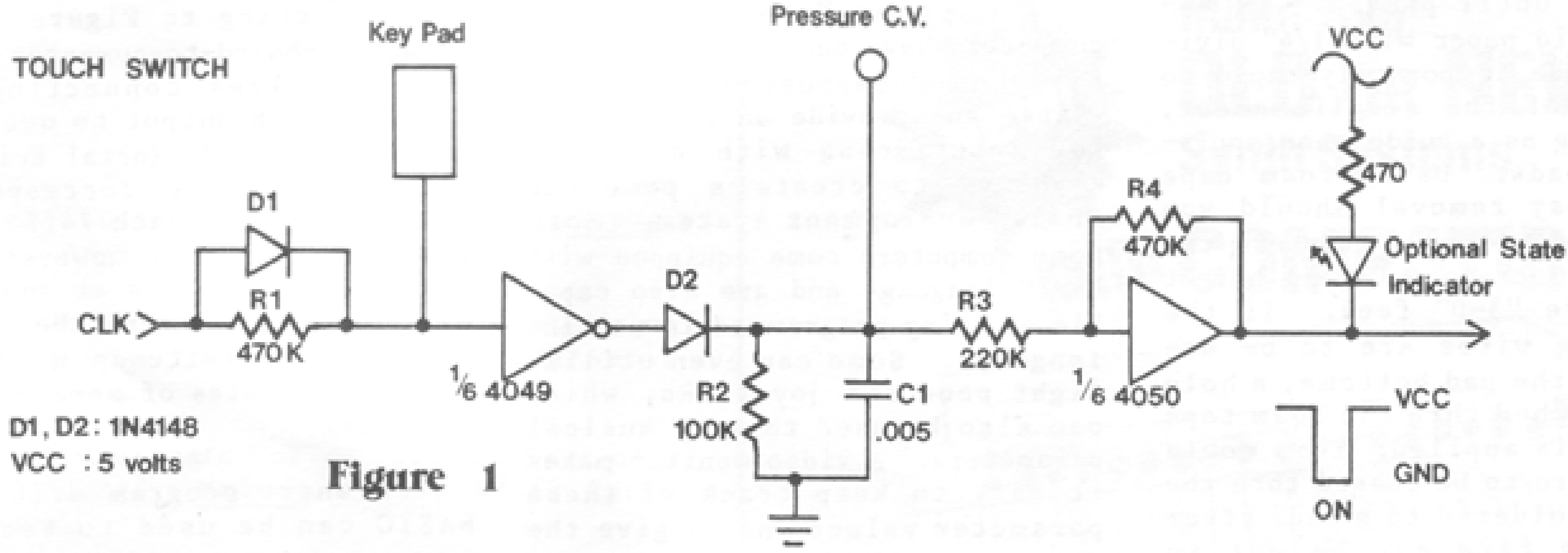
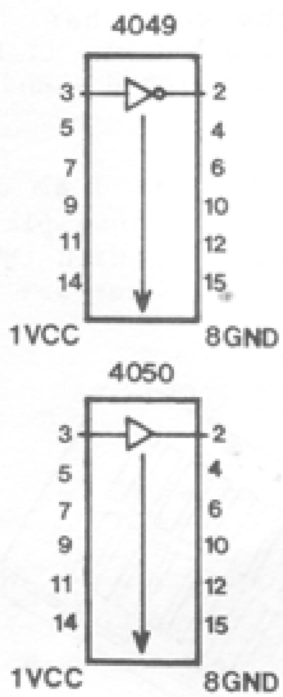


Figure 1



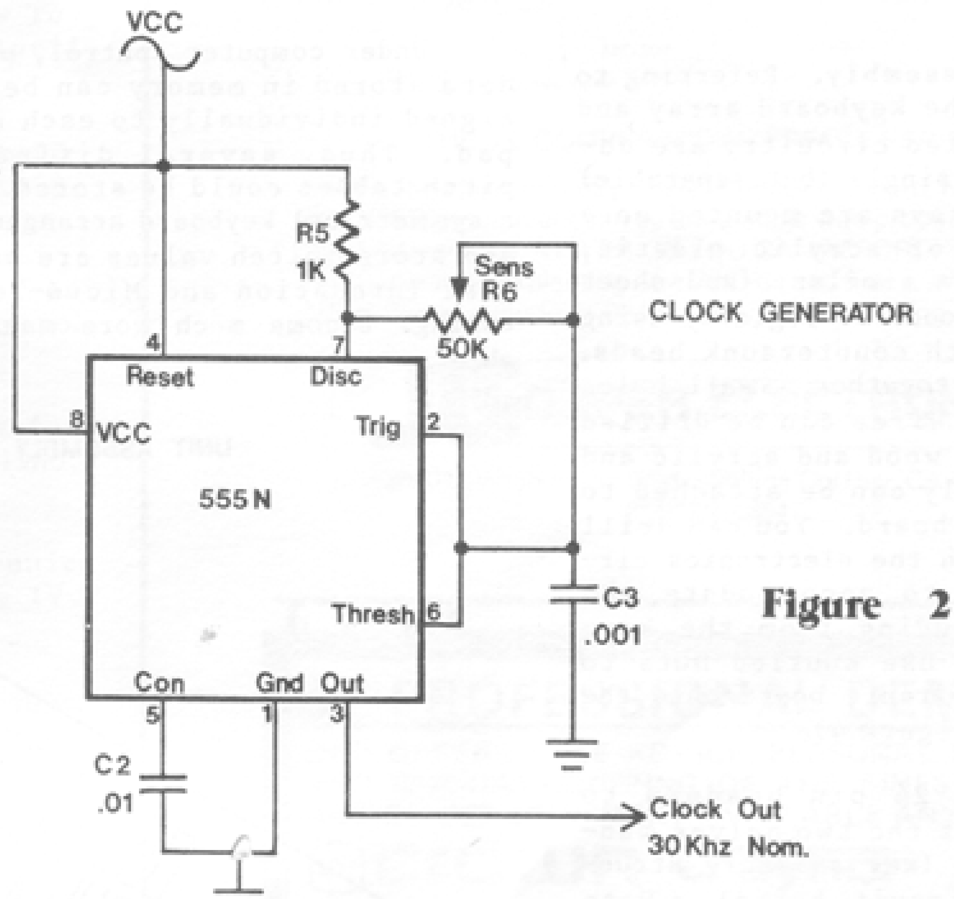


Figure 2

Also, the connecting wires can be soldered to the bottoms of the pads, thus concealing them from sight.

Once the pads are in place, apply an insulating layer of paint over them. Painting the keypads is necessary since the touch switches operate via body capacitance rather than by conduction. Recall that an algebraic expression for the value of capacitance of parallel-plate structures is

$$C = \frac{K\,e\,A}{d}$$

where **K** is the relative dielectric constant, **e** is the permittivity of free space, **A** is the area of the plates and **d** is the distance between the plates. The paint is acting as a dielectric and plate separator. As you press on the painted pad you increase the effective surface area of the plates (and possibly decrease the distance between the plates if the paint is malleable enough to compress), thereby increasing the effective capacitance. For proper operation use wear resistant paint -- but do not apply it too thickly, as sensitivity will be significantly reduced.

Experiment to determine the best painting method. To insure good adhesion, clean the pads thoroughly with steel wool and round the edges to eliminate burrs and minimize wear. You could also try making several sample keypads using different types of paint, and then test these for scratch and abrasion damage before painting the actual keys to be used. The use of a primer coat is important for proper adhesion; epoxy or polyurethane paints are good choices. Hobby shops carry model train paints, intended for use on metal, that are formulated to dry in a thin coat. And since you've gone this far, why stay with black and white? Pick your own colors -- it's your keyboard!

Double stick foam tape provides an excellent way to affix the pads to the keyboard backing, which could be an acrylic plastic sheet (these are available in many colors, even mirrored). Cut a length of foam tape and mount it to a keypad. The pad can then be set lightly upon the acrylic sheet, and if done carefully, will not stick until pressure is applied. Grid paper with 1/4" divisions can be temporarily taped to the back of the acrylic sheet, thus acting as a guide when applying the pads. Using foam tape allows easy removal should you later decide to make changes; the tape also increases keypad height for a more "3-D" feel. If the connecting wires are to be attached to the pad bottoms, a hole can be punched thru the foam tape before it is applied. This would allow a wire to be passed thru the tape and soldered to a pad, after which the tape can be put in place.

Unit Assembly. Referring to Figure 3, the keyboard array and its associated circuitry are designed as a single (but separable) unit. The keys are mounted on a 1/8" sheet of acrylic plastic, fastened to a similar sized sheet of 3/8" plywood for rigidity using 2" bolts with countersunk heads. Once bolted together, small holes for the pad wires can be drilled through the wood and acrylic and this assembly can be attached to the circuit board. You can drill holes through the electronics circuit board to accommodate the bolts protruding from the keyboard, then use knurled nuts to secure the circuit board onto the bolts (see Figure 4).

I used 24 pin headers to interconnect the two halves mentioned above (key assembly structure and circuit board). Note that the ability to separate units allows for ease of repair or modification. A 24 pin header also connects the computer interface (see below) to the completed keyboard unit. To make the header cables, solder four lengths of ribbon cable 6 conductors wide to a header while it is still plugged into its socket (this will help prevent melting or distorting the header). Separate the individual wires on the free end of the ribbon cable enough so that they may be passed thru their respective keypads. The ribbon cable used should be longer than needed and then cut to size after being passed thru the keyboard assembly. At this point the wires are soldered to the keypads and the pads secured to the acrylic sheet. Any wire slack should be gently pulled beneath the keyboard surface.

Computer Interface. Home computers have become quite versatile and inexpensive in recent years, and provide an ideal means for interfacing with a custom keyboard to create a powerful music development system. Most home computers come equipped with BASIC language and are also capable of being programmed in machine language. Some can even utilize light pens and joysticks, which can also be used to vary musical parameters. A video monitor makes it easy to keep track of these parameter values and to give the operator prompts.

Under computer control, pitch data stored in memory can be assigned individually to each keypad. Thus, several different pitch tables could be stored. If a symmetrical keyboard arrangement and stored pitch values are used, Just Intonation and Micro-Tonal tunings become much more manageable.

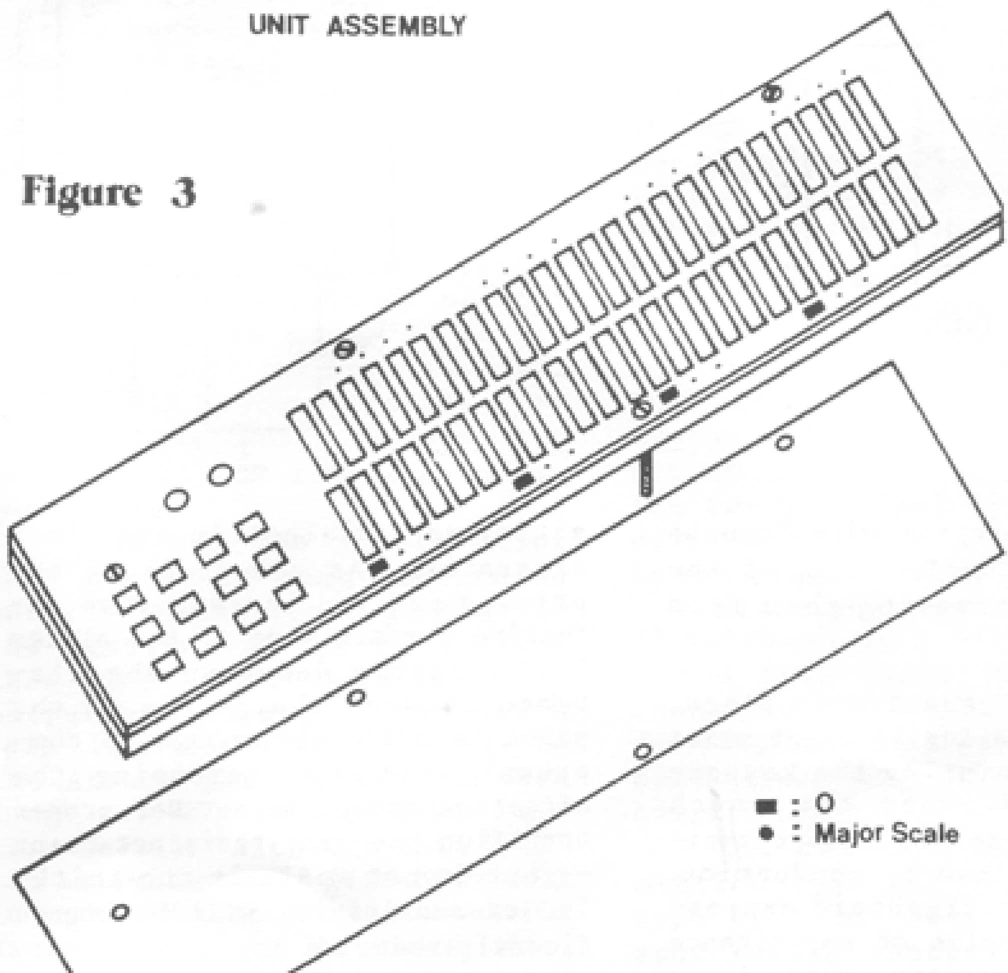
Referring to Figure 5, the actual keyboard-to-computer interface involves connecting each touch switch output to one input line of a 74LS244 (octal tri-state buffer). The eight corresponding output lines of each 74LS244 are connected together, however, only one chip is enabled at any time. Wired in this manner, the outputs of 64 touch switches will look like only 8 bytes of memory to the computer.

A short program written in BASIC can be used to test the system, although assembly language software is needed for playing in real time. A useful keyboard read algorithm would be: Check each byte for a bit on; if bit is on, determine which one and store key number.

Technique. I am still discovering the unique playing techniques possible with this type of instrument. When set to a high

UNIT ASSEMBLY

Figure 3



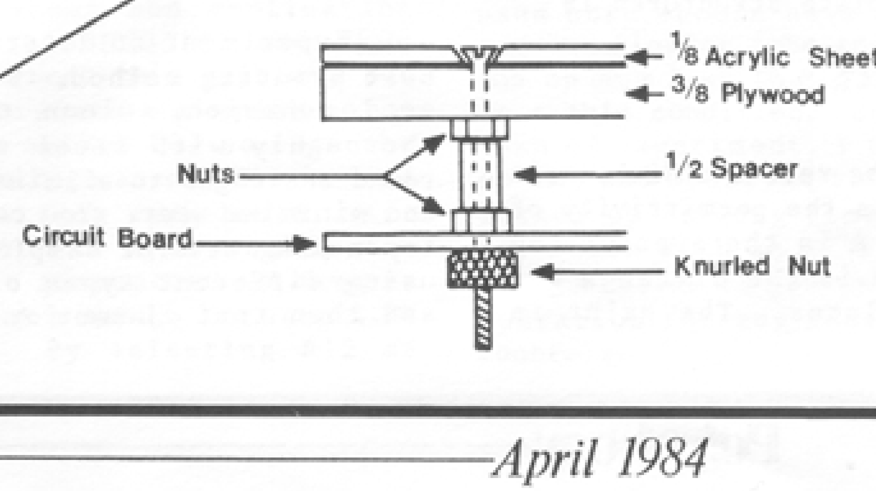


Figure 4

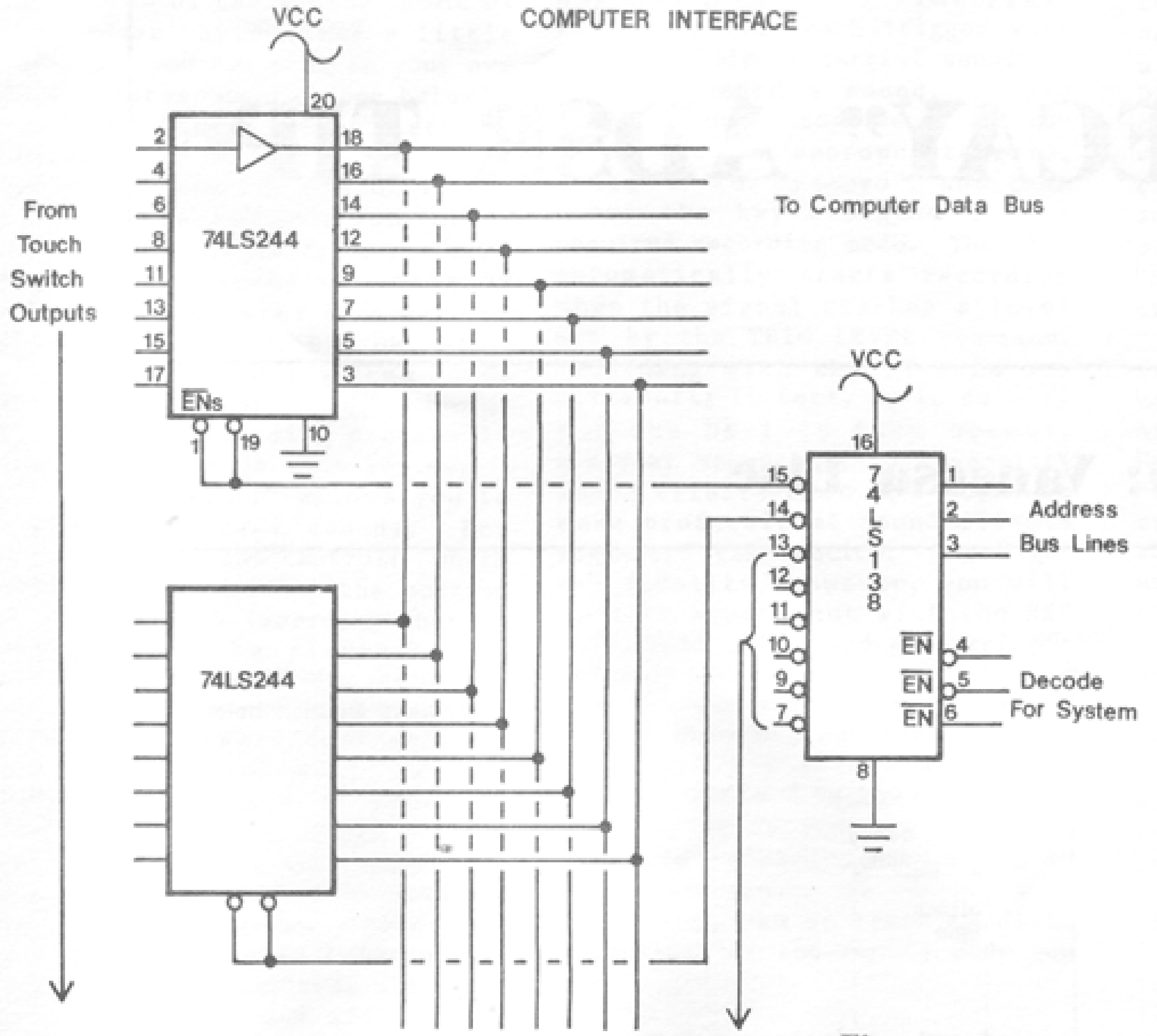


Figure 5

sensitivity only the slightest touch is necessary to trigger a note. This touch can be most anywhere on the key surface and makes percussive playing styles possible. Sliding a finger along several pads produces "finger painting" of all notes. My key spacing leaves a gap of 1/4" between keys so a finger placed lightly between two keys and rocked side to side will produce trills; by using the pad corners, trills between three notes can be played. Even playing loops is quite easy. And of course, since there is no mechanical movement to the keys, this keyboard is FAST!

Conclusion. This has been, and continues to be, a big project. I originally set out to build a keyboard that seemed more logical (to me) for musical exploration and in the process, discovered that using touch switches is much simpler and far more practical than trying to build a keyboard using traditional mechanical switching. The instrument that resulted is capable of more musical expression and subtleties than were anticipated. It certainly has been worth the time and effort required, for I now have a musical instrument to which I can relate and from which I can learn. If anyone develops or has developed these ideas further -- please share your findings with us.

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1). "The Sohler Keyboard" by Mel Sohler, Polyphony Nov/Dec 1978.

2). "New Keyboard Design" by Paul Vandervoort, Contemporary Keyboard Nov/Dec 1976.

3). "The Anderton Keyboard" by Craig Anderton, Guitar Player Jan 1978.

4). "Magic Buttons" by Steve Wood, Polyphony Sept/Oct 1978

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6.) "The Horizons of Instrument Design" "A Conversation with Don Buchla" by Jim Aikin, Keyboard Dec 1982.

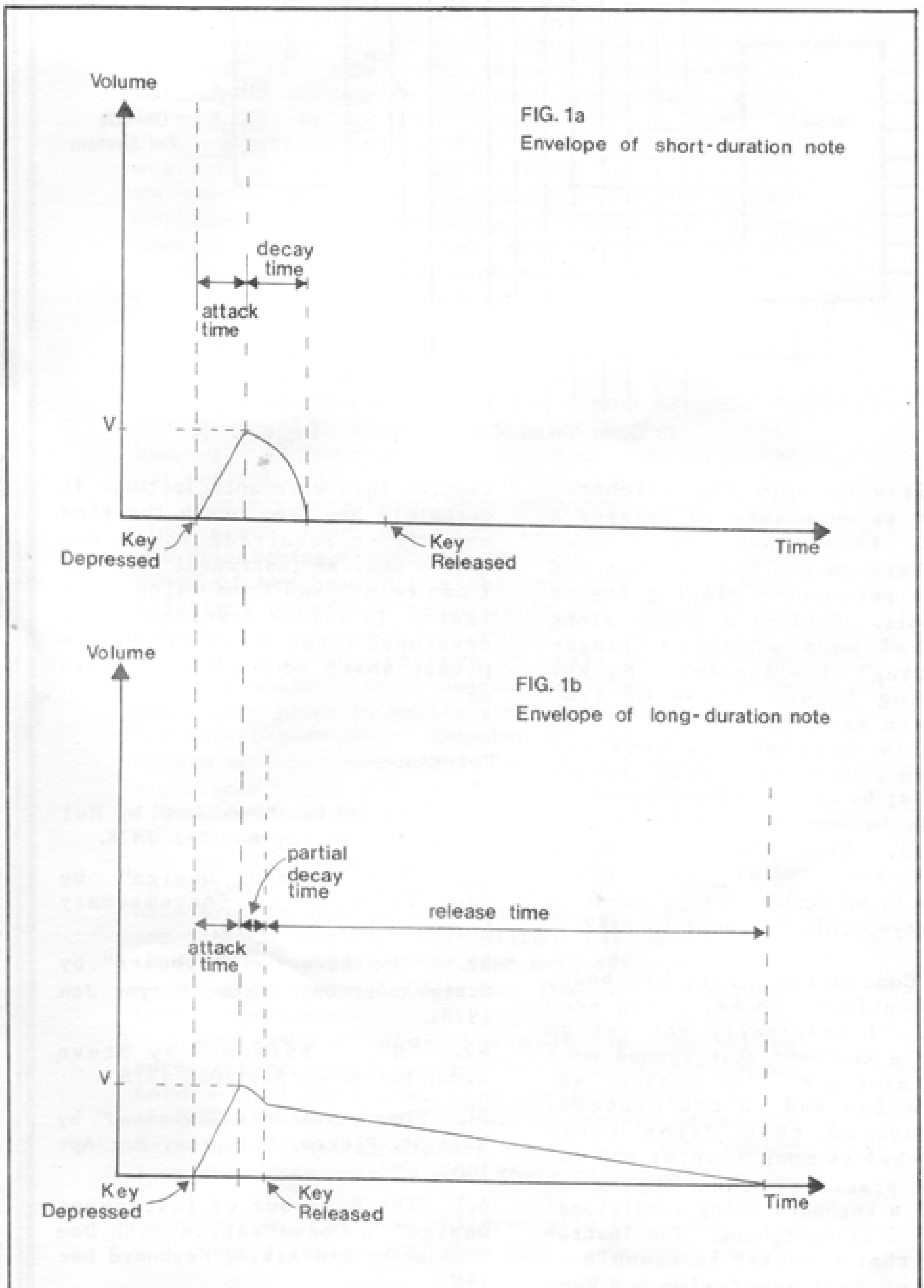
"DUAL DECAY" ADSR TIP

by: Vanessa Else

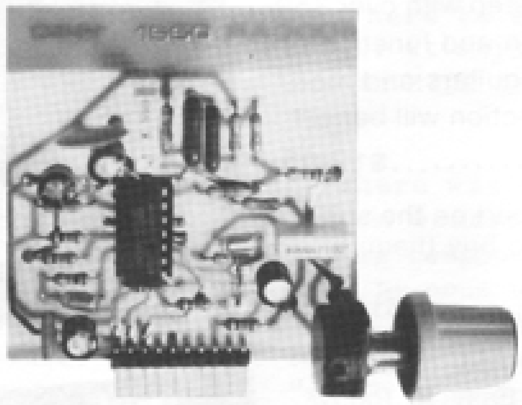
If you've ever been frustrated by only being able to play one type of sound envelope at a time on your polyphonic synthesizer, either you don't have split keyboard function or touch sensitive capabilities, or maybe you just haven't yet discovered that your simple ADSR offers some hidden versatility. Suppose you want a legato bass line accompanied by a spirited, staccato melody line, or a plunky bass riff along with a luxurious, legato soprano sound; both can be achieved with certain settings of the ADSR volume envelope generator and practiced playing technique.

In order to accomplish this, the Sustain level must be at zero and the Release time should be relatively long compared to the Attack and Decay times. Then, you can play staccato notes anywhere on the keyboard by holding the keys down during the Attack and Decay cycles, at which time the Sustain level pulls the volume to zero (see Figure 1a). Legato notes (which also are available anywhere on the keyboard) are played by quickly tapping the keys, so that the long release time kicks in before the Attack or Decay times are completed (see Figure 1b). Note that with long Attack times, you can even vary the overall amplitude of the note depending upon when you release the key along the attack curve. If your synthesizer has a separate ADSR filter envelope generator, you can also have different timbres depending on how you time coordinate the filter and amplitude envelopes.

It's sometimes surprising what kind of interesting techniques lie hidden in even the most common synthesizer modules. Next time you need to play a part which requires two different envelopes, give this simple technique a try.



Sound Strategy



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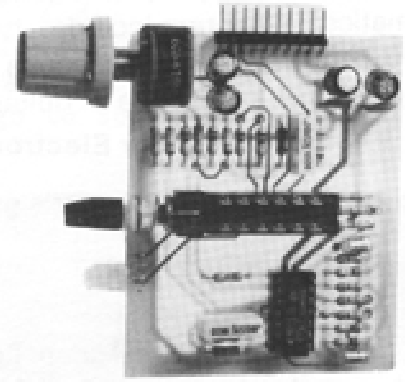

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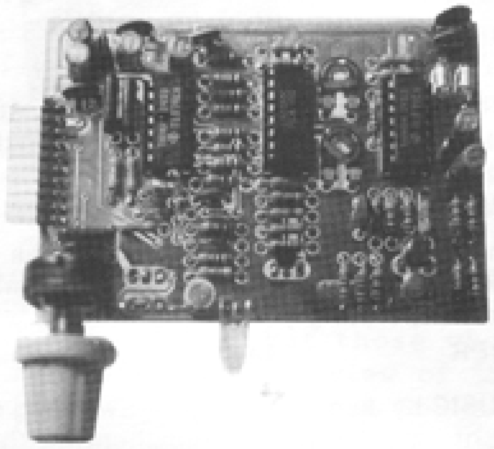

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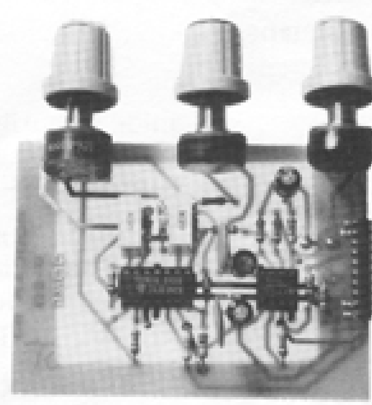

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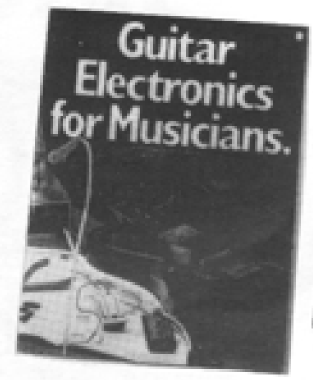

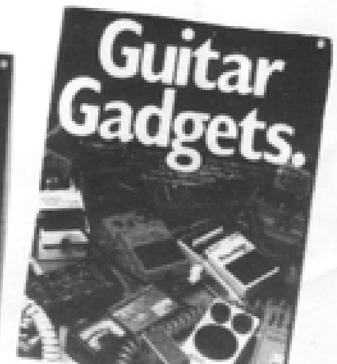

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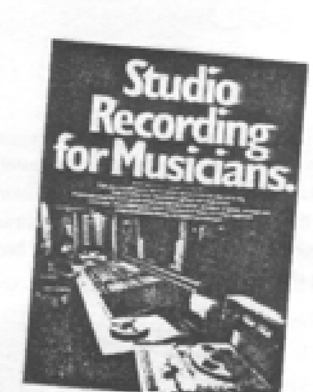

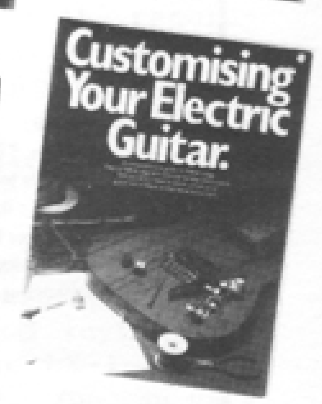

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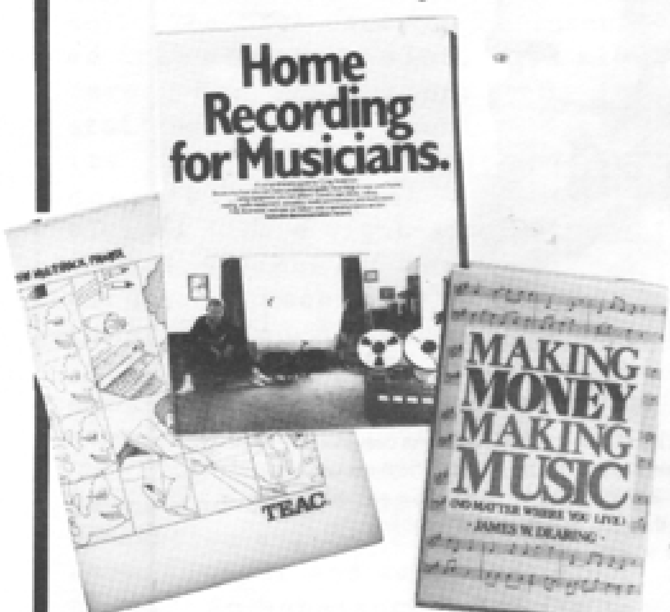

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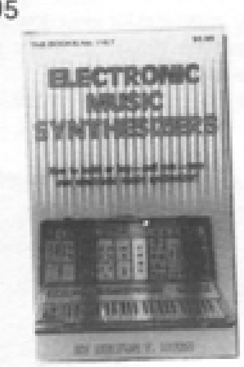

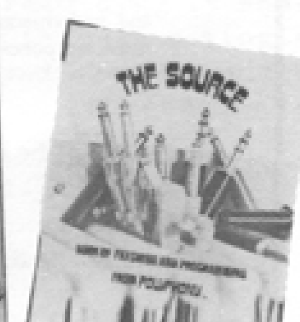

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- #0704 Jan./Feb.'82: Bob Moog interview, Chip Power - STK-050/070, Simple Square Wave Shaper, Tape Timer Ruler, Practical Circuitry: VCAs made simple, Details: Gozinda & Gozouta Revisited, Korg Trident & Casiotone 202 Reviews.
- #0705 Mar./Apr.'82: Electronic Music Math, Analog Delay Clock / Modulation; Frequency Domain Modifiers; Screen-Wave for the TRS-80; Touch Switches Revisited; Practical Circuitry: ADSR the Easy Way; Getting the most out of a Cheapo (Guitar).
- #0706 May/August '82: Anatomy of a Private record, Don Slepian Interview, Understanding Digital Synthesizers: A Digital Filter, Syn-Bow Review, Optical Audio, Profiles of SSM 2033 & 2044, The PAL Filter, Bill Rhodes Applied synthesis: Bells, Pipe Organ, Harpsichord, Electronic piano; The Realistic MG-1 Reviewed.
- #0801 Sept/Oct.'82: Ambience in Electronic Music,Tone Bypass for Fender Amps, 8 Track Reviews, Parametric EQ Tips, Solo/Cut Circuit for TASCAM Model 3, The SSM 2011, Tube Preamp, Snare + Drum Voice Circuit, Triple Pick-up Switcher, Simulated Stereo, When Quality Reocrd Mfg. Counts, Independent Record Mfg. Convention report.
- #0802 February '83: AMS-100 Gate Output, Bus Distribution Modules for Modular Synthesizers, Dynamic Touch Controller, Expanding Envelopes, MXR Limiter Review, New Age Music, An Overview, Synsonics Drum Review, Interface, Practical Circuitry: A Patch Over Scheme for Small Synthesizers, Lab Notes: Shepard Functions.
- #0803 April '83: Sound Interface Device, Build a Bass Pedal System, Dr. Rhythm Mod., Switched Capacitance/Transversal Filters, Voltage Controlled LFO, Rockman & Voyetra Eight Reviews.
- #0804 June '83: MIDI Hardware Fundamentals, What MIDI Means for Musicians, The Vangelis Interview, Creative Recording on a Shoestring Budget, A One Chip ADSR, An Electronic Switch.
- #0805 August '83; Donald Buchla Interview, An Overview of Digital Drums, Exploring Just Intonation, Build a simple Drum Synthesizer, Micro-Drums part I, The Penultimate Compressor, Why Spring Reverb Will Never Die, Gate/Sample & Hold Circuit.
- #0806 October '83 Larry Fast Interview, Basic Film Scoring Math, Foxtex X-15 Review, Build the Hip Bass Drum, Applied Synthesis: Orchestral Voicings Using the Tenth Interval.
- #0901: December '83 John Foxx Interview, Build: a Dual Trigger Delay; Center Channel Reverb. Drum Machine Modifications - PAIA, E-Mu, Roland; Polyphonic Keyboard Reviews, White noise.
- #0902 February '84 Commodore Music Software Review, Build a Just Intonnation Generator, NE572 Noise Reduction Unit, 3D Video, Vocal Basics, Build a Quadrature Function Generator.

CASIO M-10 OWNERS.......

Did you realize that your pride and joy has unseen powers? That there are voices and effects that you can add for the cost of a switch and a piece of wire? This latest booklet from POLYPHONY gives you the info that you need to transform your mini-axe and gives details on adding a "stunt box", computer interfacing and much,,much more.

No. CMOD 16 pages $3.50

SSM 2011 CHIPS

As a special service to readers interested in evaluating this exciting new chip, for a limited time POLYMART offers the SSM 2011 Microphone Preamp/Level Detector IC.

No. 2011 .....$5.75 each plus postage ($1.00)

RACK PANEL SPECIAL!

Easily machined 1/8 inch unfinished aluminum rack panels as low as $3.95 each in quantities of 3 or more. (you may mix sizes for discount prices)

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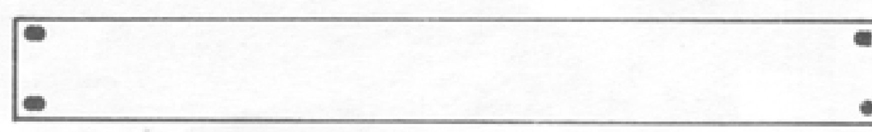

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We cannot invoice; payment must be enclosed with your order. there is a flat $.50 handling fee per order plus postage costs. MasterCharge and Visa are welcome, ($10.00 minimum charge). Foreign orders **must** be paid by certified check or money order in U.S. $ drawn on a U.S. bank (or by charge card). Phone orders welcomed for charge card orders.

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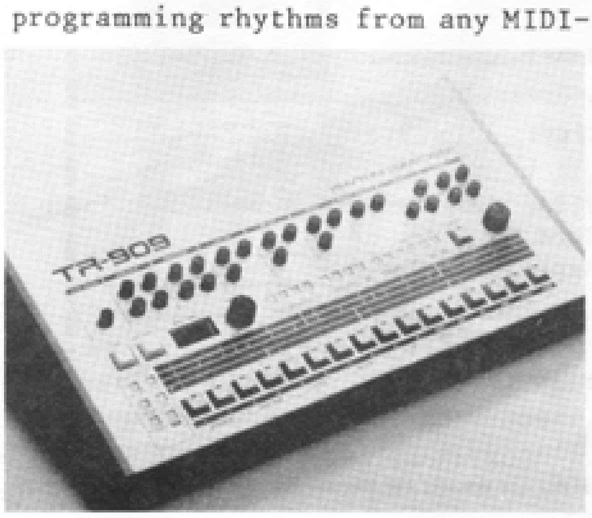
CURRENT EVENTS

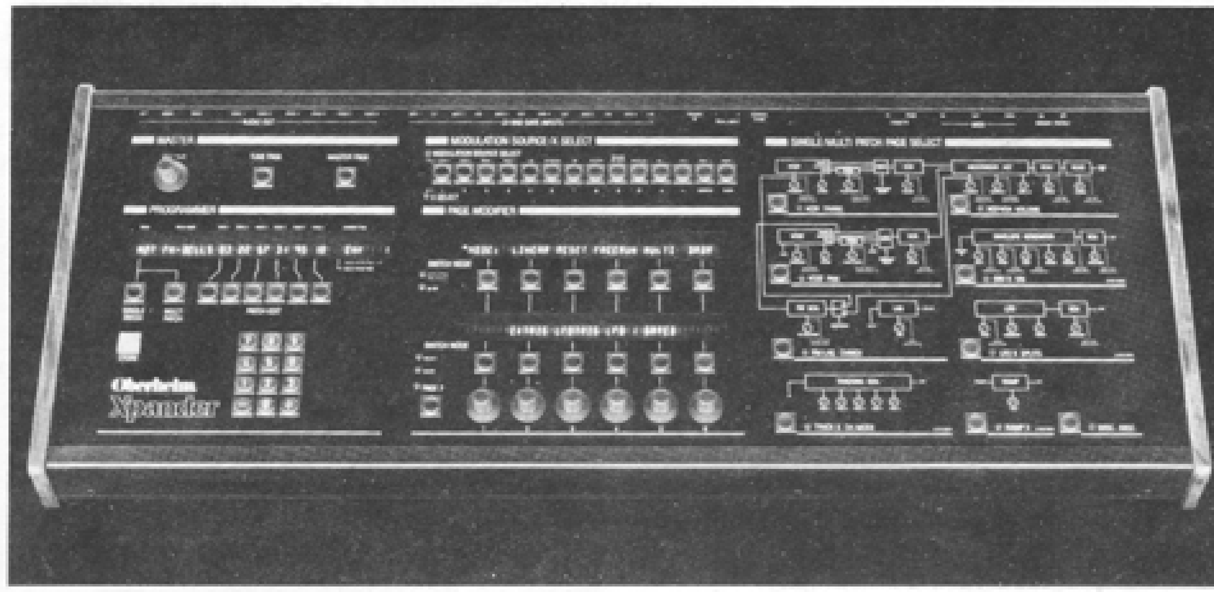
'Tell Them You Saw It In Polyphony'

MIDI Retrofits. Two companies have recently announced MIDI retrofits for existing instruments: Oberheim Electronics for the OB-8, and Korg for the Poly-61. Both can be installed by service centers for their respective companies for a nominal fee. Oberheim also has a sync-to-tape retrofit for the DX Drum Machine; service centers charge $25 for installation.

New from Waveform. Waveform (1912 Bonita Way, Berkeley, CA 94704) has released a MIDI package (list $149.95) for their MusiCalc 1 software. The package includes software on a 5-1/4" diskette and MIDI connector for driving MIDI compatible instruments. It also allows MusiCalc users to connect two Commodore 64s together for six-voice synthesis. Waveform has also released MusiCalc 2 Score-Writer (list $34.95), which lets MusiCalc 1 users see their creations in standard musical notation, either on the screen or printed out in hardcopy. MusiCalc 3 Keyboard Maker (list $34.95), which need not be used with MusiCalc 1, turns the Commodore 64 QWERTY keyboard into a musical keyboard with a choice of 70 different scales.

MIDI drum machine, sequencer. Roland has announced the TR-909 drum machine, which combines analog and digitally recorded sounds along with a MIDI interface. The latter allows for such tricks as programming rhythms from any MIDI-





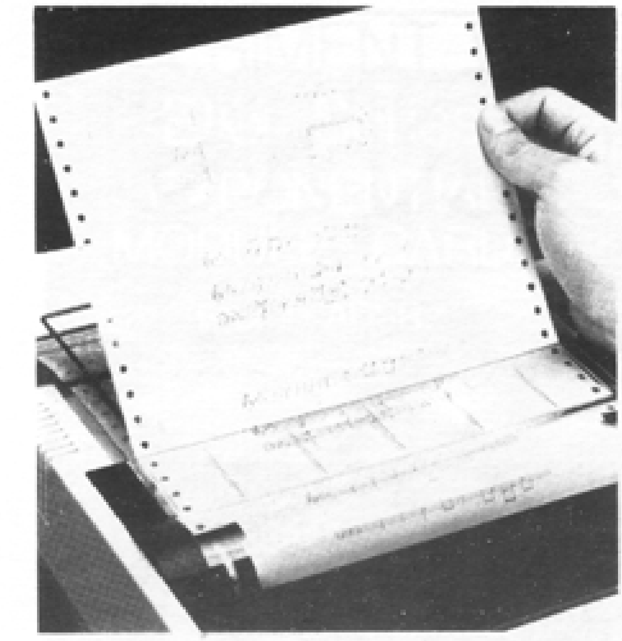
compatible keyboard; with touch sensitive keyboards, you can even program variable dynamics. List price is $1,195.

The MSQ-700 "Digital Keyboard Recorder" is a 16 voice poly sequencer with MIDI compatibility that also works with drum machines. Memory capacity is 6,500 notes, spread out over 8 fully polyphonic tracks. List price is $1,195.

Oberheim announces MIDI compatible Xpander synthesizer. This keyboardless, programmable six voice synthesizer interfaces with any MIDI-compatible or control voltage/gate compatible device. Thus, it is applicable for expansion of existing systems, connection to Roland's MIDI-compatible GR-700, connection to Waveform's MIDI software (see above), etc. Choosing this design approach allows for a list price of under $3000.

Each voice contains two oscillators with FM capabilities, 15 VCAs, 5 LFOs, 5 envelope generators, 4 ramp generators, 3 tracking generators, a 15 mode filter, and a lag processor (that's for each voice, and since each voice is individually programmable, they can have entirely different sounds). The Xpander stores 100 patches (parameters and name), and the front panel design utilizes an interactive block diagram coupled with three 40 character fluorescent displays that simplify programming. Each voice contains 27 modulation sources and 47 modulation destinations, and each source can be routed to any combination of modulation destinations through 18 independent modulation busses. (Editor's note: I briefly heard a prototype of the Xpander, and it is quite something. The voices have the complexity of digital sounds combined with the "warmth" people tend to associate with analog sound generation).

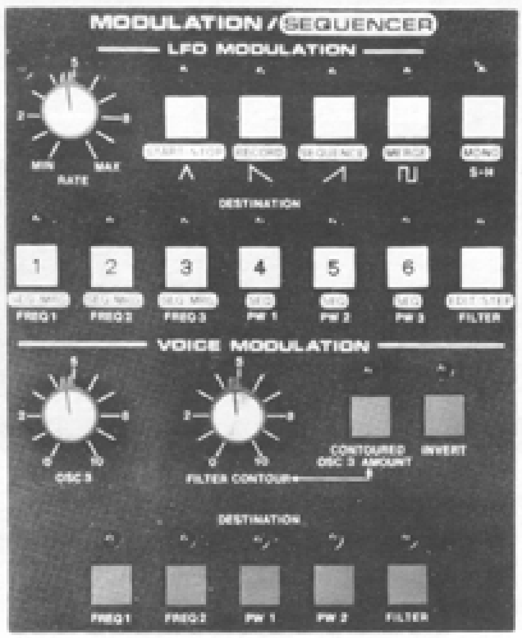
Noise checker. Valley People, Inc. (2820 Erica Place, Nashville, TN 37204) has introduced the Model 310 audio noise and level meter. Features include differential inputs, multiple pole filters for accurate measurements of different types of noise, "A" weighting filter, and many more very useful features. List price is $399.

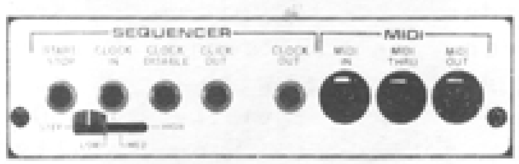


Music-writing program for Apple computers. Passport Designs (625 Miramontes St., Suite 103, Half Moon Bay, CA 94019) has introduced "Polywriter" (list $595), a software package which lets anyone get an accurate printout of whatever they play on a Soundchaser keyboard in any desired score format: single treble line, single bass line, choral score, etc. Polywriter prints in standard notation and accurately handles note division, seconds, accidentals, ties, 8vas, flags and beams, transposition, etc.

Drumulator add-ons. E-mu (2815 Chanticleer, Santa Cruz, CA 95065 has announced the Drumulator Pad Programmer with dynamically responsive pads for drum stick programming and the GRC (Graphic Rhythm Controller). The GRC, designed for the Apple II+ or //e, allows non-real-time programming of measures and songs with total dynamic control on a note-by-note basis.

Memorymoog goes MIDI. The Memorymoog Plus from Moog Music (2500 Walden Avenue, Buffalo, NY 14225) now includes a MIDI interface and polyphonic/monophonic sequencer. (Retrofits are available for existing Memorymoogs through authorized Moog service centers.) The poly sequencer provides 6 individual sequence memories, and like a drum machine, can merge and repeat sequences. The mono sequencer drives any external synth with 1 Volt/octave pitch control.





Cassette duplication. Clear Cut Cassettes (3821 N. Southport, Chicago, IL 60613) offers real-time duplication and many other cassette duplication services (labels, boxes, etc.). Typical prices are $2.60 per cassette, both sides, in 100-up quantities; chrome cassettes cost 20% more. For more information, write Clear Cut and ask for their information package.

New crossovers. RANE (6510 216th SW, Mountlake Terrace, WA 98043) has introduced the AC-22 (stereo 2-way/mono 3-way) and AC 23 (stereo 3-way/mono 4-way or 5-way) 4th-order state variable time correcting crossovers. Both models feature 24 dB/octave slopes, absolutely flat summed amplitude response, and zero phase difference between drivers through the crossover regions. List prices: AC-22, $349; AC-23, $449.

PARTS and KITS from: PGS

LINEARS

TL061	BiFet	.72
TL062	Dual BiFet	.99
TL064	Quad BiFet	1.95
TL071	BiFet	.65
TL072	Dual BiFet	1.15
TL074	Quad BiFet	1.95
NE555	Timer	.39
NE570	Compander	3.80
NE571	Compander	2.95
NE572	Compander	4.95
UA741	Comp. OpAmp	.29
MC1456	Low Noise OpAmp	.90
RC1556	Low Noise OpAmp	1.48
CA3080	OTA	.94
CA3280	Dual OTA	1.98
RC4136	Quad OpAmp	1.10
RC4739	Dual Low Noise	1.19
NE5532	Dual High Perf	3.70
NE5534	High Performance	2.65

SPECIAL PURPOSE

SAD-1024	Analog Delay	17.50
SAD-4096	Analog Delay	37.50
MK50240	Top Octave Div.	5.95
SN76477	Sound Generator	3.45

SANYO HYBRID POWER AMPS

STK050	50 Watt Power Amp	19.40
STK070	70 Watt Power Amp	24.20

SSM- SOLID STATE MICRO-TECHNOLOGY

SSM 2010	VCA	7.50
SSM 2011	PreAmp	5.75
SSM 2012	VCA	9.50
SSM 2020	VCA	7.50
SSM 2022	VCA	7.50
SSM 2030	VCO	7.50
SSM 2033	VCO	10.00
SSM 2040	VCF	7.50
SSM 2044	VCF	7.50
SSM 2050	VCTG	7.50
SSM 2056	VCTG	5.75

THERMISTER (Temp. Sensing Resistor)

TSR-Q81	Tel Labs Q81 1k	$3.50

OPTO-ISOLATOR

CLM6000	Clairex CLM6000	$2.85

CAPACITORS (25 volt)

701-100	100 pf polystyrene	.25
701-180	180 pf polystyrene	.25
701-1000	1000 pf polystyrene	.25
701-2200	2200 pf polystyrene	.25
701-2200	3300 pf polystyrene	.25
701-3900	3900 pf polystyrene	.25
702-005	.005 uf mylar	.12
702-01	.01 uf mylar	.12
702-05	.05 uf mylar	.16
702-1	.1 uf mylar	.21
702-22	.22 uf mylar	.33
703-1.0	1.0 uf tantalum	.39
703-3.3	3.3 uf tantalum	.49
703-4.7	4.7 uf tantalum	.59
704-2.2	2.2 uf electrolytic	.21
704-4.7	4.7 uf electrolytic	.21
704-10	10 uf electrolytic	.21
704-100	100 uf electrolytic	.31
705-10	10 pf ceramic disk	.15
705-.01	.01 uf ceramic disk	.12
705-.1	.1 uf ceramic disk	.17

IC SOCKETS (soldertail)

IC-S-08	8 pin high quality socket	.27
IC-S-14	14 pin high quality socket	.30
IC-S-16	16 pin high quality socket	.34
IC-S-18	18 pin high quality socket	.40
IC-S-28	28 pin hgih quality socket	.60
IC-C-08	8 pin economy socket	.13
IC-C-14	14 pin economy socket	.15
IC-C-16	16 pin economy socket	.17
IC-C-18	18 pin economy socket	.20
IC-C-28	28 pin economy socket	.40

RESISTORS 5%, 1/4 watt

All EIA values available from 2.0 ohm to 5.1 Meg. Also availble is 10 Meg.

100 each of same value	$1.50
50 each of same value	.98
25 each of same value	.75
10 each of same value	.40
5 each of same value	.25

ASSORTMENTS

10 each of 10 values (100)	3.00
25 each of 10 values (250)	6.50
50 each of 20 values (1000)	16.00

CHORUS/DELAY KIT

This chorus/delay unit, designed by Craig Anderton and featured in Guitar Player magazine, provides flanging, slapback echo, and automatic double tracking effects. The delay range is from 2 ms to 80 ms. Due to the use of compression and expansion techniques, the unit has dead-quiet operation up to about 50 ms and only minimal noise out the full 80 ms. This project kit consists of all electronics, pots, jacks, etc. Also included are the two circuit boards (etched, drilled, and legended) needed for the project. Not included is wire, solder, case, knobs, etc. The Chorus/Delay unit also needs a well regulated bi-polar 15 volt power supply (not included). (A punched and legended rack mount panel will soon be available for this project.)

Order KT-CD777 .... $78.00

"SNARE +" DRUM VOICE KIT

This percussion synthesizer was designed by Thomas Henry and appeared in POLYPHONY magazine. Here's what Craig Anderton had to say about the "SNARE+". "At last - an inexpensive drum voice that has a punchy, full sound. .....All in all, the Snare + delivers a lot of drum sounds, and I would unhesitatingly recommend it to anybody who's tired of the thin sound found in most electronic drum units."

We offer the kit with or without a panel. Kit 3770 contains all electronic parts, switches, jacks, pots, etc, as well well as etched, drilled, and legended circuit board. Kit 3772 includes all this plus a punched and legended rack mount panel (standard 1 3/4 by 19 inches) available in black or blue (both with white legends).

Not included with either kit is wire, solder, mounting hardware, etc. The SNARE + also needs a bi-polar 15 volt power supply (not supplied).

KIT 3770 Basic SNARE + kit $33.95
KIT 3772 SNARE + with rack panel ... $44.94

THE "CLARIFIER" GUITAR EQ/PREAMP

The "CLARIFIER" is an onboard preamp/EQ module for guitar. This design, by Craig Anderton, was first seen in the pages of GUITAR PLAYER magazine. Here's what the CLARIFIER will do: Replace the guitar's standard passive tone control with a two control, active circuit which provides over 12 db of bass and treble boost and up to 6 db cut.... Buffer your pickups from external loading, giving additional output and improve high freq response.... Add a nominal 6 db of gain to give your signal a bit more punch, as well as improve the signal/noise ratio in multiple effects systems... make your guitar immune to the high freq loss caused by long cable runs.

The CLARIFIER kit is available in two options, both of which include a high quality drilled, legended, and masked circuit board, as well as complete step by step instructions. Kit 2450 contains everything needed for a complete unit.. Kit 2455 contains everything execpt the pots (for those who prefer a particluar brand of potentiometer). Batteries are not included with either kit.

KIT 2450....Complete CLARIFIER kit . $18.95
KIT 2455.....CLARIFIER less controls ..$14.95

TERMS: (Check, Money Order, Cashiers Check - Add .75 if under $10.00)— ($10.00 minimum on C.O.D. (UPS only) add $1.50)— (Mastercard and Visa: $10.00 minimum. You must supply exp. date.)— (Indiana residents add sales tax.)

SHIPPING AND HANDLING: $1.00 plus 5% of purchase. We will credit any amount over our standard rate.

SATISFACTION GUARANTEED!

SIGNAL DIODE

601-60	1N914 (1N4148) signal diode	5/.35

TRANSISTORS

2N3904	2N3904 NPN Transistor	.25
2N3906	2N2906 PNP Transistor	.25

POTENTIOMETERS

(3/8 long shaft, 5/16 mounting hole)

854-401	10K Linear taper	1.09
854-501	100K Linear taper	1.09
854-505	500K Linear taper	1.09
855-401	10K Audio taper	1.09
855-501	100K Audio taper	1.09
855-505	500K Audio taper	1.09
856-401	10K Audio taper with on/off switch	1.25

TRIM POTS (vertical mount)

802-251	250 ohm trimmer	.40
802-103	10K trimmer	.40

MINI TOGGLE SWITCHES

403-20	SPDT (on/on) sub-mini (3A)	1.20
403-40	DPDT (on/on) sub-mini (3A)	1.50
405-10	SPST (on/off) bat handle (6A)	1.85

LED's

Please note that the typical DC forward current (I-fwd) of these LED's is less than those offered elsewhere making these LED's ideal for battery circuits or others where current consumption is a factor.

305-201	Red T-1¾ jumbo diffused (20 ma.)	.30
305-202	Green T-1¾ jumbo diffused (30 ma)	.40
305-203	Dual T-1¾ jumbo diffused (50 ma)	.90
305-204	Tri T-1¾ jumbo diffused (20 ma)	1.50

Note: 305-204 is a three lead, tri-color (green, red, yellow) device. It is essentially two separate LED's in one package. (The yellow is obtained by turning on both green and yellow.)

JACKS and PLUGS

1/4 In. PHONE JACKS

901-101	Mono standard phone jack	.45
901-103	Mono with n/closed contact	.52
901-105	Mono encl. jack (open back)	.55
902-211	Stereo standard phone jack	.70
902-213	Stereo encl. jack (open back)	.77

1/8 In. MINI JACKS

903-351	Mono with n/closed contact	.32
903-353	Mono encl. (open back)	.26
903-355	Mono enclosed with contact	.35

RCA JACKS

921-100	RCA jack, chassis mount	.34
921-200	RCA jack on phenolic mount	.25
921-300	Dual RCA on phenolic mount	.43

1/4 In. PHONE PLUGS

911-201	Mono, black phone plug	.48
911-203	Mono, red phone plug	.48
911-205	Mono, chrome (metal) plug	1.20
911-211	Stereo, black phone plug	.65

1/8 In. MINI PLUGS

913-251	Mono, black mini plug	.38
913-253	Mono, red mini plug	.38
913-255	Mono, chrome (metal) plug	.56

SWITCHING JACKS

These are stereo phone jacks that contain an independent switching sywtem that is controlled by the insertion of the plug. Jack 905-301 contains the equivalent of a DPST normally on switch. Jack 905-302 contains the equivent of a DPDT on/on switch making it ideal for switching bi-polar power supplies on and off in effects boxes, etc.

905-301	Stereo jack with SPST switch	.90
905-302	Stereo jack with DPDT sw.	1.00

PGS ELECTRONICS
Route 25 - Box 304
Terre Haute, IN 47802

EQUIPMENT EXCHANGE

PUT POLYPHONY TO WORK FOR YOU. List equipmment for sale or trade, job openings, positions wanted, etc. Equipment exchange classified rates for individuals offering goods or services for sale or trade: 25c per word, 20 word ($5.00) minimum charge; Commercial establishments: 50c per word. Prices, zip, phone numbers count as one word each. DISPLAY CLASSIFIED: $15 per column inch, one inch minimum, camera ready art to be supplied by advertiser. All classified advertising must be prepaid. Advertisers using a Post Office Box number for responses must furnish Polyphony Publishing Co. with a complete street address and phone number. Readers should respond directly to advertiser. Polyphony is not responsible for claims made in ads, or for the results of any transactions. Polyphony reserves the right to edit or refuse any ads submitted.

Music equipment

SYNTHI-AKS briefcase synthesizer, as used by Eno, Pink Floyd. English made with all manuals EC. 850.00. Octave Catstick EC. 200.00. Sharp 250 cassette deck EC. 95.00. Korg PS-3010 Keyboard with extras 200.00. All items tradeable. Call Walt (314) 429-2858.

ARIES Synth: 2 cabinets, 18 modules + keyboard. Dual VCO, LFO, Mixer, 3 ADSR's LoPass, Multi-mode fulter, 2 VCA's, Phaser, Preamp/EF, sample/hold, 8X2 sequencer, 4 switches, Dig. Divider, Joystick. Excellent condition - all documentation $1,000. Mark Styles 272 East 10 St., No. 4, NYC, NY 10009 (212) 677-3531.

FOR SALE: PAIA 3 octave keyboard with 8700 computer (memory expanded), dual digitizer, 8 channel QuASH with linear outputs and many programs, $500. 3 boxes of various function modules based on SSM and Curtis ICs, call or write for prices and details. Harry Norris, RFD #3 Burt Hill Rd., Winchester, NH 03470, (603) 239-4840.

FOR SALE: 8782 Digital keyboard, 8700 computer, power supply, cass. interface. $300. Misc. 2700, 4700 and 8700 synth modules, all 1/2 off list price. Eugene Watson, R.6 #117 Park Ln., Carbondale, IL 62901 (618) 529-2395.

CHAMBERLIN M-2 Fully polyphonic, tape activated, split keyboard, road case. P. O. Box 13128, San Diego, CA 92113. 562-6177.

FOR SALE: PAIA P4700-J. Includes Computer Drums, Patch cords, all manuals and software. Needs new QuASH. Asking $750. Call (201) 736-4229.

Digitally controlled analog synth. hardware: 2 PAIA Proteus voice boards, computer interface circuit (memory, D/A's, power supply) enclosure, extensive patch bay, PAIA Drum board; all assembled and working, complete documentation $450; for use with DSI-AN7000II TRS-80 work alike computer, also assembled and working $90; TV for use as display, 12" JCPenney (mint, late model) $65; RMI300b Electric Piano (5 octave, w/interface circuitry) $390. $800 takes all, a good buy for someone who can write software to run the system (Z-80 based). All hardware professionally assembled (by audio technician/ engineering student). Also: ALPHA SYNTAURI DIGITAL SYNTH., mint condition, rarely used. 5 octave touch sens. kbd.,has alpha+, metatrak, composers assistant, sounds trio, and preset sounds software: $1600 (save $600). Write for more info. or leave message (717) 733-3520 Tom Wiegand POBox 330, Ephrata PA 17522.

Parts

FOR SALE: SSM IC's and misc. from college project that never worked out. Stuff for sale as is, but is new and unused unless noted. 17 - SSM2020 VCA, 35 SSM2040 VCF, 30 SSM2050 ADSR all $6.00 each. CMOS 4016A 3/$1. 4069/74c04 used, tested 4/$1. 130 Switchcraft Hi-D 1/4" mono phone jacks 3/$1. 75 Allen Bradley 100K linear type J pots $1 each. 159 red 1-1/4" dia. knobs with aluminum inset 3/$1. Al Duester, 19 Quissett, Woods Hole, MA 02543.

Recordings

FREE: 10 minute cassettes from PROJEKT ELECTRONIC AMERIKA (influences: Kitaro, Eno, Vangelis). Write 8951 SW 53rd St., Cooper City, FL 33328.

Misc.

NORTHWEST CALIFORNIA -- New 2 bedroom home, secluded 10 acres with trees and valley view. $103,000. Call for details if you want to live in the natural beauty of Mendocino County. Jack, California Realty, 707/485-0771 or 707/462-0555.

CABLE - SATTELITE - MICROWAVE - UHF - VIDEO ACCESSORIES. S.A.S.E. 40c. H.M.S. 2011 W. 11th St. Upland, CA 91786.

AD INDEX

Psycho-acoustic Satisfaction

A speaker design with your ears in mind

When we designed the "SD" Speaker Series, our goal wasn't to produce impressive specs — we wanted to produce great sound.

Sure — extended frequency response was important. So was a smooth crossover between lows and highs. But most important was psycho-acoustic satisfaction.

Acoustics is the science of sound. But psycho-acoustics goes deeper. It's the science of how the brain perceives sound. We wanted a speaker that pleases the brain, so we focused on the characteristics that affect your ears, not our speakers.

Characteristics like tonality . . . transparency . . . and faithfulness to the original sound.

So we designed a three-way system, not two-way, for an all-around sound. For a punchy, tight bottom end, we incorporated acoustic filtering on the front panel. And we put in a moving coil tweeter for a clean high end with lots of definition. In total: great sound.

And great sound means great specs.

Specs like 360 watts continuous power handling. . .a very sensitive 102 dB efficiency rating. . .and smooth response over a wide 50 Hz to 20 kHz bandwidth.*

The Thiele-Small aligned bass reflex cabinets are a real plus. So is the high-frequency attenuation that lets you tailor the SD's output to your performing requirements and the room acoustics.

*Model 38SD

Then there's ergonomics:

- ☐ a protective steel mesh
- ☐ recessed handles
- ☐ interlocking corners for easy stacking
- ☐ a built-in adaptor for stand-mounting

Small. Lightweight. Built to take the abuse of the road. Sold with a two-year warranty. What else is there?

Besides psycho-acoustics, that is.

For complete technical data call or write:

TOA Sound & Communications

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(415) 588-2538

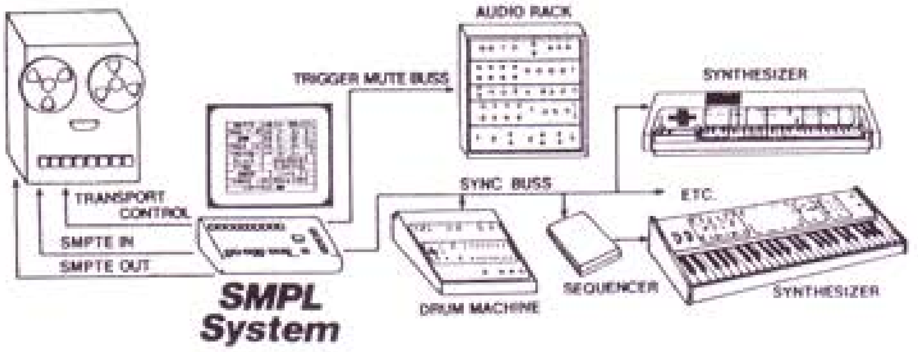
In Canada: TOA Electronics, Inc.
10712-181 Street, Edmonton
Alberta T5S 1K8
(403) 489-5511

AT LAST! COMPUTER AUTOMATION FOR THE SMALL STUDIO

THE SMPL SYSTEM BREAKS THE PRICE BARRIER FOR SMPTE TIME CODE

Synchronous Technologies' SMPL System is the only time code device specifically designed to solve the problems of the smaller recording studio. In one integrated package it provides functions and features which can't be duplicated with existing time code equipment even at many times the system's low price. Functions include:

- SMPTE Time Code generator
- SMPTE Time Code reader
- Automatic Punch In/Out
- Drum and Synth Sychronizer
- Programmable 8 event sequencer
- Autolocator
- Time Code Metronome
- Recorder Remote Control



IT'S THE ENGINEER YOU ALWAYS WANTED

With the SMPL System, insert editing no longer requires the combined skills of engineer, musician and juggler. During review, Punch In and Punch Out points are set on the fly and saved in the computer's memory. Separate Rehearse and Take modes allow you to rehearse and preview the edit points as many times as necessary before committing to tape.

Eight programmable event outputs are useful for triggering effects, changing instrument presets, fractional measure channel muting and much more.

The eight autolocator points let you get from section to section with a minimum of hassle and wasted time. And a separately programmable CUE point controls the recorder for a looping function at the end of rehearsals and takes. You concentrate on the art, the system attends to details.

SYNC-LOCK THE NEW GENERATION OF INSTRUMENT/RECORDERS

Through the SMPL System's MIDI standard 24 tick/beat synchronizing buss, an ever increasing number of Polyphonic Synthesizer Sequencers and Electronic Drum Sets can be precisely synchronized to material on tape. Many pre-MIDI instruments also conform to this standard and other non-standard sync formats can be handled with modest additional equipment.

Unlike tone or click-track type synchronizers, the SMPL System can be started at any arbitrary point in the work and the computer intantly calculates the correct phase of both metronome beat and synchronizing signal. You save time and aggravation by not having to play through the entire work to do an edit at the end.

MORE, HIGHER QUALITY "TRACKS"

Since much of today's commercial music involves digital drums and sequencer controlled polyphonic synthesizers, the SMPTE track can replace numerous tracks which might otherwise be recorded as audio. Not only does this effectively increase the number of tracks available, it allows these tracks to be mixed first generation to the master tape. No more loss of quality from ping-ponging and dubbing.

AN OFF LINE TERMINAL FOR THE ENTERTAINMENT INDUSTRY'S SYNCHRONIZING NETWORK

The benefits of using industry standard non-drop format SMPTE Time Code can't be overstated. With the SMPL System, tapes produced in the small studio will transport to larger studios and be compatible with automatic mix-down and chase-locking equipment.

Even if you never need to sync audio to video, this compatibility has compelling economic advantages. Tapes produced on machines with limited tracks can be "pyramided" to 24 and 40 track studio machines, allowing you to create in your own environment at your own pace and still have easy access to expensive studio facilities on an as-needed basis. In many cases, your savings in billed studio time will quickly pay for the SMPL System.

A VERY HUMAN INTERFACE

Either a Color or B/W Monitor or TV set can be used as the display device for the SMPL System. The easily readable display provides all current information on the operation of the system including operating mode, metronome tempo, current time, In/Out points, CUE point, recorder status and more. And the SMPL System doesn't require an advanced engineering degree to operate, all functions are straight forward and obvious.

IT'S A COMPLETE, LOW COST SYSTEM

Not only is the SMPL System itself low in price, it's designed to be used with lower cost multi-channel cassette or open reel recorders by simply plugging into their normal remote control jacks. Neither tachometer output nor speed control input are required. Even recorders without remote control jacks can usually be modified for use with the system.

The complete SMPL System consists of: Personal Computer with keyboard modified for SMPL functions, SMPL System Software/Interface cartridge, VHF channel 3/4 modulator, power supply and Using and Installation manual.

SMPL System .... **$995.00 (12 lbs)**

CALL OR WRITE FOR THE NAME OF YOUR NEAREST DEALER.

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SYNCHRONOUS TECHNOLOGIES

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