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August 1984

AN INTERVIEW with BILL NELSON

REMOTELY MIDI, PART II

E-H INSTANT REPLAY REVIEW

ISSN: 0163-4534

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AUGUST, 1984

FEATURES

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REGULARS

ON THE COVER: The MIDI Remote Keyboard as interpreted in an illustration by Lee Strauss.

Letters

EDITOR'S NOTE: ATTENTION EUROPEANS!

I expect to be visiting Europe in early-to-mid November, 1984. While I'm there, I hope to visit electronically-oriented musicians in a number of different countries. I would like to hear from any European readers who are eager to discuss musical electronics, are willing to put me up for a day or two, and possibly, could introduce me to other local electronic musicians. If you're at all interested, please write as soon as possible so that I can start working on my itinerary. Incidentally, I speak French and a little bit of Spanish and German. I look forward to hearing from you, and hope to see you in November! Thank you very much.

Craig Anderton, Editor

INTERFACE BLUES, PART 1

Some time ago I purchased a voltage controlled ADSR from PAIA Electronics, and would like to use it on my electronic organ. Will it accept an analog signal into the trigger input?

Charles Schrade
San Jose, CA

Charles -- ADSRs are generally designed to accept a logic "high" signal at their gate inputs (i.e. a steady-state DC voltage around +5V, or sometimes +10V). Generally a trigger is derived from this logic high signal by differentiating the signal through a capacitor/resistor combination. One way to interface a gate input to the organ is to take a separate feed from the organ audio output, rectify and filter it to convert it to DC, then amplify it (if necessary) to obtain the output level required to drive the ADSR gate input. You would then use the ADSR to control a VCA that inserts between the organ output and amplifier. However, by following this approach you will only be able to generate attack, decay, and sustain since taking your fingers off the keys initiates the release function; and if your fingers are off the keys, there's no sound to release. Also, note that the envelope will affect the overall sound, not each individual note.

INTERFACE BLUES, PART 2

In the past year, I have purchased a Timex ZX81 with 16K memory, Roland Juno 6, and Boss Dr. Rhythm. We both know that these toys cannot be interconnected...or can they, with the right modification? Can I interface the Dr. Rhythm to the ZX81? Can I store melodies on tape or in the ZX81 for later playback? Can the Juno 6 accept MIDI? Can I change the Juno 6 chorus speed and make it less hissy?

C. L. Jaszberenyi
Toronto, Ontario, Canada

C. L. -- For those questions relating to mods (i.e. changing chorus speed), your best bet would be to contact a Roland service center that has schematics for the equipment. Regarding interfacing to a computer, this is not like plugging into an amp by any means. If you intend to do any serious experimentation with keyboards and computers, both need to be designed with that specific task in mind. Sorry to be discouraging, but some things just aren't easy.

INTERFACE BLUES, PART 3

I have followed Thomas Henry's Micro-Drums articles with great interest, and have constructed the necessary hardware.

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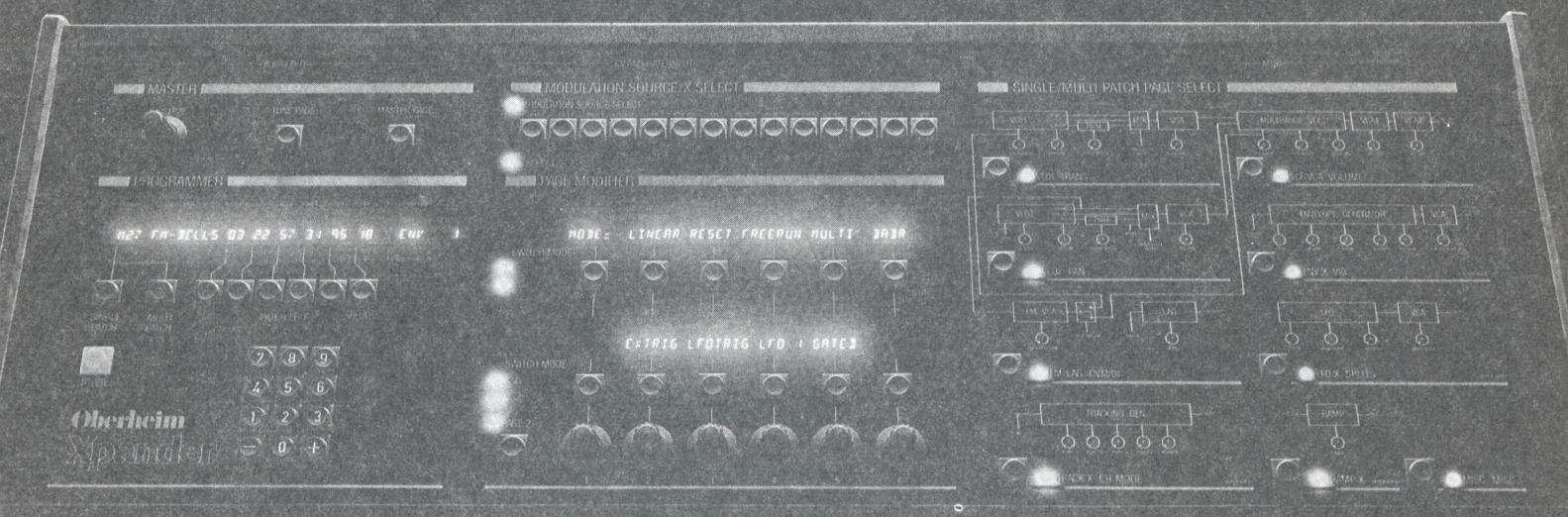
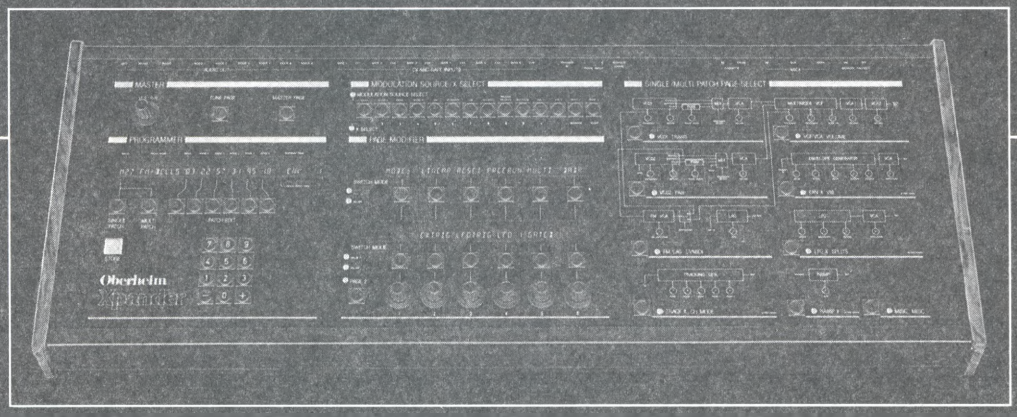
A FANTASY REALIZED





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However, many readers -- myself included -- certainly must feel left a little bit short on the software end, since Tom's program is written for a microcomputer which is no longer available, the PAIA 8700. My own 8700 has recently decided to call it quits, so I have more at stake here than most people; perhaps some ambitious computer-knowledgeable reader could translate the Micro-Drums program over to the Commodore-64, which seems to be the music-oriented budget computer.

I would also like to express my appreciation for the great bass drum circuit (October '83 Polyphony). I thought my bass drum sounds were pretty good until I heard this! How about a good handclap circuit?

David Myers
NY, NY 10014

David -- Re handclaps, we don't have that in the works but be sure to check out Thomas' hi-hat circuit in this issue. Concerning Micro-Drums, we asked Thomas if he had a listing for the C-64; his reply follows.

"I'm afraid I just don't have time to follow up on this just now (I'm in the middle of my thesis for a Master's Degree); however, in a few months I may be able to look at the conversion problem. Here are a few thoughts on the matter.

"First, the conversion should be straightforward; although the keyboard entry stuff will look different, the basic logic of the program will be similar. However, before a conversion is possible, it is necessary to know exactly what address David mapped Micro-Drums into, and what other assumptions his implementation makes. Ideally, the person owning the hardware should write the software so that immediate testing is possible.

"I would be willing to write the software for a Commodore-64 Micro-Drums, if someone else will take on the task of writing up the user's instructions. That is, in several weeks, I'll have enough time to write the software if someone else will take on the documentation part of the article."

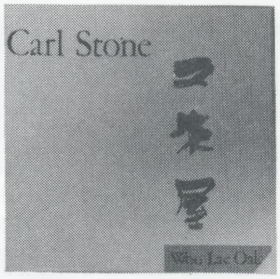
Incidentally, I'm sure that Thomas would place a high priority on this project if lots of people wrote in and wanted a C-64 Micro-Drums. I'll cast the second vote

Robert Carlberg's re-view

This column is not in the business of selling records. That's why you won't see "Highly Recommended", * * * *, "A Must Buy" or similar suggestions. Sometimes that means a good record gets hidden in the middle. Sometimes it means a bad record is described for what it is. Either way, the column only provides a forum for announcing what's available, and hopefully gives some idea of what to expect. Comments, questions and items for review are all welcomed, and should be sent to **Polyphony Reviews**, P.O. Box 16211, Seattle WA 98116.

Group 87 **A Career in Dada Processing** (Capitol 12334). Post-electronic music from keyboard/-trumpeter Mark Isham (Feb '84), percussionist Peter Van Hooke and electronic guitarist Peter Maunu. I call it "post-electronic" because they take gorgeous electronic colors and actually do something with them -- in this case a combination of slow stately themes and faster rhythmic constructions. It's highly composed and very sophisticated and I played it about 23 times straight through.

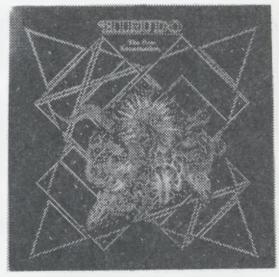
Steve Tibbetts **Safe Journey** (ECM 1270). Enigmatic guitar with various hand drums and conundrums. It's closer in spirit to the first two self-produced albums (reviewed May/June '81) than the third ECM-produced album (Sept/Oct '82), probably because it was recorded back home in Minnesota.



Carl Stone **Woo Lae Oak** (Wizard 224). Four minutes shy of an hour of one continous drone made up of a rubbed string and a blown bottle. Artificially extended by tape studio techniques, it varies texture constantly -- sounding at times like a string quartet, at times like guitar feedback, at times like Eno's Ambient series.*

Gale Ormiston & Carl Weingarten **Windfalls** (Multiphase 003). Dual synthesizer drones heavily influenced by Fripp & Eno and Kitaro and all that mid-70s mellowness.*

Yazoo **Upstairs at Eric's** (Sire 23737-1). In a never-ending search for tasteful applications, one might pause momentarily on this duo. Love lost, love found, tunes you've heard a million times in other clothes. We move on.



Hirudo **The First Incarnation** (H-001). Heavy chords and grand piano -- a very theatrical debut from Germans Uli Kutschera and Peter Fischer with maybe the ghost of Wagner. A self-financed release available through Eurock Distribution, P.O. Box 13718, Portland OR 97213.

The Happiness Boys **Resident Alien** (Duo-3, EP). They call it "aggressive structures for dance",

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EOE

An Interview With BILL NELSON

By: John K. Diliberto

"The Charleston was an appropriate soundtrack for the Prohibition era, rock 'n' roll was an appropriate soundtrack for the 50s, protest music for the 60s and Glam for the 70s. I just really think that that image of a guy strutting his stuff on stage with a shiny guitar in great clouds of dry ice had a certain magic in its day, but it was bound to be limited. In 50 years time there will be certain clubs in town where you can see people wiggling their hips around and playing guitar with their teeth. But it's not going to be the kind of vital music the the kids tend to cry out for."

--Thomas Dolby
from **Totally Wired '83**

That's easy for Thomas Dolby to say. He didn't start making music until synthesizers were firmly established and debugged for consumer usage. But what about those old guitar heros, musicians who wielded their Strats in the speed and distortion wars of the 60s and 70s? A lot of them are still at it, finding fewer novel paths between the sonic adventures of Jimi Hendrix and the high velocity forays of John McLaughlin.

Bill Nelson is a guitarist who gained a certain renown, waded through his share of dry ice, and wiggled his hips a bit when he was with his Glam-era band Be-Bop Deluxe. Be-Bop Deluxe put out several albums in the seventies, beginning with 1974's Axe Victim and continuing through until 1977's Drastic Plastic. Be-Bop Deluxe was always a forward-looking band, mixing state-of-the-art guitar playing with science-fiction imagery. Nelson has the dexterity and the signal-processing wizardry to orchestrate small symphonies out of each solo. While much of the music he wrote for Be-Bop sounds a bit leaden now, the savage grace of his guitar solos still hold up.

However, towards the end of Be-Bop's days, as Nelson himself began to push thirty, he saw the future of rock 'n' roll, and it was synthesized. He still wanted to make vital music, and the first inklings of his change came on Drastic Plastic, with its hard-edged, metric rhythms and modernistic lyrics. But, Nelson wanted more, and he saw the vehicle for his new music in the synthesizer with an ability to realize his music on his own. "It wasn't like my only thing in the band was to express myself as a guitar player," he recalls. "Suddenly there was no band. It was just myself and a 24-track tape machine surrounded by all this technology."

Nelson formed a new group, Red Noise, whose debut album (Sound-on-Sound) was almost all Bill Nelson playing drums, synthesizers, guitars, percussion, bass, vocals, and yes, a little guitar. Five years later, Sound-on-Sound still sounds fresh, alive and vibrant. It's full of odd song structures, stop-start rhythms, twisted lyrics and original instrumental textures which could be why it was also his swan song for Capitol Records. "In some ways it was a little bit ahead of its time," Nelson can now say with laughter. "That album actually lost me my deal with Capitol in the States...they heard it and couldn't believe I'd made such a quantum jump from Be-Bop to Red Noise." Capitol test marketed the record at 150 radio stations. The results, according to Nelson, were so extreme that even Capitol couldn't believe it. "They actually photostatted all the comments and sent them to me," Nelson recalls. "They thought I wouldn't believe them. They are so despairing that they're hilarious. There were things like, 'What is this crap?', 'Out Devos Devo', and 'Too whacko for us.' There wasn't one station that said this was great."

Be-Bop Deluxe fans were also chagrinned. "Where's the guitar?" they cried. Bill Nelson however, persevered, got new record contracts after a lengthy hiatus and has now developed one of the most original and provocative synthi-pop sounds around.

He also had a chance to go back into his own home-grown studio to make personal soundtracks of atmospheric guitar-synthesizer, musique concrete applications. It was almost a return to the very first Bill Nelson solo LP, Northern Dream (1971), recorded on a 2-track tape machine. Only now, instead of electrified folk songs, Nelson creates moody soundsculptures and dark landscapes. Three LPs of this genre have been released, Sounding the Ritual Echo, and two soundtracks for Yorkshire Actors Company performances of Das Kabinett (von Dr. Caligari) and Beauty and the Beast.

Nelson's concern with the nature and fabric of sound can be heard on these soundtracks and his more polished synthi-pop recordings. On tour, Nelson uses sophisticated digital synthesizers and percussion, yet he maintains a flexibility and true spontaneity that most synthi-pop bands would find completely alien. Bill Nelson, unlike programmers Thomas Dolby, Duran Duran, and Depeche Mode, can still kick out the jams onstage and improvise.

Nelson's current touring group can fully realize the complex rhythms and sophisticated tex-

tures of his recent works, Vistamix and The Love That Whirls. He has three keyboardists playing five Yamaha DX-7 digital synthesizers, two of which are connected together via the MIDI interface. One of those keyboardists is his brother, Ian Nelson, who plays oboe and saxophone. Drummer Preston Heyman employs a Simmons Digital Drum Kit that is sometimes triggered by a Linn Drum Computer. Heyman can assign complete rhythms to the computer, play parts by himself, or play parts in tandem with the computer.

Nelson himself plays only guitar on stage. He's currently using a Yamaha SG-2000S as his main instrument along with a Rickenbacker stereo 12-string for rhythm parts. His effects rack consists of an Ibanez Multi-Effects unit (with compression, flanging, stereo chorus, phaser, and overdrive), plus the Roland SD-3000 and Boss Digital Delays. He also uses an amazing device called an E-Bow to create the most gorgeous sustain, and finally, there's the familiar Morley Volume Pedal.

Nelson's home studio has improved from the 4-track TEAC deck on which he realized all of the instrumental albums. He currently has a Fostex A-8 quarter-inch 8-track, with a Fostex mixer. But when he gets home from his current tour he'll be settling in to the Fostex B-16, 16-track machine with an Allen Heath 24-Channel desk and Sony PCM F-1 digital mastering machine.

Nelson says he'll be doing more of his music at home now. Besides his stage equipment, his home studio has a Yamaha CS-70M synthesizer, Wurlitzer Electric Piano, Arp Omni, Casio 1000-P and 7000-P with the built-in 8-track, Casio MT-30, and several VL-Tones, all given to him by Casio.

After the rejection of Red Noise, Bill Nelson is hitting a new popular stride with creativity that only seems to increase with his 36 years. He still lives in Yorkshire with his second wife, Jan. He has three children, one by his first wife, whom he left after "she smashed my electric guitar," and two by Jan. He wears his hair in the peroxide, spikey blonde style that's popular with the current new wave, but as you will read, this synthi-pop artist is way ahead of the pop-star game.

John Diliberto: The big change in your music came with the Red Noise album, Sound-on-Sound, the first album after Be-Bop Deluxe. Then the next step in the evolution of your music seems to have been The Love That Whirls album. Your music's gotten more and more electronic.

Bill Nelson: The changes felt like a very natural progression for me although there were certain conscious elements to move things forward. I felt that when I was with Be-Bop Deluxe in its latter stages that we weren't stretching ourselves as far as we could as a complete team of musicians. I got my hands on a mini-moog synthesizer not long before we recorded our last album (Drastic Plastic). I also had a guitar-synthesizer, the Hagstrom Patch 2000, which was one of the earlier, primitive guitar synthesizers. I wrote most of the material on Drastic Plastic on a synthesizer.

We had a track on it called "Electrical Language" that utilized a drum loop, with the snare drum put through various devices, a fuzz-box and natural echo chambers. And I played guitar synthesizer on that. The whole basis of the song was that "I speak to you through electrical language. Maybe you hear me when our frequencies meet." It was all working on that kind of electronic imagery as well.

We recorded that in 1977 which was when punk was starting to catch on in England, which is very ironic since a lot of the guys who started out in New Wave punk bands eventually got into electronic dance music. "Electrical Language" was, in fact, an electronical dance track.

The whole thing went on from there. I got into the Red Noise thing to take some of that further; the actual visual and lyrical concerns of the Red Noise album were quite tongue-in-cheek, but actually dealt with a near future with the technology that was upon us. I started relegating the role of the guitar from a lead instrument to sort of a texture instrument. I used more chords and just minimized the soloing, making it hit hard, short, and out. It was not the centerpiece of the music.

JD: That had to be a complete change of consciousness for you, having grown up in the era of the guitar hero and having pretty much been one yourself with Be-Bop Deluxe.

BN: I got to the stage where the guitar on its own was no longer my main love. My main love was making music, having a statement projected through the musical medium. To restrict myself to one kind of tonal color seemed a bit narrow and primitive particularly with the advent of synthesis and the kind of sounds that I just couldn't get with a guitar. It gave much more expression to the song to be able to choose colors from this wide range of developing electronic sounds. So it didn't hurt to leave the guitar alone because I was still expressing myself through the keyboards, through the programming of drum machines, through the use of a bass guitar here and there. People often didn't pick up on the fact that I was playing 90% of the instruments on a track. They were listening for that guitar and when they didn't hear it they thought that I wasn't on the track.

JD: It was around that time that you also started doing instrumental pieces.

BN: That came about because I had a four-track system at home and I'd do these little doodles for fun. A few friends heard them and thought I should put them on record. The quality was very poor, distortion, drop-outs on the tape and all the rest of it. But we did put a record out called Sounding the Ritual Echo (the second disc of Quit Dreaming and Get on the Beam) which is purely these instrumental atmospheres. I've now got a box-set of four purely instrumental albums waiting to come out, which were all done on eight-track.

JD: Your instrumental work is really different from your songs. I have a whole different image of how you record them. They're much more atmospheric and moody...

BN: They're more spontaneous. They're very much like instant sketches. I allow a certain amount of error to stay there, whereas the songs are much more highly polished and have to be considered in a different light altogether. My feeling in making the instrumental music is to try to capture the initial impulse that I have to make that piece at the time. So I try to put tracks down very quickly and try not to do more than one take unless there are really serious errors in there. Any subtle error will get absorbed into the total picture by the time I've built up the layers.

I don't always know where I'm going in terms of the final melodies or arrangements. I allow each

track to suggest the next section. They're always around a central point in that I usually work it from a title first. I have a notebook with hundreds of titles in it and the titles come out of situations. I might hear somebody say something and I just write that down in the book. So when I go to do an instrumental piece I go through the book and select a dozen titles that have an immediate response and emotion for me. I put those down on a piece of paper and one by one I look at it, think about it and just start working with that title. I think of chords or a sound that go with that title and build a whole picture up from there. So it's very much a pure process without any second thoughts.

Sometimes I'll do a particular chord pattern and reverse the tape, chop it up and work with it going the wrong way for a while. The I'll turn it back again and work with it going that way. So you have all these elements that are actually produced by not quite knowing what's going to happen next. I keep allowing elements of chance and random things to occur so that I'm always being taken by surprise. And my surprise will produce a positive reaction that isn't too intellectually enlabored. The processes of making the tape are kind of intellectually worked out first, but not the music. Once the process is decided it will throw up a musical system, a means of reaching an end, that is often as much a surprise to me as anybody else.

JD: How does your pop song process differ?

BN: That's usually done in a much more calculated way. It usually starts from the basis of rhythm and working patterns on a drum machine. Again, I use titles as a spur. The lyrics are very important, too. They've tended over the last few things I've done to be more personal. So I work with visual imagery in lyrics and everything tends to be built up around that. There's an essential core put down, and then I work on the lyrics. As the lyrics take shape I can visualize tonalities and arrangements to sympathize with what's being put forward. The important thing is to say something, and not to be just a vehicle for a pretty melody or something that'll be easy to listen to on the radio.

JD: There has been a real shift in your lyrics from the Quit Dreaming and Red Noise albums to Love That Whirls and the new records. The earlier pieces involved interfaces with technology and a certain amount of alienation. You recent works are more personal, a bit on the erotic side sometimes with the technology as a surrounding, understood sort of element.

BN: I feel that the time is past for us to be awestruck by technology. There was a point in time where I was concerned very much, even with Be-Bop, the kind of imagery that technology throws up. For a while it was like the future was on our door-step and it was a culture shock sort of thing. I wrote about all the uses and misuses of technology. There's a song on Sound-on-Sound called "Stop-Go-Stop" about electronic brain implants for political and criminal manipulation.

I feel that that has now become a widely exploited genre, particularly in England, where every man and his dog is in a synthesizer band. They all use the same kind of synthesizers, hooked up in the same way, use the same processes. You end up with a very bland, but safe and acceptable kind of electronic music. It's acceptable to the radio there and the record industry and absolutely imparts no information about anything whatsoever. It doesn't say much about the people who are making the music.

So I've consciously backed off that on the last few things I've done. It's not that I've backed off technology itself. In fact, I've just gotten a new Yamaha DX-7 and the band I've got has five of them on stage. We're using a Simmons drum kit and a Linn Drum triggering it. I've got a rack of digital delays and E-Bows. So we're still using it, but it's the way we do it. I'm not too conscious of it. A lot of people say here we have a computer synthesizer and they approach it in a mathematical sort of way. I'm trying to approach things in a very organic, human way, so that the interface between people and technology is much more fluid and expressive. Instead of thinking about buttons, think about music. The machinery is here if you need it to help.

The Love That Whirls was an album of varied ideas based around trance things. The rhythmic structures were based on trance principles and eastern things, also in the melodies. The idea it was putting across was that there is a fusion between sexuality and mysticism that has obviously been known to the East for centuries, but which my generation may only know a little about. So I was dealing with those images in what on the surface is a very acceptable pop way. You could dance to it, you could sit back and listen to it. But at the same time there was this spirit in it, this blend of sex and religion.

That's been developed and become more subtle on the Chimera album, which is part of the Vistamix record in the states. Songs like "Tender is the Night" and "Another Day Another Ray of Hope," there's a kind of spiritual quality. It's not just sensuality, but there's an element of that in there. The music is more spiritually aligned. I'm conscious of not wanting to come across like some sort of brown rice and beads, far-out, let's drop some acid, you know. I've been through that and I've found it wanting. It's a more realistic and personal kind of discovery. It comes with age and maturity. I'm 36 now and I can't play at being a pop star anymore. I have to be a human being and one who expresses that humaness through his art. I'm learning to believe in myself a little bit more and not worry about whether it sells or not. I just worry about whether it was honest or not.

JD: From Red Noise to The Love That Whirls there was also a real rhythmic shift. On the Red Noise record you played drums and there were lots of maniac rhythms, stop-time sequences. Since Love That Whirls you've been using drum machines alot and the rhythms have become pretty static within a song.

BN: That's right. I've done things which repeat over a certain number of bars. I wanted to simplify things and have this element of repetition being part of the fascination of the song.

Some of the newer things, like the album I'm working on, are getting somewhat away from that. It's a little less rigid rhythmically and a little more organic. There's also a bit more guitar creeping in, mainly as a reaction to synthesizers becoming a common language. Not that it's bad particularly, but when I do things that sound like other things I start to worry a bit. I try to maintain that identity and personal vision.

JD: What came first, the ideas for the rhythms or

the drum machines that could produce them?

BN: On the Red Noise record I played a real kit and while I can conceive of rhythms, I don't have the physical stamina of a real drummer and there are certain things that I can't get past physically because the body gets in the way. For me the drum computer was just a means around that. It also enabled me to do poly-rhythmic things that I couldn't technically accomplish on a kit. So to have all these elements of percussion was like becoming a drummer and percussionist with limitless stamina and access to sounds that I could never get out of a normal kit.

JD: There've also been some ethnic elements creeping into your music. On **Savage Gestures** there's a kalimba and a marimba.

BN: I like the blend of acoustic and organic materials with synthetic materials. I like the contrasts and ironies that are created between the two. I've used marimbas on a couple of albums now as well as acoustic percussion. I've been using acoustic guitar too.

JD: Could you tell me how the E-Bow works?

BN: It produces infinite sustain, not by filtering the strings through any devices, though. It simply drives the string into permanent sustain by creating a magnetic field around the string causing the string to vibrate in that field. As soon as you take the E-Bow away it stops. It was invented by Greg Heet in California who gave one to me the first time I toured America with Be-Bop. Since I started playing guitar again in England, a lot of people heard it and asked me what it was, so now he's started making them again after having gone out of business. People like Big Country are using them now.

He gave me some new ones in LA which now have an on-off switch. You just hold it in your hand. It looks like a little iron or something.

JD: Do you pick with it?

BN: No, there's no picking at all. The E-Bow has a groove in the bottom and two finer grooves on either side of the main groove. The two finer grooves dampen the strings next to the one you're working on. When the bow is slid towards the pick-up, the magnet in the pick-up and the electro-magnetic in the E-Bow interact positively and negatively, thus creating a circle of energy around the string. The string starts vibrating and will keep going until the battery dies or you take the E-Bow away. You can adjust the harmonics of the note by sliding the E-Bow slightly forward or behind the hotspot on the pole piece (or by pushing down on the string -- Ed.).

After awhile you can make it do things and get incredible harmonic sounds out of it. It's a very fluid sound; I've used it with all kinds of effects in the studio, such as harmonizers tuned to fifths. It's easier to play the E-Bow one string at a time because changing strings is difficult and a a bit abrupt. So you have to think in modal terms and therefore you get very Indian kind of scales coming out.

JD: Even with all of the synthesizers, you still use a lot of musique concrete techniques.

BN: Oh yeah! Slowed down, double-speed...that came about initially when I started messing about at home with my four-track. I had no outboard processing gear whatsoever and wanted to achieve certain effects. I was doing the soundtrack to The Cabinet of Dr. Caligari, which is a very expressionistic play, like the movie with black & white images. I wanted to use lots of percussion but I didn't have much around the house. So I went around finding pots and pans, boxes, bits of wood to hit. I thought how can I make them sound less like pots and pans. So I did things like having the tape at half-speed when I recorded it, so when I played it back I'd get a pitch change and a faster pattern. I'd use reverse echo simply by turning the tape the other way around and re-recording it with echo and then turning back so that the echo comes before the note. I'd chop the tape up, record things off the TV and radio, just playing physically with the tape. It's an ancient and primitive technique, especially considering the things you can do with the new digital synthesizers. I find it nice to get to grips with it. I also think that certain crafts and technologies should be kept alive. It gives a certain quality that's hard to define.

JD: How do you like the sounds that you get on the digital synthesizers compared to the ones you get on your own?

BN: Well, I've got lots of other synths as well. My main synth until I got the DX-7, and it still will be my main synth because I like it very much, is the Yamaha CS-70M, which is an analog synth. But the beauty of it is that it comes without any preset sounds whatsoever. It has 30 memories on board that you can dump off onto magnetic cards. It's now obsolete even though it's only a few years old. But all the sounds I have in there are unique to me because you don't have any factory presets. It's also richer and mellower sounding than the DX-7. The DX-7s are brilliant for percussive voices, tubular bells, harpsichords, kotos and so on. Some of the stringier things aren't quite as nice as they could be but that's the nature of FM synthesis, I think. So I use the SC-70 for richer tones.

I've also got a mini-moog which is the first synth I ever owned. I still use it for bass lines because the oscillators are nice and fat.

JD: You mentioned that you acquired a younger audience after the switch to electronics. Do you think that limits you at all, in that you have to keep coming around to what that audience is into at the given time?

BN: Not really! I've never been as conscious as I should've been about my market. It's obviously a concern that I stay alive. I don't want to go back to the day job, you know? But beyond certain obvious things, like can we mix this so it will sound better on radio or whatever, the actual creation of the music is always whatever I'm interested in at any point in time. It just happens that a lot of the things I was doing towards the end of Be-Bop were laying the foundation for a lot of things that became new wave. The bands that I tend to work with in the studios, tend to be bands that have been to Be-Bop concerts and were fans anyway. They grew up learning from Be-Bop Deluxe, so there are common references all the time. So I'm not too conscious about keeping up or ahead or behind the younger ones.

People talk about rock being sexist, but it's also ageist in England particularly, though not so much here. In England, the age where you can be considered to be a pop musician gets younger and younger and finishes at an earlier date. There was a time when thirty was the end and now you're past

Cont. on pg.15

SUMMER 1984:

NAMM SHOW REPORT

by: Craig Anderton

(Editor's note: The following is excerpted and expanded from the narration for the "Summer '84 NAMM-On-Video", a one-hour VHS video documentary of the NAMM show. Produced by video director David Karr and hosted by yours truly, the video includes equipment demos, interviews, commentary, and background information on the latest musical developments. The "Summer '84 NAMM-On-Video" is available from Polymart for $49.95 plus shipping; see the ad in this issue for more info.)

The National Association of Music Merchants -- NAMM for short -- sponsors two trade shows per year for the music industry. These shows, which are closed to the general public, introduce the products and ideas which set trends in the music industry for months and years to come. This summer's NAMM was, as usual, a musician's dream come true: over a quarter million square feet of the latest in guitars, synthesizers, drum machines, recording equipment, pianos, accessories, and sheet music -- in fact, virtually anything that relates to playing music. It was attended by over 23,000 manufacturers, store owners, guest musicians, and members of the press.

The attitude at this summer's NAMM show was extremely positive, due largely to exciting new developments in electronic instruments. However, guitars -- electric, electronic, and otherwise -- also made quite a comeback. For example, the Gittler guitar, seen on the video for "Synchronicity II" by the Police, is a radical re-design of the traditional electric guitar. It is made totally of metal (you can even play it underwater, according to the inventor) with a long bar serving as the neck. The frets mount on this bar; the end result resembles a highly stylized fish skeleton (with the frets forming the ribs). Each string has its own pickup (which goes parallel to the string, not perpendicularly), thereby opening up a lot of possibilities for hex processing systems. The Gittler guitar is expensive -- in the $2000 range -- but it is beautiful, and functional as well.

T. F. Barrett exhibited a new electric violin, available with a plastic body, at the show. Sending the violin through different special effects produced sounds such as cello, plucked bass, string section, and lots more. There were also guitars made out of magnesium, tiny "travel" guitars, and guitars optimized for specific types of playing (such as the Melobar slide guitar). But there was also one entirely new type of stringed instrument called the Starrett Touchboard. Imagine an autoharp that's laid out in a square shape and has frets underneath the strings, and you have a pretty good idea of what John Starrett has come up with. Like Emmett Chapman's "Stick", another innovative instrument, the Touchboard is designed to be tapped percussively rather than plucked. One of the most unusual aspects of the Touchboard is that the strings are tuned chromatically, so you can increase pitch by either moving rightward towards the next string, or moving upwards on a single string.

Guitar synthesizers were also a hot topic at the Summer show. While early models had gotten a bad reputation due to numerous technical and design problems, Roland's newer GR-series of guitar synthesizers has gained widespread acceptance. In fact, Hamer now makes a guitar designed specifically for the Roland synthesizer, and you can even hook a GR-series guitar up to the Synclavier digital synthesizer. But the latest news was a prototype guitar synthesizer from JTG of Nashville, who gave a very convincing demo of the device's capabilities by hooking it up to a Chroma synthesizer. While not slated for production until the end of the year, the tracking was incredible and there was no detectable delay between hitting the string and hearing the note. You could also do some pretty bizarre tricks with the thing, such as flip the order of the strings so that the high string is on the bottom and the low string is on the top.

Although guitar synthesizers have improved remarkably in the past five years, they are still too expensive for many musicians. However, there is another way to coax synthesizer sounds from a traditional guitar: the E-Bow, invented several years ago by Greg Heet and now making a comeback at the Summer NAMM show. See the Bill Nelson interview in this issue for further comments on the E-Bow.

In special effects, Peavey introduced the "Cybersystems" programmable rack mount effects box. This device comprises a number of popular effects, plus a programmer that lets you store particular combinations of sounds for later recall -- just like a programmable synthesizer. A footswitch LED readout, oriented for easy viewing by the musician,

shows the currently selected patch. It's about time someone put out a product like this; guitarists shouldn't have to switch zillions of dials whenever they change sound settings.

Keyboards. At the January NAMM show, the MIDI specification and sampling keyboards (namely E-mu's Emulator II and the Kurzweil 250) had been the talk of the show. To recap, MIDI (the acronym for Musical Instrument Digital Interface) provides a communications link over which computer-controlled musical instruments can share data. For example, a MIDI compatible synthesizer can send data representing notes through the MIDI out channel into a second MIDI synthesizer's MIDI in channel. Since the second synth will play whatever is being played on the main keyboard, setting the second synthesizer for a different patch can let a single keyboard trigger two entirely different sounds. MIDI sequencers can store data which corresponds to the notes being played, and even drive several keyboards simultaneously (as well as drum machines) for "multi-tracking" effects. Adding home computers to the MIDI system increases your options -- software exists that lets you store more sounds than stand-alone units, print out scores, keep track of song lists, and more.

Of course, like any new technology MIDI is not without controversy. Some musicians have experienced difficulties getting MIDI equipment to work together, but several companies now offer help. In particular, JL Cooper Electronics specializes in producing MIDI interface boxes designed to take care of specific problems, such as interfacing standard analog synthesizers to MIDI.

Although digitally-oriented synthesizers have gotten most of the limelight at recent NAMM shows (i.e. Yamaha DX-7, Emulator, Kurzweil, etc.), Oberheim Electronics showed that there's a lot of life left in analog synthesis. Their latest product, the Oberheim Xpander, combines the flexibility of older modular synthesizers with the convenience -- and computerized efficiency -- of the latest programmable synthesizers. It's interesting that we seem to have come full circle from the early days when synthesizers didn't even have keyboards, but were thought of more as general purpose instruments: the Xpander has no keyboard and is designed specifically to be controlled from a MIDI keyboard, MIDI guitar synthesizer, or any other MIDI controller.

The Xpander includes several touches that make it a truly brilliant piece of engineering. First off, each of the six voices has amazing flexibility -- lots of filter modes (a la "Multiple Identity Filter" I wrote up for Keyboard several years ago), tons of LFOs and VCAs, scaling of any parameter, and so on. But more importantly, the Xpander is very playable and accessible despite its complexity. There are six pots (instead of the usual single pot) for parameter control, and multiple "pages" where the pots assume different identities (for example, if you're on the VCO page, the pots adjust VCO parameters such as pulse width). Best of all, there is an alpha-numeric display (one of several on the instrument) above the pots, and as you switch pages, the label above each pot changes to show its new identity. You can also name patches instead of just giving them numbers, which again makes life easier for the working musician. There was quite a buzz about the Xpander at the show, and it's easy to see why -- this is the most exciting event I've seen in analog synthesis since companies started making programmable synthesizers.

Some companies even combined analog and digital technologies. PPG, the German synthesizer company now distributed in the US by Europa Technology, showed the "Wave" system which uses digital oscillators and analog filters. The overall sound has the complexity of digital synthesis and the characteristic "warmth" of analog synthesizers.

Many synthesizer companies did not show new hardware but instead concentrated on software. Over at the Moog Music booth, the emphasis was on MIDI, computers, and software. Moog Music was one of several companies that has put extensive efforts into coming up with products to enhance their existing instruments. Octave-Plateau has also enhanced the Voyetra-8 with more features, including an IBM interface for patch storage. They also gave a great demo featuring Polyphony author Mark Styles.

Like Oberheim, Korg also unveiled a MIDI compatible expander module. Their EX-800 is essentially a Poly-800 without the keyboard; it can expand the sound of the Poly-800 or other MIDI-compatible synthesizers. Korg's new RK-100, a compact, lightweight, inexpensive MIDI remote keyboard capable of driving MIDI-controlled devices, seemed like a logical choice for controlling the EX-800.

Yamaha also debuted a new remote MIDI keyboard, the KX5, which lists for under $500. This is a pretty impressive piece of gear that even allows for dynamics.

A week or so before the show Kurzweil, makers of the Kurzweil 250 mentioned in my last NAMM report (April 1984 Polyphony), announced that synthesizer pioneer Robert Moog had been named chief engineer. Then, just a few days before the show opened, Kimball Organ announced that they had been collaborating on a synthesizer project with noted instrument designer Donald Buchla. The results of that collaboration, the Buchla 400 by Kimball, will go into production later this year. While I didn't get a chance to play with the instrument, what struck me as most significant was the way the system software handles music notation. As the music plays notes scroll across the screen, but the method of notation takes excellent advantage of the power of computers. Longer notes are represented by longer bars of color than shorter notes; also, different voices have different colors to aid in differentiating them. Prices were not given, but as this is a pretty high-end piece of gear I would assume the Buchla 400 will retail somewhere in the $14,000 range.

Computers. Computers have made their mark in consumer products as well as professional gear. Jazz guitarist Ryo Kawasaki designed a snap-on organ mini-keyboard for the Commodore-64, along with software that is graphically as well as musically appealing. Melodian also showed a keyboard add-on for the Commodore plus an easy-to-use software package. MusicData was one of several companies offering a MIDI sequencer for the Commodore 64, and JMC, a new German company, showed a MIDI-based multi-tracking system for the Commodore. The Sequential Circuits

MIDI sequencer, another C-64 compatible product, continues to grow in popularity; according to SCI, it's one of their best-selling products.

However, not all software was for personal computers. MusicData introduced a line of patch cassettes for various keyboard synthesizers and drum machines. These cassettes include ready-to-use patches programmed by recording artists, studio musicians (in fact, I have done MusicData patch cassettes for the Poly-800, OB-8, and Polysix), and in-house programmers at MusicData.

Synchronization. Synchronization goes hand-in-hand with synthesizers, drum units, sequencers, and computers -- after all, you need some way to make sure that all this equipment plays together. Many musical devices are now compatible with SMPTE, the synchronization standard for film and television. SMPTE is a digitally coded audio signal that keeps track of running time, and records this time every few milliseconds on film or tape. This recorded time code then serves as a master timing reference to which other devices may synchronize. By synchronizing a MIDI system to SMPTE time code, musicians can use the SMPTE signal as the timebase for a song's rhythm, thus guaranteeing perfect audio and video sync.

Roland presented the SBX-80 synchronizer, which allows any MIDI instrument to sync to SMPTE time code tracks. The SBX-80 also writes and records SMPTE time code, reads audio click tracks or MIDI, and can even convert rhythms tapped into the machine into a system tempo. Europa Technology demonstrated their latest SMPTE controller, and Korg introduced the KMS-30 MIDI synchronizer. Garfield Electronics had a number of new interface and synchronization boxes, including the "Nano-Doc". This relatively inexpensive unit accepts either 24, 48, or 96 pulses-per-quarter note sync signals (or the Roland DIN sync signal) and translates it into 24, 48, or 96 pulses-per-quarter note signals or the Roland DIN sync signal.

Drums. Programmable rhythm machines, like polyphonic keyboard synthesizers, have reached a level of maturity where the main emphasis is now on cost reduction. Naturally, you don't get something for nothing; the drum sounds on budget units often have shorter decays and poorer high frequency response than more expensive devices. Nonetheless, these low-cost drum machines make digital drumming possible for budget-conscious musicians (a related story on the Dr. Bohm programmable digital drum kit will appear in the October issue.) Korg received a great deal of interest for their DDM-110 and DDM-220 drum units, each of which retails for around $500. Rather than make one expensive drum machine with a wide variety of sounds, the DDM-110 provides standard drum kit effects while the DDM-220 provides percussive sounds, Musicians on a budget can start of with one machine and then, at a later date, sync the two machines together for greater flexibility.

Ensoniq, a new company formed by members of Commodore's original home computer design team which includes Polyphony author Robert Yannes, introduced two drum devices at the show with limited fidelity but extremely low price tags. Their "Drum Key" board plugs into an Apple II, turning this popular computer into a sophisticated drum machine for under $150(!). Ensoniq also showed a prototype stand-alone digital drum unit with a projected $200 list price.

Yamaha introduced an under-$500 MIDI compatible drum machine. The RX-15 offers good quality sounds and easy programming via either the unit's built-in controls or from any MIDI keyboard. Programming it from a dynamically-responsive MIDI keyboard is something else -- I had never seen a keyboard player play a drum solo, with dynamics, from a remote keyboard before.

As you might expect, the original drum machine makers continue to refine their products. There are now several sets of alternate drum sounds available for the E-mu Drumulator, Oberheim DMX, MXR Drum Computer I and their brand-new Drum Computer II, as well as for the pioneering Linn Drum. E-mu has further enhanced the Drumulator with the Graphic Rhythm Composer software package, which gives the Drumulator more memory and programming flexibility by interfacing it to an Apple II computer.

However, programmable drum units are not all there is to electronic percussion. All-electronic drum kits, such as those made by Simmons, are played like conventional drums and respond to all the nuances associated with traditional drumming; yet they provide virtually unlimited sounds that can go way beyond those of acoustic drums. In fact, in addition to triggering drum sound modules, drum pads can also trigger analog keyboard synthesizers, digital sampling devices, or analog special effects. Some electronic drum kits offer optional sequencers, or home computer interfaces, for drummers who want to program parts as well as play them. One of the benefits of the all-electronic drum kit is that you may combine sequencing and manual playing, where the sequencer plays repetitive patterns and the manual playing adds accents and fills. This enables one drummer to sound like many drummers.

Looking towards the future, Simmons, Akai, and others will soon introduce devices that allow the musicians themselves to record their favorite percussion sounds into memory ICs. These custom ICs may then substitute for the stock memory ICs included with the drum unit.

It's interesting that only a couple of years ago, some people thought programmable electronic drums would obsolete human drummers. But if anything, electronics has given drummers more of the spotlight than they have ever had before.

Recording. The four track cassette decks introduced at previous shows -- such as the Yamaha MT-44, TASCAM's high-end Model 234, and the notebook-sized Fostex X-15 -- remain extremely popular. In the world of stereo cassette decks TOA, a new company with some really interesting products, showed a powered mixer with a built-in cassette deck suitable for recording a performance or playing back recorded sounds.

With respect to recording accessories, Fostex introduced a four channel portable mixer with built-in compression to complement their X-15, but digital reverberation gained the most attention. Formerly costing thousands of dollars, the price of digital

reverb is dropping rapidly thanks to recent technological advances. Lexicon introduced the PCM-60, retailing for about $1500; MXR updated their 01 reverb introduced at the last show; and Yamaha continues to produce both pro and semi-pro digital reverbs.

I recently had a chance to check out the 01, and must say that I'm quite impressed. The degree of control, and the quality of sound, is astonishing. Digital reverb is an effect whose time has come; in the months ahead, we can expect several companies to introduce even better and more cost-effective digital reverbs.

Last NAMM show Synchronous Technologies demonstrated a prototype of the SMPL system (a unique tape recorder controller and synchronizing device) at the TASCAM booth. This show, they had their own booth and demonstrated the latest version of SMPL. It now provides 96 and 48 pulses-per-quarter note sync outputs in addition to the standard 24 pulses-per-quarter output, as well as boasting some other enhancements.

While SMPL is designed to retrofit almost all existing tape recorders to computer control, Akai now makes a recorder with many computerized functions built-in. Long known for their consumer audio products, Akai entered the music market in a big way at the Summer '84 NAMM. They not only introduced a complete line of MIDI compatible electronic instruments (including the AX80 polyphonic synthesizer, MR16 drum machine, MS08 sequencer, and "Memory-Cussion" drum pads), but also the MG1212 twelve-channel mini-recording studio that combines a transport and mixer. The tape transport uses 1/2" tape cartridges (not standard VCR cartridges, however) and provides 14 tracks. Two of these tracks are used for synchronization and control purposes, thus leaving 12 tracks free for audio recording. The MG1212 includes automatic punch-in, muting, search-to-cue, and similar functions (although it does not use a standard time code format such as SMPTE). Priced at around $7000, Akai's latest machine seems designed to compete with the new generation of low-cost 16 track recorders by offering computerized functions at little additional cost.

Conclusions. As the NAMM show drew to a close, several trends became clear. While electronic instruments remain extremely popular, acoustic instruments continue to evolve and are making somewhat of a comeback. Also, guitars are back in the limelight after being eclipsed for a few years by all the new electronic developments.

Home recording has yet to peak, as more and more musicians settle in at home with their four and eight track machines. And MIDI is extremely significant; its influence is so pervasive that most manufacturers accept it not as the wave of the future, but the wave of today.

Finally, computers were everywhere: inside instruments, as stand-alone units, as vehicles for useful music software, as sequencers for MIDI equipment, and more. If anyone had any doubts, this show proved that the marriage of music and computers is going to last for at least a while.

So that's it for 1984. I can hardly wait to see what's going to amaze and delight us at the next show, scheduled for Anaheim in early 1985.

BILL NELSON...Continued

it if you're twenty. Obviously that's bunk and rubbish and should be thrown out the window right away. Not because I'm getting old but because I've never felt that way. If you look at serious music, as opposed to folk or pop, most of the best things are achieved in the composers' middle-age. Obviously there are exceptions, but there's a maturing process that takes place and the art becomes stronger and more powerful with the experience behind the years.

JD: Do you have any keyboard technique that you bring to the synthesizer?

BN: I had no knowledge of keyboard playing whatsoever and even now my keyboard technique is minimal beyond belief. But I can get out of it what I need to make the thing work.

The poor guys that are playing for me now are all highly regarded English session guys and good musicians and I give them these quirky things, like playing a line 100 times and then playing it another 100 times with just this one note change. They think I should get a sequencer and I say, well I could, but it sounds better when people play it. It sounds different. So I've refused the temptation to hook everything up to an MC-4.

JD: You don't use any sequencers at all?

BN: I've never used a sequencer at all and anything that sounds like a sequencer, isn't. It's me actually playing it over and over and over again.

(John Diliberto is the co-producer of Totally Wired, an ongoing radio documentary program on electronic music. The first 26 episodes of Totally Wired have been aired on National Public Radio stations throughout the U.S. Totally Wired Mark II, which will include this Bill Nelson interview, will begin airing in January of 1985. For more information, write to Totally Wired, Box 5426, Philadelphia, PA 19143.)

Discography

Artist	Album	Label
Bill Nelson	Northern Dream	Smile
BeBop Deluxe	Axe Victim	Harvest
	Futurama	Harvest
	Sunburst Finish	Harvest
	Modern Music	Harvest
	Live In The Air Age (plus live EP)	
	Drastic Plastic	Harvest
	Best And The Rest (Double)	Harvest
	A's and B's (compilation of singles)	Heritage
Red Noise	Sound on Sound	Harvest
Bill Nelson	Quit Dreaming and Get On The Beam	Mercury
	Sounding The Ritual Echo	Mercury
	Das Kabinett (the cabinet of Dr. Caligari)	Cocteau
	The Love That Whirls	Mercury
	La Belle et la Bette (Beauty & the Beast)	Mercury
	Chimera	Mercury
	Savage Gestures For Charm's Sake	Cocteau

Practical Circuitry

The HI-HAT & PERCUSSIVE VOICE

by: Thomas Henry

I hope your soldering iron is hot and you're all set to start building, because this time in "Practical Circuitry" we're going to develop a new circuit which is sure to appeal to lots of users! You will recall that here in the pages of **Polyphony** we've already seen how to synthesize fairly nice snare drum and bass drum sounds (see my "Snare Plus Drum Voice," September/October 1982, pp. 28-31 and Craig Anderton's "Build the Hip Bass Drum," October 1983, for full details). This time we're going to wrap up the drum kit with the addition of a hi-hat synthesizing circuit. In fact, this circuit does quite a bit more than just hi-hat type sounds, so I have dubbed it the "Hi-Hat Plus"! If you're looking for a new drum sound, check this one out; it creates a number of sounds unattainable with standard drum voices.

Now I'm not going to claim that the Hi-Hat Plus exactly duplicates the sound of a standard hi-hat, but it does suggest the sound more closely than any other analog circuit that I've heard. It does this by making available an "open" and a "closed" sound, tunable "clank" and several other exotic features. It can be triggered by a computer output but is equally usable with a manual triggering system. A foot pedal can "open" and "close" the "cymbals" just like a real hi-hat. If I haven't enticed you sufficiently, read on and see what else this unusual drum circuit has to offer.

To fully understand how the Hi-Hat Plus works, we first need to get some terminology out of the way. Not being a drummer, I just made up the words but they should be descriptive enough to convey the ideas. A true hi-hat generates at least three distinct sounds. The first is the sound of the stick hitting the surface of the cymbal; I call this the "impact" tone. The metallic chime of the cymbals (as opposed to the sound of a drum body, for example) follows immediately. We'll call this parameter "clank". Finally there is the sound of the two cymbals beating against each other and this will be called the "clatter." Obviously the clatter will sound different depending on whether the cymbals are open or shut tightly against each other. To distinguish between these two cases, we'll refer to the clatter sounds as "open" and "closed." With these notions under control, set's see what it takes to generate a hi-hat sound electronically.

Figure 1 shows a block diagram for the Hi-Hat Plus circuit. In general terms, note that there are three sound sources; one creates the impact, another the clank and the last generates the clatter sound. The three sounds feed the master VCA, which is modulated by one of two possible envelopes. The envelope select logic determines whether the envelope should be that of the open sound or closed sound. It selects the proper envelope generator by means of an open trigger, closed trigger or by detecting what the foot pedal is doing at present. If you're playing the circuit in realtime, for instance, you would feed a series of triggers to the open trigger input, and then depress the pedal (which is nothing more than an SPST footswitch) to select the closed envelope generator. Alternatively, a computer could send either open or closed triggers to the unit and these would automatically select the proper envelope.

Let's back up a bit and see how the three sounds are generated. The impact tone generator is identical to the one used in the "Snare Plus Drum Voice" (see reference above). Two parameters are available for twiddling, the pitch and the volume. By adjusting the impact pitch control it is possible to go from dull thuds to bright snaps.

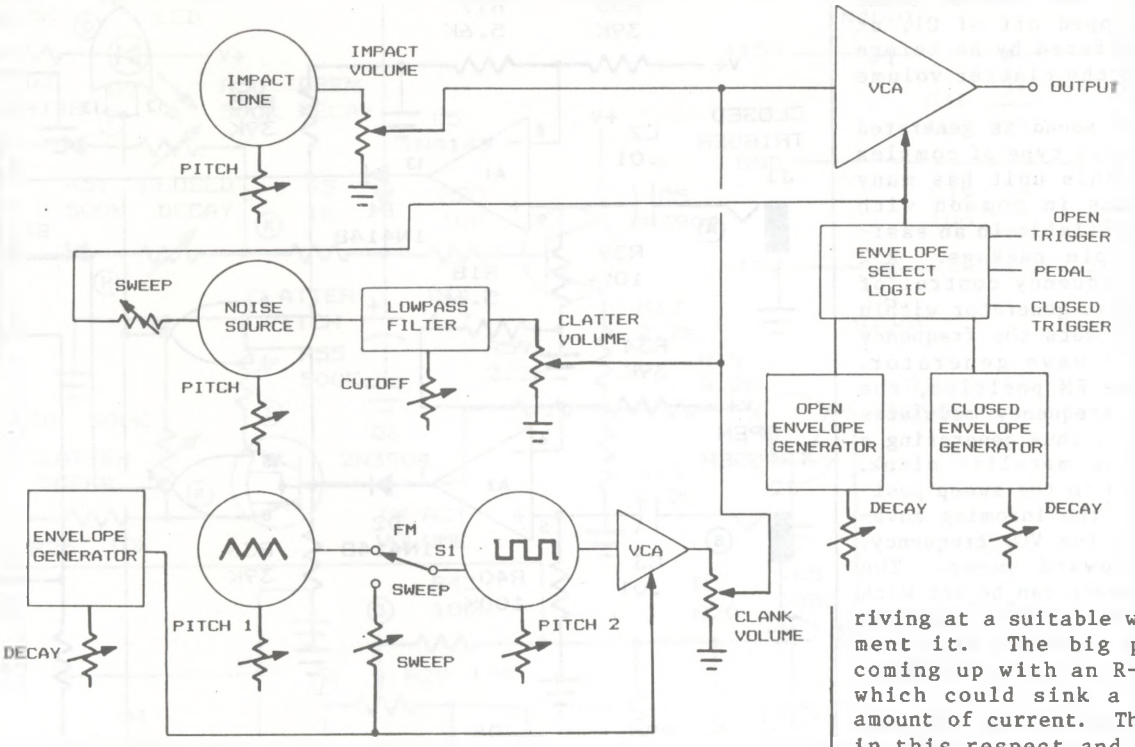
The clatter is synthesized with white noise generated by a pseudo-random noise generator. The pitch control sets the clock rate and hence the basic center frequency of the noise, while the sweep control adjusts the depth of envelope modulation. The effect is similar to a lowpass filter closing down, and in terms of a real hi-hat, the sound is not unlike that created by shutting the two cymbals against one another. The clatter generator is followed by a manually adjustable lowpass filter and volume control.

The clank is created by means of two VCOs, with one frequency modulating the other (FM). The sound thus generated is indeed quite metallic in nature. The pitch 1 control adjusts the frequency of the triangle wave generator, and the output of this device modulates the square wave generator. The pitch 2 control sets the center frequency of the square wave. By experimenting with the pitch 1 and pitch 2 controls it is possible to create a variety of clangorous sounds, from the tinkle of thin shards to the dull roar of boinging sheets of metal. As a bonus, S1 lets you switch the modulation so that the square wave is controlled by an envelope generator, thus creating unearthly upward sweeping sounds. The sweep control sets the strength of this effect. Finally, notice how the clank sound has its own envelope generator. This allows for the more realistic effect of the clank dying away before the clatter (as in a real hi-hat).

If the block diagram makes sense to you, then it's time to move on to the actual schematic. Since this is a big circuit, there simply isn't space to discuss every little detail. However, by referring back to the block diagram for the "big picture," you

FIGURE 1

BLOCK DIAGRAM: HI-HAT PLUS



should be able to keep the details in their proper place. Also, you might want to check out "The Snare Plus Drum Voice" article mentioned earlier, as this sheds light on a number of the ideas employed here.

Refer to the schematic in **Figure 2.** IC5, which is our old friend the 3080 transconductance op-amp, is pressed into service as the master VCA. Note how three lines feed into this chip via R41, R42 and R43; these lines come from the clank, clatter and impact tone generators, respectively. Three pots, R27, R28 and R29, allow for setting the desired ratios of these sounds before the mix is amplitude modulated by the master VCA.

The VCA is controlled by one of two envelopes chosen by the envelope select logic. Let's see how this works. Jacks J1 and J2 send open and close triggers to the unit. Op-amps A1 and A2 shape these up into standard 1 millisecond pulses which are then fed to the logic circuitry consisting of the NOR gates and IC3, the 555 timer. Now before you say, "I've seen this all before," you might want to note that IC3 is not being used as a timer! In this configuration, it is set up as high power R-S flip-flop. Pin 2 is the set input while pin 6 provides the reset function. Pin 3 is the output. Depending on the state of the output, either D3 or D4 (but not both) is pulled to ground, thus providing a discharge path for C11 through either R50 (the open decay control) or R51 (the closed decay control). Pulling this all together then, an open or closed trigger either sets or resets the R-S flip-flop, and its output selects one of two possible discharge paths. Hence, we now have the means to create the open and closed sounds. By the way, it should be obvious that the attack is fixed, and is created by dumping a charge onto the timing cap, C11, via diode D5. Notice that D5 passes current when either the open or closed triggers occur. This gives an instantaneous attack; it is the decay which is adjustable by R50 or R51.

Pin 4 of the 555 acts as a master reset control. It will override whatever the chip is currently doing and pull the output to ground, thus closing the hi-hat. An ordinary SPST footswitch can be plugged into jack J3 for pedal control.

By the way, two LEDs give an indication of which decay control is currently selected. D9 lights when the open decay control is in effect, while D10 indicates that the closed decay control is in operation.

I really puzzled over this envelope select scheme before arriving at a suitable way to implement it. The big problem was coming up with an R-S flip-flop which could sink a substantial amount of current. The 555 shines in this respect, and at the same time provided all of the niceties like a master reset (pin 4) and an auxiliary output (pin 7) for the LED.

As mentioned above, the currently selected envelope is developed across C11, and the emitter follower made up of Q5 and associated components buffers the signal. This envelope voltage is converted to a current by Q7 which then modulates the master VCA.

Let's now look at the sound sources. The impact tone is generated by the VCO and envelope generator within IC6, the SN76477. The method in which this is done is identical to that employed by "The Snare Plus Drum Voice," so not much more need be said about it (see above). R30 provides control of the impact pitch.

The clatter is created by the pseudo-random noise source within IC6. Normally a resistor from pin 4 to ground sets the basic operating range and hence the "color" of the sound, but to provide dynamic control over this parameter, Q6 is set up as a variable resistor. Notice that the base of Q6 is modulated by the envelope generator via R59. This, then, creates the sweeping sound characteristic of cymbals dying away. R55 sets the center pitch of the noise while R56 lets you dial in varying amounts of sweep. The output of the noise generator then

goes to a simple one pole filter within IC6, and R57 sets the cutoff frequency. The clatter sound is finally tapped off of C1, at pin 6, and buffered by A4 before being sent to the clatter volume control, R28.

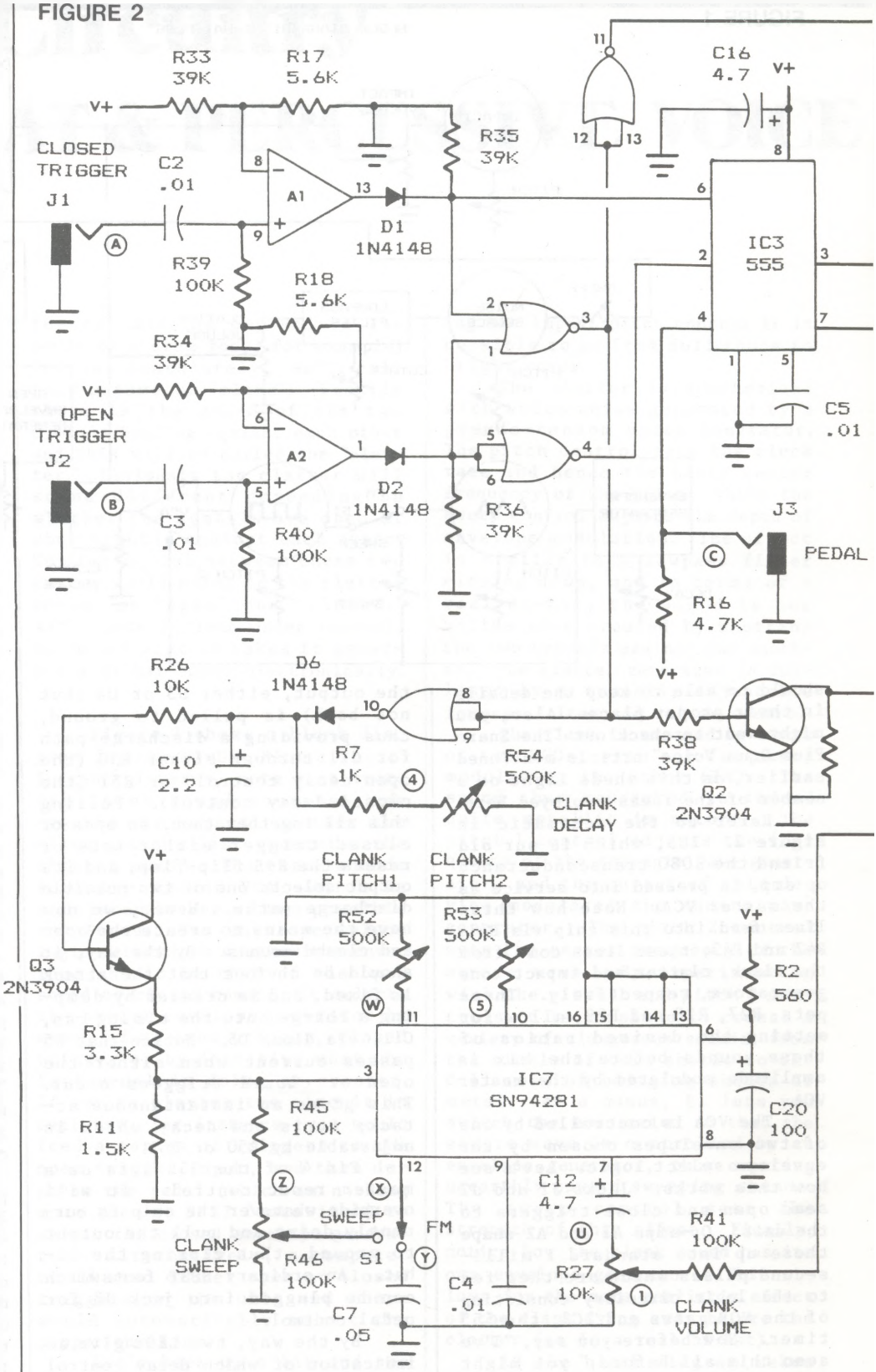
The clank sound is generated by IC7, a simpler type of complex noise chip. This unit has many characteristics in common with IC6, but is available in an easier-to-use 16 pin package. R52 allows for frequency control of the triangle wave generator within IC7, while R53 sets the frequency of the square wave generator. With S1 in the FM position, the triangle wave frequency modulates the square wave, thus generating a very convincing metallic clank. If S1 is thrown to the sweep position, however, the incoming envelope modulates the VCO frequency, creating an upward sweep. The depth of the sweep can be set with R46. Notice that in this position of S1, R52 has no effect since the triangle wave generator has been disabled.

IC7 contains its own VCA, and a voltage of 0V to +3.5V at pin 3 controls the gain. A simple envelope generator comprising D6, R7, R54 and C10 creates the desired envelope and this is buffered by Q3. The final signal is chopped down by R15 and R11 to the required range and this then modulates the VCA within IC6 (and also creates the clank sweep effect mentioned above). All in all, a very simple affair -- but it does work quite well.

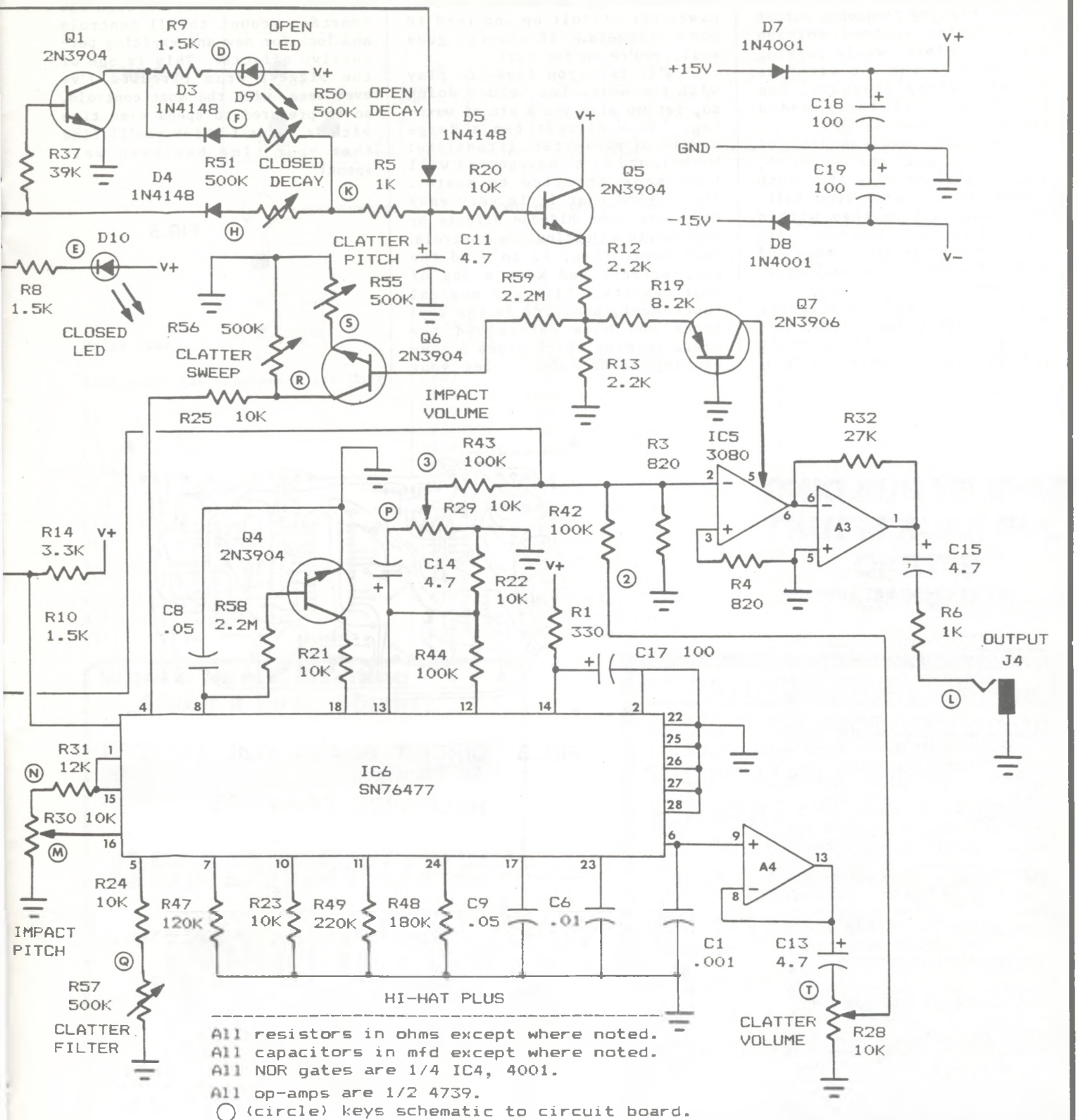
Both IC6 and IC7 require nonstandard supply voltages, but fortunately these chips contain their own internal Zener diodes. R1 drops the supply accordingly to IC6, while R2 performs a similar role for IC7. Hence, we have been able to retain our normal bipolar power supply voltage of ±15 Volts. Since there is a lot of switching and noise going on in this circuit, C17 through C20 provide a hefty amount of decoupling.

Well, this pretty much covers the operation of the Hi-Hat Plus; I'll leave you to ponder the details. Now, however, we need to quickly cover how to actually build the thing. With a circuit this big, the easiest way to go is with a printed circuit board. To simplify the task of whipping a board up, **Figure 3** shows a tested circuit board design, while **Figure 4** presents the parts placement guide. **Figure 5** shows the transistor orientation assumed by the circuit board; be sure to check that your transistors obey this configuration.

FIGURE 2



Here are a few tips to guide you in the task of building the Hi-Hat Plus. First, when loading the circuit board, be sure to note the polarity of all of those diodes and likewise, watch the electrolytic capacitors. Use sockets for the ICs, being sure to



note the proper orientation of pin 1 in all cases. The circuit board requires some jumpers (denoted by J); use excess resistor clippings for these. Finally, be certain that you have correctly installed the transistors, and have noted that Q1 through Q6 are all NPNs while only Q7 is a PNP.

After loading the circuit board, prepare a suitable front panel and secure the board to it with small angles and #4 hardware. **Figure 6** shows a suggested panel layout using a standard 3-1/2" by 19" rack panel. Complete the wiring to the panel and note that the circled letters on the schematic key the circuit board for this operation. Notice that a pad labeled V+ is available for running to the two LEDs. Also, one subtle point is that R30, the impact pitch control, should be wired in "reverse". This is be-

cause the VCO within the SN76477 gives decreasing frequency output for increasing control voltage input. Therefore, while looking at the back of the pot with the terminals facing downward, the leftmost terminal is grounded while the rightmost is hot.

Concerning availability of the SN76477 and the SN94281, you'll be glad to know that both of these are available from Radio Shack, thus putting them within reach of just about everyone. All of the other parts are common and may be obtained from a variety of mail order houses.

For the final hookup, apply +15V, -15V and ground to the appropriate pads on the circuit board (ground is denoted by "G"). After checking for wiring errors, power the circuit up and feed it some triggers. If all has gone well, you're on the air!

I'll turn you loose to play with the unit, but before doing so, let me give you a bit of warning. This circuit has a large number of parameters (translate: knobs), and as a consequence will take some practice to master. You'll find that it is very easy to create some hideous effects by improperly adjusting the controls. Your goal, then, is to find the good effects and keep a log of your results. Like any musical instrument, practice is the key! After you have determined the basic setting which gives a convincing hi-hat sound, let your mind and ears wander through the fourteen (count them!) controls and look for new and exciting percussive effects. This is one of the biggest drum circuits I've ever seen, with the most controls, so be prepared to spend some time with it. But I think you'll find that your time has been well spent!

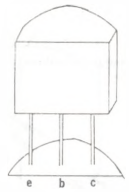


FIG.5

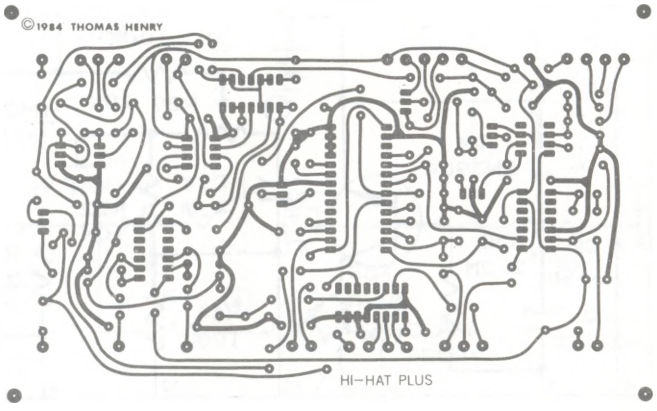


FIG. 3 CIRCUIT BOARD FOIL PATTERN

HALF-SIZE DRAWINGS

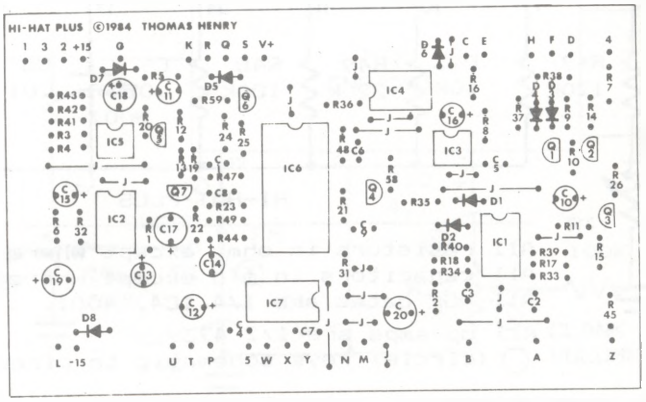
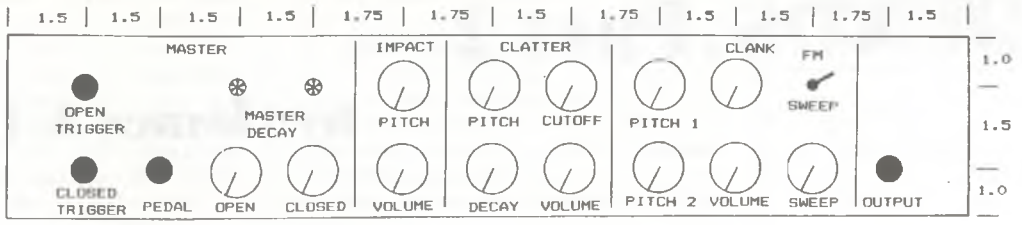


FIG. 4 CIRCUIT BOARD COMPONENT LAYOUT

FIGURE 6



= POTENTIOMETER

= JACK

= SWITCH

= LED

FRONT PANEL DESIGN: HI-HAT PLUS

All dimensions in inches.

Parts List

Resistors (5% tolerance, 1/4 Watt)

R1	330
R2	560
R3, R4	820
R5-R7	1k
R8-R11	1.5k
R12, R13	2.2k
R14, R15	3.3k
R16	4.7k
R17, R18	5.6k
R19	8.2k
R20-R26	10k
R27-R30	10k audio pot
R31	12k
R32	27k
R33-R38	39k
R39-R45	100k
R46	100k linear pot
R47	120k
R48	180k
R49	220k
R50-R57	500k linear pot
R58, R59	2.2M

Capacitors (15 or more Volts)

C1	0.001 uF mylar
C2-C6	0.01 uF mylar
C7-C9	0.05 uF mylar
C10	2.2 uF electrolytic
C11-C16	4.7 uF electrolytic
C17-C20	100 uF electrolytic

Semiconductors

D1-D6	1N4148 or equivalent
D7, D8	1N4001
D9, D10	LED
Q1-Q6	2N3904 NPN
Q7	2N3906 PNP
IC1, IC2	4739 dual op-amp
IC3	555 timer
IC4	4001 quad NOR gate
IC5	3080 OTA
IC6	SN76477 sound chip
IC7	SN94281 sound chip

Mechanical parts

J1-J4	1/4" phone jacks
S1	SPDT switch
Misc.	LED holders, wire, solder, knobs, front panel, hardware, etc.

64 SOUNDS, Part 2

by: James A. Lisowski

(Editor's note: Last issue, James presented introductory material on the Commodore 64 and on programming the C-64 for sound. In this installment, he describes a "software breadboard" for testing out sounds in a more thorough manner. The concluding installment, scheduled for next issue, presents a number of useful mini-programs (metronome, guitar tuner, external audio filter, etc.).

* *

Now it's time to explore some of the Commodore 64's sound options with SOUND TEST. Load INIT (described last month), then type the rest of the SOUND TEST program listing (**Figure 1**) so that both are combined into one large program. Double-check your typing, then save before running the program. (Note: This combined program was first listed in Part 1 as "Fig 2 (cont)" for those who wanted to get a head start on entering the program. It is reprinted for your convenience as **Figure 1** in this installment.) Once the program has been saved, RUN it.

One quick note: Easy-to-use programs are **hard to design!** Because of all of the "tricks" involved in this particular general use program, it is the hardest program of the lot to understand. If some of this looks confusing, just read through it and continue on -- the remaining programs are much easier.

Here's what happens in SOUND TEST: Line 0 is a program title REMark that identifies the program. Next comes the INIT section (covered in detail last issue). The TV speaker should click as INIT does its work. Next the rest of the program is executed, starting with some printed instructions that help the user operate the program. Line 300 POKEs the video screen background and border colors to an easy on the eyes GRAY. Line 310 DIMensions (defines the program Variables WV and WS to be tables of 3 values that will be used later on to hold Waveform and Waveform Sustain numbers). Lines 320 to 370 PRINT some instructions on the video screen; whatever appears in-between the quote marks (") is printed. Line 320 starts off with two special characters: a "clear the video screen and start printing at the top" (SC in braces) and a "print the following lines of text in DARK GRAY (black) color" (G1 in braces) character. See the table of special characters to

Special Characters Used in Program Listings

Name	Code	Type this
Screen Clear	{SC}	Hold SHIFT, press CLR HOME
Gray	{G1}	Hold Commodore Logo key, press 4
Cursor Down	{CD}	Press CRSR Down Arrow key
Home Cursor	{HM}	Press CLR HOME key

SOUND TEST

```
0 REM SOUND TEST V3 (C)1983 JAL SOFTWARE
200 AU=54272:F1=AU+1:F2=AU+8:F3=AU+15
210 T1=54276:T2=54283:T3=54290:AA=AU
212 P1=54297:P3=P1+1:B1=56321:BD=53280
215 FORII=AUTO54300:POKEII,0:NEXTII:POKEAU+24,15
220 READAV:IFAV>-1THENPOKEAA,AV:AA=AA+1:GOTO220
229 REM  FL  FH  PL  PH  W   AD  SR
230 DATA 000,000,000,000,000,000,000
235 DATA 000,000,000,000,000,000,000
240 DATA 000,000,000,000,000,000,000,-1
300 POKEBD+1,15:POKEBD,15
310 DIM WV(3),WS(3)
320 PRINT"{SC}{G1}SOUND TEST V3 JAL SOFTWARE"
330 PRINT:PRINT"SET UP SOUND DATA THEN"
340 PRINT"PRESS SPACEBAR TO TRIGGER THE SOUND"
350 PRINT"OR":PRINT"PRESS RETURN TO END"
360 PRINT"THEN USE SCREEN EDITING TO MAKE NEW"
370 PRINT"CHANGES AND RE-RUN"
380 RESTORE:FORI=1TO3
390 FORII=1TO7:READV:IFII=5THENWV(I)=V
395 IFII=7THENWS(I)=WV(I)+(V>0)
400 NEXT II,I
410 SF=(WS(1)+WS(2)+WS(3)<>0)
500 GETIN$:IFIN$=""THEN500
510 IFIN$=CHR$(13)THENPRINT"{SC}{CD}{CD}{CD}{CD}{CD}{CD}{CD}
{CD}RUN":PRINT"{HM}";:LIST229-240
515 POKET1,0:POKET2,0:POKET3,0
520 POKET1,WV(1):POKET2,WV(2):POKET3,WV(3)
525 IFNOT(SF)THENFORD=1TO500:NEXTD
530 POKET1,WS(1):POKET2,WS(2):POKET3,WS(3)
540 GOTO500

READY.
```

FIG. 1

find out which keystrokes produce these characters. Line 300 and the special characters in Line 320 are optional but help insure that the instructions will be legible. The instructions tell you to change the DATA values in the INIT section to create the desired sound effect; and unlike the other programs, you must also set a Waveform Value in the DATA. You can change the DATA statements before or after you run the SOUND TEST program.

Continuing with the line-by-line explanation, Line 380 RESTOREs the DATA statements so that the values will begin from the first value, then starts a FOR NEXT loop with the variable I that will perform the following statements (up to the Next II, I statement) three times. Line 390 starts another FOR NEXT loop with the variable II and this loop repeats the following statements (up to the NEXT II, I) seven times. The statements that are done over and over again are the READ and IF THEN statements. In brief, Lines 390 through 400 READ through the INIT DATA statements and extract the Waveform values, placing them in variables WV(1), WV(2) and WV(3) for later use in triggering the voices. Line 395 extracts the Sustain/Release values and uses the value of a Logic condition (V>0) to determine whether the sound should be turned off with zero or Released (by resetting the GATE bit). It then stores the results in the WS table. Line 410 uses more logic to set a Sustain indicator (SF) for later use if any Sustain or Release values were called for. (See your computer manual to see how the logic expressions used here are evaluated as numbers.) Line 500 GETs one character from the keyboard, without prompting, and stores it in string variable IN$. IF no keys have been pressed, a null string (empty of contents) results and the IF comparison of IN$ to "" (two quotes with no blank space or other character in-between them) is TRUE. The THEN part of the statement directs program execution back to the start of Line 500, to GET and test again. This is a simple "keyboard scan" routine that just keeps looping on the same line (500) until some key is pressed on the keyboard. When a key is pressed, the IF statement tests FALSE and the next Line (510) is executed. Line 510 checks to see IF the character stored in the IN$ is equal to the value of the String Function CHR$(13), which is the value you get when you press the RETURN key. If RETURN was the key that was typed, the IF condition is TRUE and so the statement following THEN is executed. In this case something fancy happens: A PRINT statement clears the video screen, moves down several lines from the top, prints the word "RUN", moves back to the top of the screen, LISTs lines 229 through 240 (the DATA statements), and then the program stops. I'll cover what to do next in a bit, but first, let's assume that when the program flow reached Line 510, the key that was typed was not the RETURN key -- perhaps the spacebar was pressed. In this case, the IF condition on Line 510 proves FALSE and the program flow goes on to LINE 515. Line 515 does something simple: It POKES all three SID voice Gate Trigger registers with zeroes (the voices are turned OFF). Line 520 is next and it POKES Trigger 1 with Waveform 1 (including a GATE bit), Trigger 2 with Wave 2, etc. The three SID voices make their sounds at this point. Line 525 checks if SF signals the presence of a Sustain value. If SF represents a FALSE logic condition, then a strange-looking FOR NEXT loop seemingly does nothing 500 times. Since it takes some time for BASIC to execute this loop 500 times, we create a time delay period for Sustain. When Line 530 is reached, the Voices are released by POKEing them with their waveform values minus the GATE bit (the WS values). Finally, the GOTO on Line 540 sends the program execution back to Line 500 for another round of "check the keyboard."

Now, back to the case of what happens when you do hit RETURN. The C-64 has a very useful feature called "Screen Editing" in which the programmer can move the cursor (a flashing box that indicates where the next character will be printed on the video screen) anywhere on screen, make changes to any program line, and re-enter the line without having to actually re-type any of the unaltered sections. As mentioned earlier, in this program pressing RETURN prints RUN, LISTs the DATA lines, and ends. The user can then use screen editing to alter the DATA values to change the sound effects, then press RETURN to enter

cont. ... pg. 29

re-view

but their DMX seems to have a short. God love them, it's just as invigorating as their last one (Aug '83), a cold shower with electrodes. Zow!*

Steps Ahead **Steps Ahead** (Elektra Musician 60168-1); **Modern Times** (Elektra Musician 60351-1). Like Weather Report (whence cometh drummer Peter Erskine), S.A. proves that jazz can be very up-to-the-minute, replete with modern time signatures, open structures and the latest in digital technology. The new record is the more electronic of the two.

Michael McNabb **Computer Music** (1750 Arch 1800). Using the facilities at Stanford University, McNabb turns familiar instruments and voices into delicious digital drones, and back again. It was dumped directly from computer to master disc, showcasing the clarity and dynamic range of full-digital production.*

Polkaholics **Polkaholics** (EP, Utility Grade Records). Despite being not entirely serious about it, the Polks play real music. Seven jumpy, off-balance songs too well executed to dismiss offhand.*

Emily **I've Got a Steel Bar In My Head** (MDM-10, cassette). Dark, slightly scarey tunes with rhythm box, probably Korg synthesizers, and indecipherable nihilist lyrics. It's lo-tech (Portastudio) but imaginative and earnest. $6.00 from Emily Faryna, Mo=Da=Mu, 374-810 West Broadway, Vancouver British Columbia V5Z 1J8.

Executive Slacks **Executive Slacks** (Red 005, EP). This one isn't. I think a review should tell you up front whether the record is good or not. These guys never got past picking a name.*

Ralph Towner **Blue Sun** (ECM 23788-1). Meditative jazz from one of the great painters of sound. Acoustic guitar and piano are joined for the first time by Prophet 5 colors.

Michel Redolfi **Sonic Waters** (hat ART 2002). Music for underwater -- one disc dry and one actually recorded submerged. Academic

cont. pg. 29

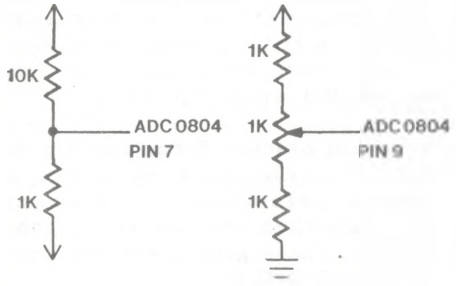
Remotely MIDI

PART II

By: Kirk Austin

(Editor's Note: In the April 1984 Polyphony, Kirk covered the hardware for a remote MIDI keyboard controller. This simple but extremely useful project generates the MIDI signals necessary to drive MIDI controlled equipment such as the Prophet-600. For more information on what's happening with MIDI, see the related story "On Location -- Summer 1984 NAMM" in this issue. For parts kit ordering information, see the end of this article.)

Figure 1



In this concluding installment of "Remotely MIDI", we're going to concentrate on the software. First, though, I have to point out some hardware changes from the last article. To adjust the full scale reading of the ADC0804 to make the pitch wheel work better, we have to add a couple of voltage dividers (see **Figure 1**). This gives a slight dead area at each end of the pot's travel, and also lets us set the position of the center band to match the detent on the pot. Also, I've decided to use Port D for the function switches, and since nobody seems to make a sequencer that will accept MIDI commands yet, I've designed the switches to allow eight different program selections from the remote keyboard. Referring to **Figure 2**, this requires adding eight 4.7K pullup resistors to the port D lines, which are then wired to eight SPST pushbuttons. The remaining switch contacts connect to ground.

Line PA7 is also wired to an SPST pushbutton in a similar manner. On power-up, the software allows the Port D pushbuttons (which I call "SELECT" pushbuttons) to switch between programs 0-7. However, they can be set up to choose any arbitrary program number by using the pushbutton wired to PA7 (which I call the "PROGRAM" pushbutton). Here's how it works:

1. Hold down "PROGRAM".

2. Hold down the desired "SELECT" button.

3. Press one of the top four AGO keys to select the desired bank (0-31, 32-63, 64-95, or 96-127), then release.

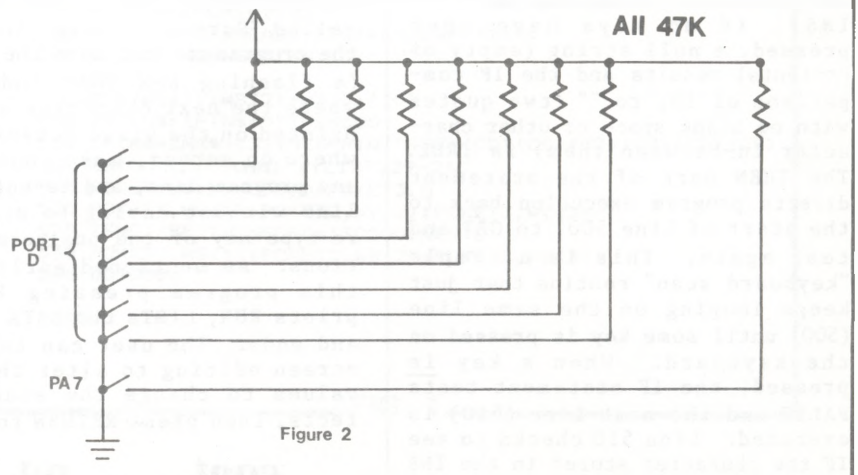


Figure 2

4. Press one of the 32 lower AGO keys to select the desired program number, then release all buttons.

Now when you press the "SELECT" button it will switch your synthesizer to the chosen program. Thus, the "SELECT" buttons can choose your eight favorite programs at the touch of a single button. With my Prophet 600 this is particularly useful, because otherwise I have to enter two digits on the membrane switch keypad -- which is kind of clumsy to do while playing.

Also, you can change octaves by holding down "PROGRAM" and pressing down the fifth AGO key from the top. The first time you do this, the keyboard will change up one octave. The next time you press the key the keyboard will drop down three octaves, then it will move up one octave at a time on subsequent pressings. By the way, the Prophet 600 does not respond to key numbers in the highest octave, so if you are using this particular synthesizer you will probably not want to use the top octave position.

The software. The listing is a pretty good example for the first time user of how to program in 6502 assembly code; if you plan to get into writing assembly language, I would encourage you to study this example. It makes use of loops, interrupts, and lookup tables, yet it is really a pretty simple bit of code. I will explain each section as we go along and try to make it as understandable as possible without being too tedious. However, it is beyond the scope of this article to teach assembly language programming. To find out more about programming the 6511, pick up "Programming and Interfacing the 6502" by Marvin DeJong.

Before we start with the code let's look at the symbol table. "$" means that the number is in hexadecimal. "%" means that the number is in binary. Otherwise, the number is a decimal representation.

```
CONSTANTS
     KEYSDN = $60
     KEYBUF = $70
     LSTSCN = $80
     PGTBLE = $90
     PWTBLE = $FE00
     TCODE = %11111000
     DNCODE = %10010000
     UPCODE = %10000000
     PWCODE = %11100000
     PGCODE = %11000000
     CNCODE = %10110000
     CON2HI = 1
     VELCTY = 64
     PORTA = 0
     COLOUT = 1
     ROWIN = 2
     PORTD = 3
     IFR = $11
     IER = $12
     MCR = $14
     SCCR = $15
     SCSR = $16
     SDR = $17
     TALO = $18
     TAHI = $1A
     BITRLO = 1
     BITRHI = 0
     EOC = %00010000
     ATOD = $8000
     OCTAVE = 57
     SHIFT1 = 58
     SHIFT2 = 59
     SHIFT3 = 60
     SHIFT4 = 61
     BANK1 = $E8
     BANK2 = $08
     BANK3 = $28
     BANK4 = $48

VARIABLES
     XTEMP = $40
     ROWBUF = $41
     COLBUF = $42
     KEYNO = $43
     XDATA = $44
     PTCH = $45
     MOD = $46
     LPTCH = $47
     LMOD = $48
     PABUF = $49
     TPTCH = $4A
     TMOD = $4B
     PBUF = $4C
     LOWKEY = $4D
     PDBUF = $4E
     FNCDN = $4F
     FNCKEY = $50
     LOWBUF = $51
     LPGM = $52
     DEBNCE = $53
     MBUF = $54
```

First, consider the RESET routine. This is where the 6511 starts from when power is applied. Since we are using a 2716 PROM, the program starts at $F800. The internal registers are initialized, and a dummy scan is performed just to get everything prepared. The address of the RESET routine must be stored as the reset vector at memory locations $FFFA and $FFFB.

```
; SET STACK POINTER AND CLEAR THE
DECIMAL FLAG
     LDX #$FF
     TXS
     CLD
; SET MCR
     LDA #$40
     STA MCR
; SET SCCR
     LDA #$80
     STA SCCR
; SET BIT RATE
     LDA #BITRLO
     STA TALO
     LDA #BITRHI
     STA TAHI
; SET DATA DIRECTION
     LDA #$FF
     STA ROWIN
; SET LOWKEY
     LDA #36
     STA LOWKEY
; SET LPGM
     LDA #$FF
     STA LPGM
; SET PROGRAM TABLE
     LDX #0
     TXA
PGINIT
     STA PGTBLE,X
     INX
     TXA
     CPX #8
     BNE PGINIT
; DUMMY SCAN
     JSR SCAN
     JSR WHEELS
     JSR DELTAX
     LDA PTCH
     STA LPTCH
     LDA MOD
     STA LMOD
; SET INTERRUPT
     LDA #%00001000
     STA IER
     CLI
```

This sets us up for the MAIN routine, an endless loop that actually performs all of the work.

```
MAIN
     JSR SCAN
     JSR WHEELS
     JSR DELTAX
     JSR XMIT
     JSR PROFNC
     JSR CNGEPG
     CLC
     BCC MAIN
```

Pretty simple, yes? This approach divides up the program into functional modules, much like the higher level language FORTH. We will examine each subroutine separately. The SCAN routine, in conjunction with the DELTAX routine, maintains three lists --- KEYSDN, KEYBUF, & LSTSCN. The SCAN routine looks at the AGO keys and stores all keys down in the

list KEYSDN. If no keys are down it stores 0 in each element of the list KEYSDN.

```
SCAN
     JSR FEEDOG
     LDA #0
     LDY #0
CLEAR0
     STA KEYSDN,Y
     INY
     CPY #$10
     BNE CLEAR0
; CHECK FOR KEYS
     LDA #$FF
     STA COLOUT
     LDA ROWIN
     BEQ EXIT0
; SET UP COL SCAN
     LDA LOWKEY
     STA KEYNO
     LDA #1
     STA COLBUF
     STA COLOUT
     LDX #8
     LDY #0
; SCAN COL
COLSCN
     LDA ROWIN
     BEQ NXTROW
     STA ROWBUF
; SET UP ROW SCAN
     STX XTEMP
     LDX #8
; SCAN ROW
ROWSCN
     LSR ROWBUF
     BCC KEYUP
     LDA KEYNO
     STA KEYSDN,Y
     INY
KEYUP
     INC KEYNO
; LOOP TO ROWSCN
     DEX
     BNE ROWSCN
; KEY UP OR DOWN ?
     LDX XTEMP
     CLC
     BCC KEYDN
; IF NO KEYS DOWN ADD 8 TO KEYNO
NXTROW
     LDA KEYNO
     CLC
     ADC  #8
     STA KEYNO
; TAKE NEXT COL HI
KEYDN
     LDA COLBUF
     ASL A
     STA COLBUF
     STA COLOUT
; LOOP TO COLSCN
     DEX
     BNE COLSCN
EXIT0
     RTS
```

The subroutine WHEELS performs the A to D conversion on the pitch and modulation thumbwheels and scales the mod information to a useable maximum. It also checks to make sure that there are no false readings by "debouncing" the A to D results.

```
WHEELS
     LDA #1
     STA DEBNCE
FLOW
     JSR FEEDOG
; PITCH WHEEL
     LDA #$F8
     STA PABUF
     STA PORTA
     JSR FEEDOG
; CONVERT
     STA ATOD
DONE0
     JSR FEEDOG
     LDA PORTA
     AND #EOC
     BNE DONE0
; GET PITCH DATA
     LDA ATOD
     STA PBUF
; MOD WHEEL
     LDA #$F9
     STA PABUF
     STA PORTA
     JSR FEEDOG
; CONVERT
     STA ATOD
DONE1
     JSR FEEDOG
     LDA PORTA
     AND #EOC
     BNE DONE1
; GET MOD DATA AND SCALE DOWN
     LDA ATOD
     LSR A
     LSR A
     LSR A
     STA MBUF
     LDA PBUF
     CMP PTHC
     BEQ GOOD0
     LDA PBUF
     STA PTCH
     JMP FLOW
GOOD0
     LDA MBUF
     CMP MOD
     BEQ GOODD1
     LDA MBUF
     STA MOD
     JMP FLOW
GOOD1
     DEC DEBNCE
     BNE FLOW
RTS
```

Now that we have a list of the keys that are down (KEYSDN) we need to extract the delta, or change, information. The routine DELTAX transfers LSTSCN to KEYBUF, and also transfers KEYSDN to LSTSCN. At this point KEYSDN is a list of the keys that are held down on this current scan, and KEYBUF is a list of the keys that were held down on the previous scan. Then the DELTAX routine goes through these two lists and eliminates (zeros) keys that are common to both lists. This leaves us with KEYSDN being a list of zeros and the keys that are newly pressed, while KEYBUF is a list of zeros and the keys that are newly released. LSTSCN is kept as a record of the current scan for use the next time around. DELTAX also checks to see if the wheels have been changed by more than two bits. This suppresses extraneous transmissions of wheel information that hasn't significantly changed.

```
DELTAX
; TRANSFER LSTSCN TO KEYBUF
     LDY #0
TRANS0
     LDA LSTSCN,Y
     STA KEYBUF,Y
     INY
     CPY #$10
     BNE TRANS0
; TRANSFER KEYSDN TO LSTSCN
     LDY #0
TRANS1
     LDA KEYSDN,Y
     STA LSTSCN,Y
     INY
     CPY #$10
     BNE TRANS1
; ZERO NOTES COMMON TO KEYSDN &
     KEYBUF
     LDY #0
     LDX #0
MATCH0
     LDA KEYSDN,Y
     CMP KEYBUF,X
     BNE NEXT0
     LDA #0
     STA KEYSDN,
     STA KEYBUF,X
     CLC
     BCC NEXT1
NEXT0
     INX
     CPX #$10
     BNE MATCH0
NEXT1
     LDX #0
     INY
     CPY #$10
     BNE MATCH0
; PITCH AND MOD DELTAX
     LDA #0
     STA TPTCH
     STA TMOD
     LDX LPTCH
     LDY LPTCH
     CPX PTCH
     BEQ NOTPCH
     INX
     CPX PTCH
     BEQ NOPTCH
     INX
     CPX PTCH
```

```
     BEQ NOTPCH
     DEY
     CPY  PTCH
     BEQ NOTPCH
     DEY
     CPY PTCH
     BEQ NOTPCH
     LDA #$FF
     STA TPTCH
NOTPCH
; MOD WHEEL
     LDX LMOD
     LDY LMOD
     CPX MOD
     BEQ NOMOD
     INX
     CPX MOD
     BEQ NOMOD
     INX
     CPX MOD
     BEQ NOMOD
     DEY
     CPY MOD
     BEQ NOMOD
     DEY
     CPY MOD
     BEQ NOMOD
     LDA #$FF
     STA TMOD
NOMOD
     RTS
```

At this point it is a simple matter to transmit the necessary information. The subroutine XMIT goes through the lists KEYSDN and KEYBUF, and transmits anything that is not a zero. Then it checks the TPTCH and TMOD flags, and transmits the wheel information if the flags are true. When the pitch wheel is transmitted the program uses the A to D value as an index to select the actual pitch value from a lookup table that is located from $FE00 to $FEFF. This technique lets us use any arbitrary response for the wheel, so I have constructed the table to create a "dead band" at the center of the pot.

```
XMIT
; KEYS DOWN
     LDY #0
; XMIT KEY DOWN CODE
XMITD
     LDA KEYSDN,Y
     BEQ NEXT2
     LDA #DNCODE
     STA XDATA
     JSR OUTPUT
; XMIT KEY NUM
     LDA KEYSDN,Y
     STA XDATA
     JSR OUTPUT
; XMIT VELOCITY
     LDA #VELCTY
     STA XDATA
     JSR OUTPUT
; LOOP
NEXT2
     INY
     CPY #$10
     BNE XMITD
; KEYS UP
     LDY #0
; XMIT KEY UP CODE
XMITU
     LDA KEYBUF,Y
     BEQ NEXT3
     LDA #UPCODE
     STA XDATA
     JSR OUTPUT
; TRANSMIT KEY NUM
     LDA KEYBUF,Y
     STA XDATA
     JSR OUTPUT
; TRANSMIT VELOCITY
     LDA #VELCTY
     STA XDATA
     JSR OUTPUT
; LOOP
NEXT3
     INY
     CPY #$10
     BNE XMITU
; XMIT PTCH & MOD
     LDA TPTCH
     BEQ XPTCH
     LDX PTCH
     STX LPTCH
     LDA PWTBLE,X
     STA PBUF
     LDA #PWCODE
     STA XDATA
     JSR OUTPUT
     LDA #0
     LSR PBUF
     ROR A
     LSR A
     STA XDATA
     JSR  OUTPUT
     LDA PBUF
     STA XDATA
     JSR OUTPUT
XPTCH
     LDA TMOD
     BEQ XMOD
     LDA #CNCODE
     STA XDATA
     JSR OUTPUT
     LDA #CON2HI
     STA XDATA
     JSR OUTPUT
     LDA MOD
     STA XDATA
     JSR OUTPUT
     LDA MOD
     STA LMOD
XMOD
     RTS
```

The subroutine PROFNC checks to see if the "PROGRAM" pushbutton is being held down. If so, the routine either changes octaves or programs the "SELECT" pushbutton as described earlier.

```
PROFNC
     LDA LOWKEY
     STA LOWBUF
     LDA #1
     STA LOWKEY
PFNC
     JSR FEEDOG
     LDA #%10000000
     ORA PABUF
     STA PABUF
     STA PORTA
     LDA PORTA
     ASL A
     BCC KEEPON
     LDA LOWBUF
     STA LOWKEY
     RTS
KEEPON
     JSR SCAN
     LDA KEYSDN
     BEQ OCTOUT
     CMP #OCTAVE
     BNE  OCTOUT
     LDA LOWBUF
     CMP #48
     BNE OCTUP
     LDA #12
     STA LOWBUF
     JMP OCTSET
OCTUP
     LDA LOWBUF
     CLC
     ADC #12
     STA LOWBUF
OCTSET
     LDA LOWBUF
     STA LOWKEY
GETOFF
     LDA #$FF
     STA DEBNCE
DBNCE0
     JSR SCAN
     LDA KEYSDN
     BNE DBNCE0
     DEC DEBNCE
     BNE DBNCE0
     RTS
OCTOUT
     JSR FNCSCN
     LDA FNCDN
     BEQ PFNC
     JSR SCAN
     LDA KEYSDN
     BEQ PFNC
     CMP #SHIFT1
     BNE NXTBT1
     LDA #BANK1
     STA LOWKEY
     JMP NXTBT4
NXTBT1
     CMP #SHIFT2
     BNE NXTBT2
     LDA #BANK2
     STA LOWKEY
     JMP NXTBT4
NXTBT2
     CMP #SHIFT3
     BNE NXTBT3
     LDA #BANK3
     STA LOWKEY
     JMP NXTBT4
NXTBT3
```

in favor of a C-64 Micro-Drums; how do the rest of you feel?

INTERFACE BLUES, PART 4

I need to know how to interface the Master Synchronizer with the TASCAM Model 144 Portastudio. The problem is that the Porta-Studio has only stereo outputs from the mixer, which means that there is no way to isolate the click track from the other tracks. It seems that I need a way of getting a straight feed out of one of the channels, and I don't have a schematic to enable me to do that. I would appreciate any help you might be able to give.

While I'm at it, I'd like to thank you for the fine job you have done with Polyphony. Keep up the good work, I know a lot of people really appreciate it.

Ted Kastelic
Washington, DC

Ted -- First, thanks for the compliments; I'll keep editing Polyphony for as long as the readers will let me. Concerning the Portastudio, your best bet is to feed the Master Synchronizer input from the aux buss output. Yes, this is a mono output, but all you need to do is turn up the fader for the channel receiving the Master Synchronizer signal and leave the other channels turned down. You could also try the same trick with the cue buss if the aux buss is occupied. Incidentally, this is a useful trick to know if you want a separate output from each track -- feed one track into the L main output, one track into the R main output, one track into the cue output, and one track into the aux buss output.

One caution: You may have crosstalk problems with the Master Synchronizer from adjacent, high-level signals. So, record the sync signal on an outside track (1 or 4) and be careful when setting levels.

A LETTER WHICH DOESN'T INVOLVE INTERFACING!

I like the idea of the matrix system used in the ARP 2500, and would like to know who makes these

cont. pg.30

```
      CMP #SHIFT4
      BEQ SHFTOK
      JMP PFNC
SHFTOK
      LDA #BANK4
      STA LOWKEY
NXTBT4
      LDA #$FF
      STA DEBNCE
DBNCE1
      JSR SCAN
      LDA KEYSDN
      BNE DBNCE1
      LDA DEBNCE
      BNE DBNCE1
PICK
      JSR SCAN
      LDA KEYSDN
      BEQ PICK
      ASL A
      BCC INBNDS
      LDA #$FF
INBNDS
      LSR A
      LDX FNCKEY
      STA PGTBLE,X
      LDA LOWBUF
      STA LOWKEY
GTOFF1
      JSR FEEDOG
      LDA PORTA
      ASL A
      BCC GTOFF1
      RTS
```

Since the "SELECT" pushbuttons are now programmed, the CNGEPG subroutine looks at the "SELECT" pushbuttons and transmits a program change if one is held down.

```
CNGEPG
      JSR FNCSCN
      LDA FNCDN
      BNE CONTIN
      RTS
CONTIN
      LDX FNCKEY
      LDA LPGM
      CMP PGTBLE,X
      BNE ALLGO
      RTS
ALLGO
      LDA #PGCODE
      STA XDATA
      JSR OUTPUT
      LDA PGTBLE,X
      STA LPBM
      STA XDATA
      JSR OUTPUT
      RTS
```

That's all there is to it -- almost. There are a few subroutines called by the previous code that must be mentioned. The first one is the FEEDOG routine. This sends a pulse to the watchdog timer to keep it from automatically resetting the processor.

```
FEEDOG
      LDA PABUF
      AND #%00100000
      BEQ TOGLE0
      LDA #%11011111
      AND PABUF
      STA PABUF
      CLC
      BCC TOGLE1
TOGLE0
      LDA #%00100000
      ORA PABUF
      STA PABUF
TOGLE1
      LDA PABUF
      STA PORTA
      RTS
```

The OUTPUT subroutine takes the variable XDATA and transmits it.

```
OUTPUT
      JSR FEEDOG
      LDA SCSR
      AND #$40
      BEQ OUTPUT
      LDA XDATA
      STA SDR
      RTS
```

The FNCSCN subroutine scans the Port D pushbuttons. If a button is being held down, the subroutine exits with the pushbutton number stored in the variable FNCKEY and the flag FNCDN true.

```
FNCSCN
      LDA #0
      STA FNCDN
      LDA PORTD
      CMP #$FF
      BNE SCNFNC
      RTS
SCNFNC
      LDA PORTD
      STA PDBUF
      LDA #$FF
      STA FNCDN
      LDX #0
BUTSCN
      LSR PDBUF
      BCS NXTFNC
      STX FNCKEY
NXTFNC
      INX
      CPX #8
      BNE BUTSCN
      RTS
```

Finally, the CLICK subroutine transmits a MIDI timing code if a positive edge is detected on the external clock input line. This positive edge interrupts the processor from its normal functioning. The starting address of the CLICK routine must be stored as an interrupt vector at memory locations $FFFE and $FFFF.

(cont. pg.30)

64 SOUNDS continued

the changed Line. The cursor then can be moved to the word "RUN" on screen and upon pressing RETURN, the SOUND TEST program RUNs -- this time with the new sound values. Note also, a single press of the spacebar will trigger the sound once while holding it down will cycle the sound repetitively. With this program, it is quite simple to try several different one to three voice sounds in the space of a few minutes. (Try the example data lines in **Figure 2.**)

The "Sound Test" program is hard to describe, but easy to use. If it still seems to be too much work, JAL SOFTWARE offers a screen oriented sound effects editing program called SOUND'ED that makes experiments even easier: Just move around the screen and press the spacebar to advance the register values -- it puts in all the right numbers and you don't even have to know how to count in binary!

Next issue, we'll describe the final programs of this series.

Example DATA lines for SOUND TEST

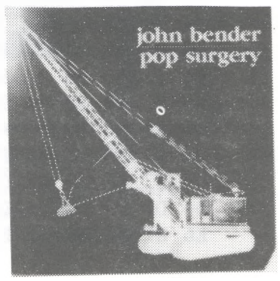
```
230 DATA 000,090,000,000,017,088,000

Medium ATTACK /DECAY Beep


230 DATA 000,090,000,000,129,008,000

Percussive Noise


230 DATA 000,090,000,000,129,009,000
235 DATA 000,004,000,000,033,005,000

Noise and Strike Sound Drum


230 DATA 073,004,000,000,033,004,255
235 DATA 103,005,000,000,033,005,255
240 DATA 108,006,000,004,065,004,255,-1

C Chord with Long RELEASE


230 DATA 000,004,000,008,065,176,000
235 DATA 003,004,000,008,065,182,000
240 DATA 009,004,000,008,065,180,000,-1

3 Voice Pulse Sound with LF Offsets
     for a Thick Phasing Sound


Waveform Values for Sound Programs

Wave        With Gate    Without Gate

TRIANGLE        17            16
SAWTOOTH        33            32
PULSE           65            64
NOISE          129           128
```

FIG. 2

re-view

noodling on Synclavier -- to my ear both records are a little dry.*

Laurie Anderson **Mister Heartbreak** (Warner Bros. 25077-1). Between this, Thomas Dolby's new one (last month) and Mark Isham (Feb and this month), digital synthesizers are finally getting out of school and into the hands of working musicians. One giant leap forward for Laurie, who moves from a novelty act to somewhere in the realm of Peter Gabriel (who guests with several other notables).



John Bender **Pop Surgery** (Record Sluts 004, EP). Rhythm box, cheap synthesizers and slurred talking -- edited down from 15 longer tapes I hope to miss.*

Martin Kornberger & Volker Kuhn **Bal Macabre** (Syntape 020, cassette). Modal improvisations, usually over a sequenced backing, not unlike middle-period Tangerine Dream. Well done for an independent. Syntape, C.L. Schleich Str. 5, D-7518 Bretten, West Germany or from Eurock.

Jon English & Candace Natvig **Triptych** (1750 Arch 1797). How many sounds can one draw from trombone, violin and voice? Let's see -- you can take apart the trombone and blow through each

cont. pg.42

REMOTELY MIDI...CONT.

```
CLICK
      PHA
      LDA XDATA
      PHA
      LDA #TCODE
      STA XDATA
      JSR OUTPUT
      LDA #0
      STA $10
      PLA
      STA XDATA
      PLA
      RTI
```

Some fun, huh? Well, it may not be the most elegant piece of code in the world, but it gets the job done. If you want to modify the program it shouldn't be too hard; just remember to include a JSR FEEDOG if you do any loops that will take over a millisecond or so. Probably any modifications would leave the SCAN, WHEELS, DELTAX, and XMIT routines intact, concentrating instead on the push-buttons and/or the pitch wheel lookup table.

Now all that's left is the pitch wheel table, which starts at $FE00 (see **Figure 3**). The table is in hexadecimal.

In conclusion, I should point that this project was developed on a Rockwell Aim-65 microcomputer and tested with a Prophet-600 synthesizer. Due to inconsistencies in the way that manufacturers are currently implementing the MIDI standard it may not work with your particular synthesizer. If you have a specific idea as to what modifications might prove useful let me know.

Figure 3: Pitch Wheel Table

```
00 02 04 06 08 0A 0C 0E 10 12 14 15 16 17 18 19
1A 1B 1C 1D 1E 1F 20 21 22 23 24 25 26 27 28 29
2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37 38 39
3A 3B 3C 3D 3E 3F 40 41 42 43 44 45 46 47 48 49
4A 4B 4C 4D 4E 4F 50 51 52 53 54 55 56 57 58 59
5A 5B 5C 5D 5E 5F 60 61 62 63 64 65 66 67 68 69
6A 6B 6C 6D 6E 6F 70 71 72 73 74 75 76 77 78 79
7A 7B 7C 7D 7E 7F 80 80 80 80 80 80 80 80 80 80
80 80 80 80 80 80 80 80 80 80 80 81 82 83 84 85
86 87 88 89 8A 8B 8C 8D 8E 8F 90 91 92 93 94 95
96 97 98 99 9A 9B 9C 9D 9E 9F A0 A1 A2 A3 A4 A5
A6 A7 A8 A9 AA AB AC AD AE AF B0 B1 B2 B3 B4 B5
B6 B7 B8 B9 BA BB BC BD BE BF C0 C1 C2 C3 C4 C5
C6 C7 C8 C9 CA CB CC CD CE CF D0 D1 D2 D3 D4 D5
D6 D7 D8 D9 DA DB DC DD DE DF E0 E1 E2 E3 E4 E5
E6 E7 E8 E9 EA EB ED EF F1 F3 F5 F7 F9 FB FD FF
```

Letters

matrix boards. I would very like to incorporate the matrix system into my home studio (in Malaysia) to interconnect signal routes, effects, etc.

Second question: How about an article on how to design a modular breadboard for building up circuits from scratch -- with power supply, clock circuitry, plug-in switches and pots, and so on?

Last question: How much on the average does an electronic musician have to spend to make an album (solo musician with drum machines, synths, effects, and synchro-sonic devices) in a recording studio?

Well, that's it but before I end I'd like to say that Polyphony is a great publication but one complaint -- when are you going to make it monthly?

Khew Sin-Sun
Boston, MA

Khew -- Matrix pin switches are available from Sealectro Corp., 225 Hoyt St., Mamaroneck, NY 10543), but they are quite expensive (especially the pins that go into the matrix). Also, although I have no personal experience in this matter I have heard that there are crosstalk problems when running low-level and high-level signals next to each other with matrix switches; capacitance between lines could also cause problems. You might be better off with a traditional patch bay/patch cord setup.

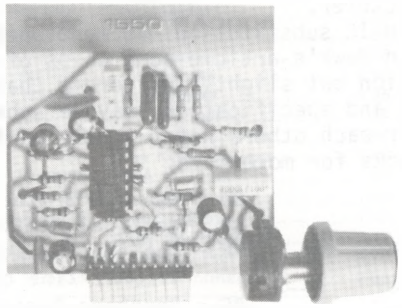
Second question: We have no such article planned, but your letter might inspire a reader to come up with something for you.

Third question: If you cut an album at home with budget gear, it can cost under $1500 -- including the recorder. If you cut an album in a 48 track pro studio with a top-name producer, it could cost tens (or even hundreds) of thousands of dollars.

As far as going monthly, right now it just isn't possible. However, this is a growing magazine and you never know what tomorrow may bring.

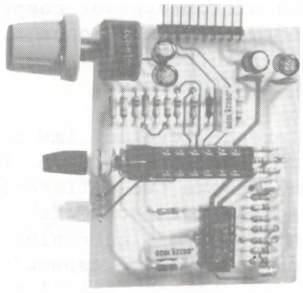
cont. pg. 35

Sound Strategy



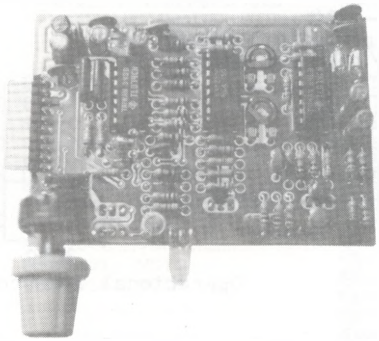
#1550 **$19.95**

The #1550 is a special signal processing card similar in function and principle to what is commonly called an "aural exciter." The circuit analyzes and amplifies the usable portion of the upper harmonic segment of the input signal and mixes it back into the original. This technique restores the brightness that is lost in recording, signal processing and broadcasting while simultaneously enhancing depth and definition.



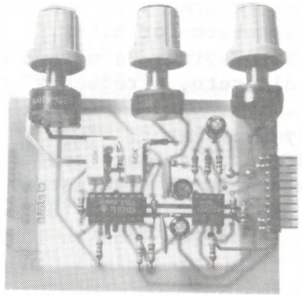
#1650 **$19.95**

A unique signal processing circuit, the #1650 Image Enhancer widens the stereo image to surround you with sound and heighten your sense of "being there." All program material, stereo or mono, will benefit from the increased ambience and depth provided. A perfect way to bring concert hall realism to small rooms and acoustically dead environments. This dramatic effect is not restricted to playback, but may be utilized in the recording process as well.



#1580 **$24.95**

THE #1580 Dynamic Noise Reduction kit is ideal for those seeking the versatility of a single-ended, non-encode/decode system. Its two channels of filtering provide effective noise reduction of 14 db and may be connected in stereo, mono, or in parallel for even greater noise reduction. Although design and performance are similar to many professional dynamic filters, their respective prices are worlds apart.



#1500C **$54.95**

The #1500C is a complete three band Parametric Equalizer kit designed to provide the ultimate in custom tailoring of your audio system. The three cards cover a frequency range of 20 Hz - 23 KHz waith 12 db of boost and cut. In addition, the instructions include theories and formulas enabling you to customize this equalizer to suit your specific needs.

All of the kits described, as well as the entire line of Rodcar modular kits, are designed to function optimally when integrated with our #1560 Motherboard. This 3" X 15" board will accept up to ten cards and may be set up for stereo, mono, or any combination. Features include on-board power switch, LED "on" indicator, and a professional quality power supply (transformer not included). The Rodcar modular kit series and Motherboard provides a freedom of design and versatility of function unavailable until now.

Every Rodcar kit features premium grade components, state-of-the-art design technology, and is easily combined with existing consumer or pro-audio systems. Detailed, simple instructions are provided along with data sheets and theoretical discussions which offer ideas for broadening the applications of your new equipment. There is also a complete warranty program with service and technical assistance upon request. If you want the finest audio gear available, and like the idea of saving money while you learn and have fun, place your order today! Send for free catalogue.

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8700+E - a 6502 based microprocessor computer with full memory compliment once available from PAIA Electronics.

DAC - Digital to Analog Converter.

dB = $20\log(V/V_{ref})$

dBm - a dB zero reference level of 1mW of power across a 600 Ohm line (=0.775 Volts). (+4dBm and +8dBm are two different standard 0 VU readings for pro decks. Since these indicate system electronics handling 1.23 and 1.95 Volts respectively at 0 VU they offer better signal-to-noise ratio than do -10dBV decks which pass smaller voltages through their system electronics.)

dBV - a dB zero reference level of 1 Volt. (-10dBV is the standard 0 VU meter reading for semi-pro decks.)

DCB - DigitalControl Bus; a Roland communications bus that existed prior to MIDI.

desk - British English term for mixer.

FSK - Frequency Shift Keying; a method of data transfer by discrete, frequency modulations.

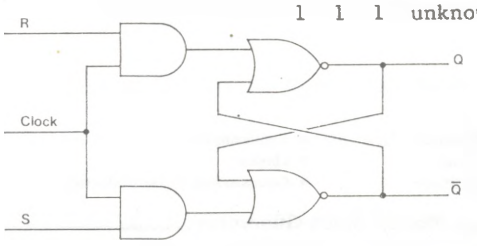
LFO - Low Frequency Oscillator.

hexadecimal numbers - are numbers specified in base 16 where A is the character representing 10, B=11, C=12, D=13, E=14 and F=15 and 16 in decimal equals 10 in hex. To convert from hexadecimal to decimal apply this formula:

$H_n \ldots H_3 H_2 H_1 H_0{}_{(16)} = (16^n H_n + \ldots + 16^2 H_2 + 16^1 H_1 + 16^0 H_0)_{10}$. For example, A92B in hex equals $(10\times16^3 + 9\times16^2 + 2\times16^1 + 11\times16^0)=43307$ in decimal. To convert from hex to binary simply turn each hex digit into a four digit binary word. For example, $F_{(16)}=1111_{(2)}$, $C_{(16)}=1110_{(2)}$ and $3_{(16)}=0101_{(2)}$. Therefore, $FC3_{(16)}=1111\ 1110\ 0101_{(2)}$.

RS flip-flop logic table:

$Q_{\overline{U}}$	S U	R U	Q_{next} $\overline{U}$
0	0	1	0
0	1	0	1
0	1	1	unknown
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	unknown

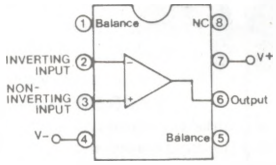


SPST - Single-Pole-Single-Throw switch

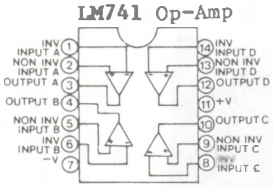
VCA - Voltage Controlled Amplifier
VCO - Voltage Controlled Oscillator

Note on chip numbers : many chips of the same number are available from different manufacturers. The lettered prefix identifies the manufacturer.
Note on IC substitution: as mentioned in Stephen Hawk's article some chips of similar operation but slightly different characteristics and specifications may be substituted for each other. Refer to the manufacturers' databooks for more info.

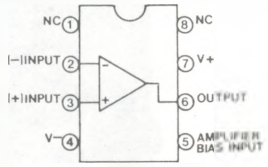
CD - RCA (CMOS line of ICs)
LM - National Semiconductor
LF - National Semiconductor (Bi-FET line of ICs)
RC - Raytheon Semiconductor
TL - Texas Instruments (Linear)



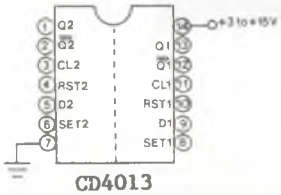
LF351 Wide Bandwidth JFET-Input Op-Amp
LM356 (commercial grade) Series Monolithic
LM741 Op-Amp JFET-Input Op-Amps



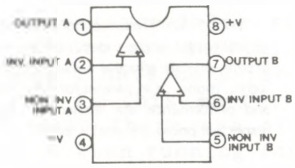
RC4136
Quad 741 High-Gain Op-Amps



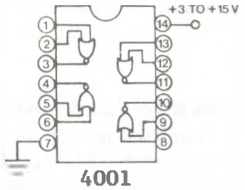
3080
Operational Transconductance Amp (OTA)



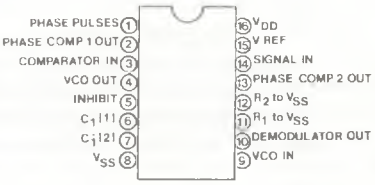
CD4013
Dual 'D'-Type Flip-Flop



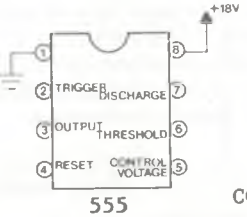
LM1458
Dual Op-Amp



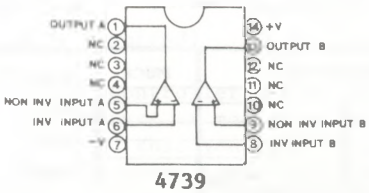
4001
Quad NOR gate



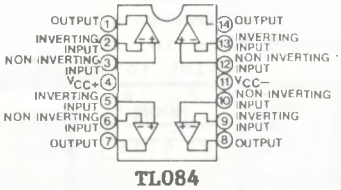
CD4046
COS/MOS Micropower Phase-Locked Loop



555
Timer



4739
Dual Low-Noise Op-Amp



TL084
Low Noise JFET-Input Quad Op-Amps

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

REVIEW:

ELECTRO-HARMONIX INSTANT REPLAY

by: Chuck Pogan

Hey...remember the guys who made those gizmos in the late 60s and 70s with names like "Screaming Bird" and "Big Muff Pi"? Well, after a lengthy hiatus due to external union harassment (as reported in Reader's Digest*) big wheel Mike Matthews has tied the loose ends together and revamped Electro-Harmonix. With the advent of their "Instant-Replay," Mike and E-H get my vote for "Comeback Player of the Year".

The "Replay" digitally records any short sound, which can then be replayed at the users' command. Features include drum pad triggering with dynamics (or use alternate controllers such as keyboards or gate triggers), a repeat (loop) function, and AC power operation.

The unit is housed in the standard E-H sheet metal box, with knobs for "Mic Level", "Trig Level", and "Pitch". There is also a "Record" button, along with LEDs to indicate "record" and "overload".

Recording with the Replay. Begin by feeding your signal into the mic input jack and adjusting the mic level sensitivity pot until the "Overload" LED indicator just begins to flicker on peaks. Next, adjust the trigger level pot until the sampled sound plays back at approximately the same volume as the input sound (this may require a few "test runs" since the trig level is very sensitive). To record the sample, set the "Pitch" knob pretty much counter-clockwise (i.e. longest sampling time) and press the record button. The red record LED should light and stay lit to indicate that the Replay is waiting for a sound; as soon as the sound to be sampled begins, the Replay starts sampling (the LED then flashes until the sampling time is over). The maximum sampling time is 2 seconds with pitch fully counter-clockwise. Turning pitch clockwise decreases the sample time but increases fidelity.

Playback. Connect the external trigger pad provided with the Replay to its "ext. trig." input jack, then start crashing on the pad. Since the pad has dynamics, the harder you hit, the louder the playback. You can also auto-trigger without a pad (a repeat switch on the back repeats the event; the period is equal to the sampling time). Hint: When recording a sound you expect to play back with the trigger pad, set the pitch knob at about 20-30% of maximum as this will give the widest pitch variation range on playback.

Applications. The Replay's uses are limited only by your imagination (weirdness?). It's a real kick to record your voice and transpose it to a different register. My "Lurch" impression is a dead

ringer...also, lowering the pitch of grunts and snarls sounds like the San Diego Zoo.

Using the audio signal from an external keyboard as a trigger increases control possibilities, as it allows for transposing the sampled sound from the keyboard. Try sampling an acoustic guitar strum or a fuzzed-out electric guitar note, and then triggering the Replay with a typical synth (I'm currently using a little M-10 and it works just fine). Even a VL-Tone will work. Try dumping a two-handed chord from a polysynth into the box and play 10 note leads on your VL-Tone...impressive or what? You can also prepare sounds in advance, like multi-tracked sound effects or handclaps, for dumping into the unit directly from tape.

Pros. For me, the mere accessibility of a unit that hints at sampling techniques is the major breakthrough. Not too many of us in the real world can afford the bigger machines that specialize in all facets of sampling, and as a low-cost alternative the Replay stands alone. Its sound reproduction quality is quite good and not too noisy with proper level-setting. Also, the keyboard pitch control capability, however limited, is a definite advantage.

Cons. For a device that packs so much wallop into such a small box for such a low price, the Replay's shortcomings are of little real consequence. My only real gripe is that they didn't put an on-off switch on the box so we wouldn't be yanking on the AC cord all the time. I would also like to see a souped-up Replay with some kind of program or patch storage in the future, since the present unit loses the stored sound when turned off.

Another limitation is that changing the pitch control also changes the playback speed of the sampled sound, and is thus not a true frequency shift. And alas, an external keyboard controller can only transpose over a 2-octave range.

Conclusions. I'm not usually one for getting overly excited about new boxes because most companies just produce the same basic devices and nothing else. E-H, however, is one of the few companies that really takes chances -- creating unique gizmos and presenting them at affordable prices. I think the Replay is a whole new ballgame. I mean...a digital sampling device with pitch and trigger control for under $300 list seems too good to be true! Don't expect the Replay to be "the poor man's Emulator" but do expect it to be what it is: a crude controller of real-world sounds. And that's plenty!

You'll have to meet the unit half-way to make it work well, but a little practice will make loading any type of sound easy. For those of you with a studio, the Replay can be a real "ace in the hole" for solving creative blocks.

The Replay is the only device of its kind I know of in this price range, and because of this I unhesitatingly recommend the unit to anyone interested in music recording, theatrical events or just plain-ole lipped-out party toys. You're sure to find many uses (some quite bizzare) for this box. The EH Instant Replay...you rang?

*Reprints of the article appearing in **Readers Digest** concerning Electro Harmonix are available from Electro Harmonix, 27 W. 23rd St., New York, NY 10010. Tel. (212) 741-1770.

SUBSCRIBE SEE PAGE 4

Letters

SHIFTY INFORMATION

I recently spoke to Michael Iceberg, who showed me some of his gadgets. One thing that fascinated and later confused me was this. He spoke into a microphone and, using a modulator, shifted the frequency of his voice down about a hundred cycles. What do you know about audio frequency shifting? Who knows, maybe somewhere in there is an interesting article for Polyphony.

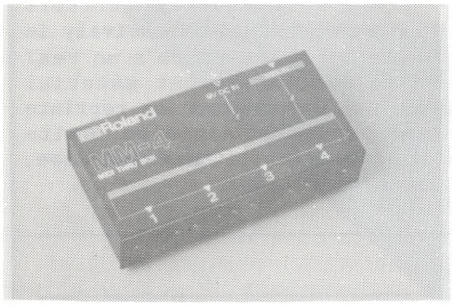
John Piskulic
St. Louis, MO

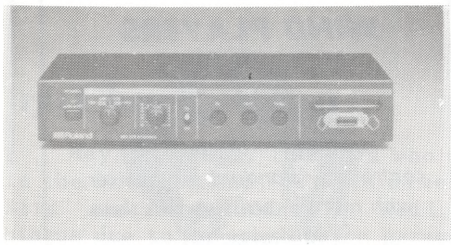
John -- Frequency shifters have been discussed extensively in Electronotes, so there's no real need to duplicate that material here. For information on reprints of the pertinent articles, write B. A. Hutchins at 1 Pheasant Lane, Ithaca, NY 14850.

CURRENT EVENTS

'Tell Them You Saw It In Polyphony'

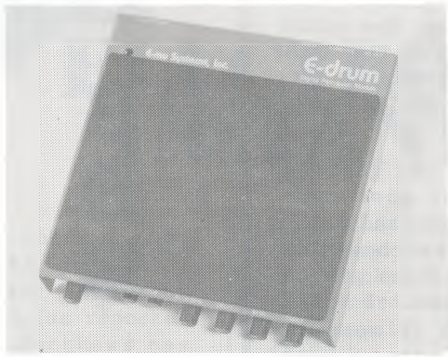
Cassette distribution. Llewellyn Communications (213 E. Fourth St., St. Paul, MN 55101) offers a cassette distribution service that is said to link independent tape and LP producers with a direct mail consumer market. Products chosen by Llewellyn for distribution are advertised and promoted in a bi-monthly tabloid that reaches approximately 30,000 subscribers. For more information write Llewellyn, or call 1-800/843-6666 (in Minnesota call 612/291-1970).





Roland MIDI products. Roland (7200 Dominion Circle, Los Angeles, CA 90040) has introduced the MM-4 MIDI Thru Box ($70 list), which expands one MIDI In signal to four MIDI Thru signals. The MD-8 ($295 list) is a MIDI to Roland DCB buss interface that allows DCB instruments (such as the Jupiter-8 and Juno-60) to work in a MIDI system.

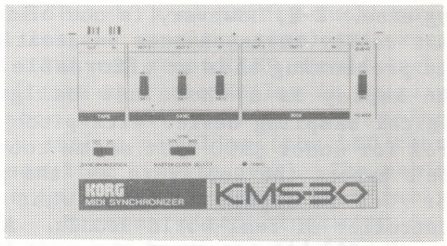
See the light. ETA Lighting (1710 Enterprise Parkway, Twinsburg, OH 44087) announces the Model 1661 (1200 Watts/channel) and 1662 (2400 Watts/channel) dimmer packs for stage lighting. Features include six channels per pack, rack format, fan cooling, low voltage DC remote control, heavy duty toroidal choke filtering, and all-steel chassis.



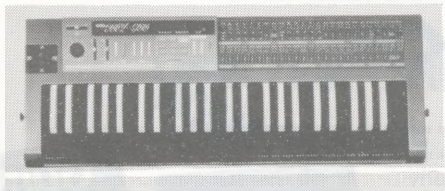
E-Drum. The E-Drum by E-mu (2815 Chanticleer, Santa Cruz, CA 95065-1891) combines digitally recorded percussion sounds (available as plug-in cartridges) with a dynamically-responsive trigger pad in a single package. The E-Drum can be triggered from DC triggers, gates, drum machines, and even audio sources.

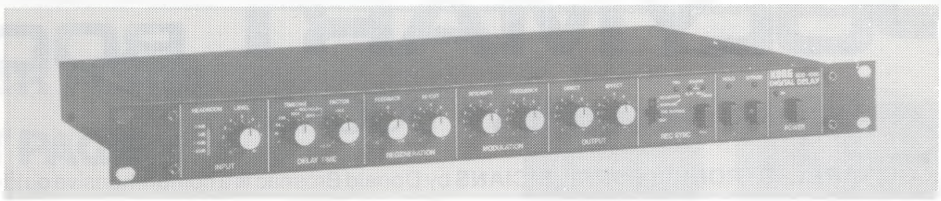
16 bit DAC. The PCM53JP-V from Burr-Brown is a 16 bit DAC with 0.002% THD, 96 dB dynamic range, 3 microsecond settling time (typical), and a 100-piece price of $19.

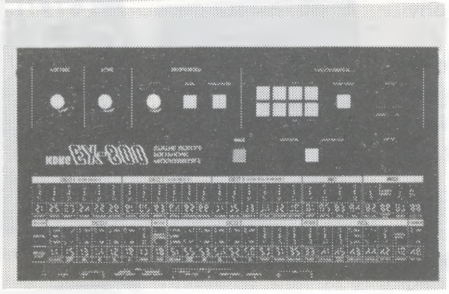
New drum sounds. Oberheim Electronics (2250 S. Barrington Ave., Los Angeles, CA 90064) has introduced the first alternate drum sound set for the DX. Retailing for $249, the set includes analog electronic drum sounds. Subsequent releases will include alternate acoustic drum and cymbal sounds, plus a wide variety of percussion voices. Nine Zero Insertion Force sockets are available for $90 to facilitate chip insertion and removal.



Unicord floods us with press releases. Unicord (89 Frost St., Westbury, NY 11590 has a lot happening. 1) Their "Patches" newsletter covers Korg products, personalities, and tech talk. 2) New PME40X effects modules include Dist-Wah (distortion, envelope follower, multi-mode filter), Octave V octave divider, and Waveshaper (converts guitar audio to square/sawtooth waveforms). 3) The MKS-30 MIDI synchronizer puts a sync track on tape and can synchronize MIDI and sync devices. 4) The Poly-800 is now available in a limited edition with reversed





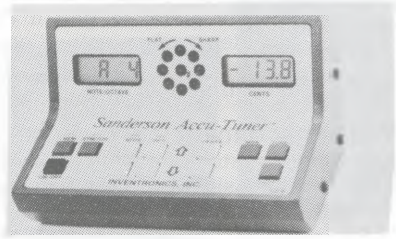


key colors (black keys, white flats/sharps). The EX-800 expander module is a MIDI controllable Poly-800 without the keyboard. 5) The SDD-1000 delay is quiet and has interesting features such as record cancel, drum machine/sequencer sync, and sample-and-trigger. $395 list.

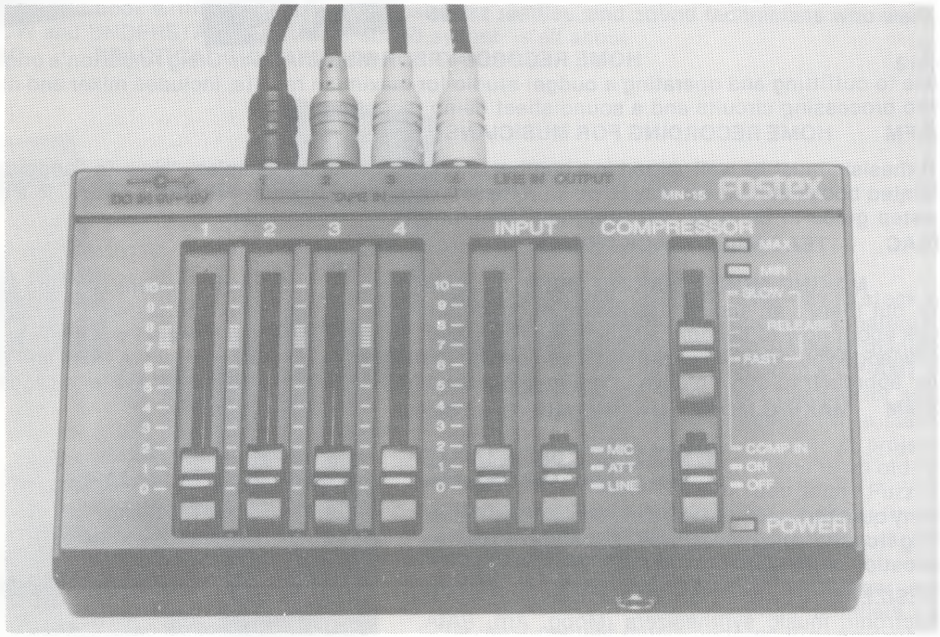
Moog software package. The Moog "Song Producer" music system, based around the Commodore-64, includes MIDI COMMAND (turns any MIDI keyboard into a split/layer keyboard) and SONGSTEPPER. The latter allows for pitch entry via MIDI keyboard in step mode or the C-64 keyboard, and provides video display of every element of a composition including drum score, music voice score, and main score. An optional printer produces score printouts. SONGSTEPPER also provides 8 independent drum trigger outputs and software programmable clock division.

The hardware interface includes MIDI IN, THRU, and four full-bandwidth MIDI outputs. Clock capabilities include CLOCK IN, CLOCK OUT, START, and STOP. The hardware/software package retails for $395.

New software. Metawave from Paul D. Lehrman (31 Maple Avenue #1, Cambridge, MA 02139) enhances the alphaSyntauri system with real-sound sampling (requires a Decillionix DX-1 digital recorder card), wave-building (for combining waveforms), wave splicing and editing, and filtering. $89.95 postpaid from the author.



Programmable piano tuner. Inventronics (70 Park Forest Drive, Carlisle, MA 01741) has introduced the Sanderson Accu-Tuner. Holding up to 54 complete 88-note piano tunings in 14K of memory, this portable unit indicates tuning on a rotating LED display. Accurate to 1/1000 of a semitone, the Accu-Tuner allows for stretch tunings, pitch raising, and stored tunings. From $950 list, depending on number of tuning programs.



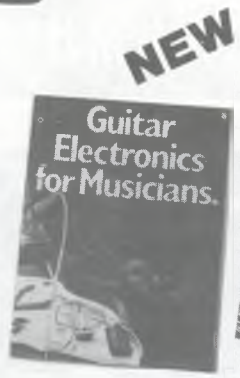
New from Fostex. The MN-15 from Fostex (15431 Blackburn Ave., Norwalk, CA 90650) is a 5-in, 1-out mixer with 4 line inputs, 1 mic/line selectable input, and a master compressor with variable release time. $55 retail. The 5030 eight-channel line amp converts eight -10 dBv signals to eight +4 dBm signals (or vice-versa), thus making for easy transfer of tracks from home studio to pro studio recorders. Transformerless design, switchable balanced or unbalanced XLR outputs, balanced XLR inputs, S/N of 92 dB. $595 retail.

New mic. Shure (222 Hartrey Ave., Evanston, IL 60204) has introduced the SM87 "Crowd Pleaser". This supercardioid microphone is claimed to provide vocalists with a tailored frequency response for maximum gain before feedback. $329 list for the SM87-LC (less cable) and $355 list for the SM87-CN (with 25' cable and pro audio connectors).

Tester. The Port-A-Tone from Micropro Audio, 8150 SW 54 Ave., Miami, FL 33143 has three 1 kHz outputs (-40 dB, -10 dB, 1W speaker level), tests phono and 1/4" phone cables for shorts and opens, and tests 3-conductor mic cables for shorts, open, and phasing (pin polarity). $129.95 list.

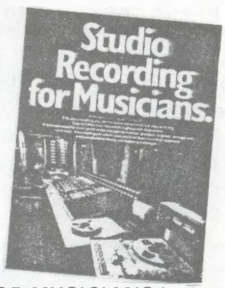
POLYMART BOOKS

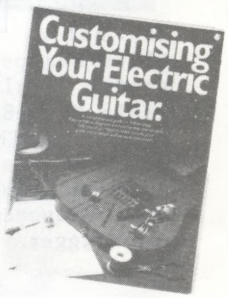
NEW BOOKS!



GUITAR ELECTRONICS FOR MUSICIANS by Donald Brosnac is a comprehensive guide for anyone interested in electric guitars. It clearly explains guitar electronics step-by-step with over 350 photos, drawings and schematics. Chapters include: types of pickups, design and function of hardware components, servicing electric guitar circuits, hot rodding electric guitars and more. Anyone who wants to increase his knowledge of guitar construction and function will benefit from reading this book. **# GEM..... Guitar Electronics for Musicians.....$12.95**

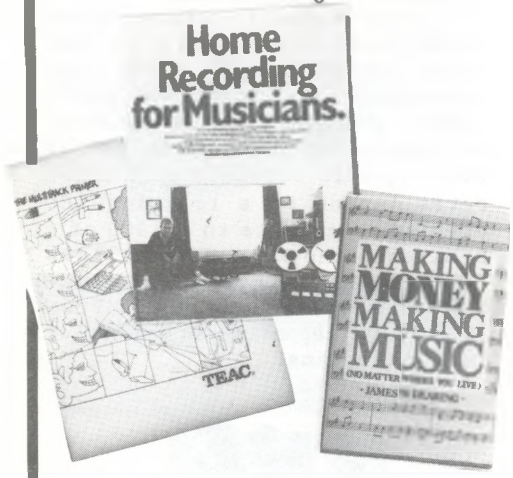
GUITAR GADGETS by Craig Anderton — A consumer's guide written by *the* expert on the subject. For the guitarist who wants to know all about electronic gadgets. How to buy them, fix them, and get the most out of them. Includes a demonstration record.
#GG Guitar Gadgets **$14.95**





CUSTOMIZING YOUR ELECTRIC GUITAR by Adrian Legg — An Easy to follow guide for customizing your guitar to turn it into a unique and personal instrument. Easy to follow diagrams and step-by-step instructions shows you how to get new and better sound from your guitar.
#CEG Customizing your Electric Guitar **$7.95**

STUDIO RECORDING FOR MUSICIANS by Fred Miller — Tells you everything you need to know about modern studio recording. Easy to follow text, backed throughout with illustrations. A must for professional and aspiring musicians — and for producers, engineers, arrangers and contractors.
#SRM Studio recording for Musicians **$14.95**

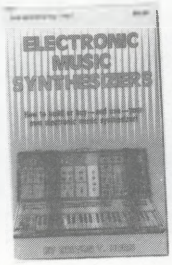


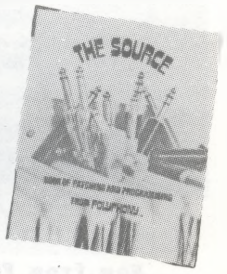
HOME RECORDING FOR MUSICIANS is Craig Anderton's original guide to outfitting and operating a budget studio for maximum results, includes mixer and other audio processing circuits and a sound sheet demo recording.
#HRFM HOME RECORDING FOR MUSICIANS $14.95

Synthesists must be well versed in a number of techniques and principles. "How To" and project oriented books are a great way to pick up these skills. **MULTITRACK PRIMER** by TEAC is a step-by-step guide to building, outfitting and operating your home studio.
#TEAC TEAC MULTITRACK PRIMER $4.95

MAKING MONEY MAKING MUSIC by James Dearing — Everyong dreams of being at the top, but there's an enormous amount of "middle money" out there for the taking. This is not a book about how to become a Millionaire Rock Star, but the strategies revealed will give you the knowledge you need to keep afloat if you decide to pursue a recording contract. A fresh and practical approach to staying alive in the music business. From the publishers of Writer's Digest.
#MMM MAKING MONEY MAKING MUSIC $12.95

REFERENCE





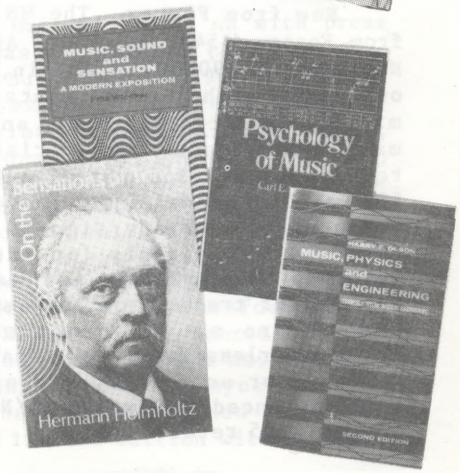
Often used reference materials to answer the many questions encountered in everyday synthesis. **THE SOURCE** Book of Patching and Programming from Polyphony has over 125 pages of patches in universal flow chart notation; the largest publication of its type.

ELECTRONIC MUSIC SYNTHESIZERS by Delton Horn devotes the first half to descriptions and functions of commercial electronic music synthesizers (Moog, Arp, PAIA, Oberheim, EML, and RMI); the second section provides schematics and projects for the experimenter.

#SOURCE THE SOURCE $4.00

#EMS ELECTRONIC MUSIC SYNTHESIZERS $6.95

SCIENCE OF SOUND



The physical and psycho-acoustical background to music is an important part of musical synthesis. Helmholtz's **SENSATION OF TONE** is, a century after its publication, still the standard text for the physiological acoustics. **PSYCHOLOGY OF MUSIC** by Carl Seashore, developer of the Seashore Music Test, provides an in-depth analysis of musical style and performance characteristics of many instruments. **MUSIC, PHYSICS AND ENGINEERING** by Harry Olson, who worked on the first RCA synthesizer, is a thorough discussion of the physical properties and design of traditional musical instruments (plus a chapter on electronic music). **MUSIC, SOUND AND SENSATION** by Winckel is much like the Helmotz work, with a bit less detail and more concentration on psycho-acoustics.

#SENS ON THE SENSATIONS OF TONE $8.95
#MPE MUSIC PHYSICS AND ENGINEERING $6.95
#PSYCH PHYCHOLOGY OF MUSIC $6.50
#MSS MUSIC, SOUND AND SENSATION $4.50

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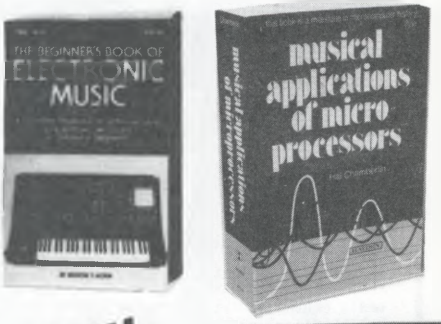


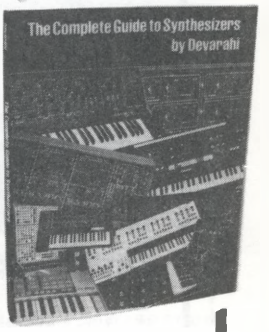
THE BEGINNERS BOOK OF ELECTRONIC MUSIC by Delton T. Horn — A fascinating introduction to synthesized sound using build-your-own circuits or commercial equipment.

#BEM Beginners Book of Electronic Music **$12.95**

MUSICAL APPLICATIONS OF MICRO-PROCESSORS by Hal Chamberlain — If you only have space in your library for one book on music synthesis, this is the book. The easily read text is entertaining and enlightening and teaches both basics and advanced theory without plowing through pages of equations. Liberal examples illustrate theory and practice of both digital and analog signal generation and processing.

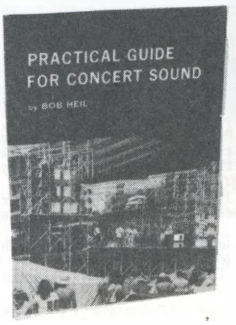
#MAM MUSICAL APPLICATIONS OF MICRO-PROCESSORS $21.95

NEW



THE COMPLETE GUIDE TO SYNTHESIZERS by Devarahi — An extraordinarily thorough treatment of the subject of analog synthesizers. Covers everything clearly, and the suggested experiments are excellent. Well organized and leaves nothing out.

#CGS THE COMPLETE GUIDE TO SYNTHESIZERS $18.95



PRACTICAL GUIDE FOR CONCERT SOUND by Bob Heil — Finally, a manual that explains in very simple language those many "magic terms" you've heard for years and never really understood. It's the first book written especially for musicians, roadies, and sound technicians who want to KNOW and UNDERSTAND what their sound system is all about.

#PGC PRACTICAL GUIDE FOR CONCERT SOUND $10.00

ELECTRONICS

Electronic Cookbooks are a great way to stock your library with materials that are not only heavy on theory, definitions and educational material but chock full of practical applications as well. These books can easily replace stacks of manufacturers data sheets and applications notes all in an easy to use reference. Walt Jung's **OP-AMP** and Don Lancaster's **ACTIVE FILTER** Cookbooks are self-explanatory — required reading for synthesists! **ELECTRONIC PROJECTS FOR MUSICIANS** by Craig Anderton is almost in a class by itself. It discusses electronic construction technique for the novice and provides 27 projects with printed circuit board patterns and a demo recording of the effects. Even if you're an old hand at musical electronics, you'll appreciate that all of these processors, from Tube sound Fuzz to Phase shifter are compatible and work together without creating noise, signal loss, bandwidth compression or any of the problems common to interconnecting effects from different manufacturers. There's even a complete chapter on how to modify and combine effects to produce your own custom pedalboard. **ELECTRONIC MUSIC CIRCUITS** by Barry Klein covers synthesizer system design, power supplies, control voltage generators, VCOs, Filters, analog multipliers and more. Lots of schematics and data sheets on the most popular music oriented ICs. An excellent technical reference.

#EPFM	**ELECTRONIC PROJECTS FOR MUSICIANS**	**$14.95**	**#OACB**	**OP-AMP COOKBOOK**	**$15.95**
#EMCR	**ELECTRONIC MUSIC CIRCUITS**	**$16.95**	**#AFCB**	**ACTIVE FILTER COOKBOOK**	**$14.95**
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4/8TRACK STUDIO LOG BOOK designed by Craig Anderton provides a place to keep all the important information on your tape library. Log in timing, type of tape used, record patches, make notes and use the expanded track sheet to list sequential changes in tape tracks relating to the settings of the indes counter. Craig Anderton's **CONTEMPORARY KEYBOARD ARTICLES** is a collected reprint of all the articles from June 1977 through February 1981, covers tips, technique, theory, maintenance, and numerous construction projects. **DEVICE BACK ISSUES** — during the year that this newsletter was published, it featured almost 200 pages of technical information for the guitarist/musician. A wealth of articles on design, product reviews, and modification and construction projects. Sold in complete set, individual issues not available. Limited number available. **CRAIG ANDERTON MUSIC TAPE** — Delightful listening plus a booklet explaining how the effects were achieved.

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Find out what you've missed!

▬ #0301: 7/77: frequency divider project, random tone generator project, normalizing synthesizer controls, eliminating patch cords, computer control of analog modules. Chord Egg

▬ #0302: 11/77: The Sensuous Envelope Follower, digital gates, LED wall art, build a bionic sax, data to music peripheral project, Apple II as a music controller, using the NE566 as a VCO, patches.

▬ #0303: 2/78: computer controled Gnome, using joysticks, build a bionic trumpet, ultra-VCO modifications, voltage control the Mu-Tron Bi-Phase, oral joystick, patches.

▬ #0304: April/May'78:Minimoog Mods, non-keyboard module use, phasing and flanging (theory and circuits) memory expansion for programmable drums, digitally addressed transposer, polyphonic software.

▬ #0402: Sept/Oct 78: electronic music notation, notes on the recording of "Cords" by Larry Fast, sequencer software - part one, rhythmic control of analog sequencers, touch switch projects, modular vocoder techniques. PET as a music controller, patches.

▬ #0404: January/March 79: add-ons for vocal F and V converter, shorthand patch notation, more on note to frequency conversion, graphic monitor project, George Russell, super VCA circuit. echo software, Vol. 4 index.

▬ #0502: July/August 79: hex VCA/mixer project, electronic music schools and studios, modify the Oberheim Expander Module, profile of Ernest Garthwaite, budget microphones, digitizer projects and software. bar graph ICs

▬ #0505: January/February 80: Joseph Byrd, Mort Garson, Larry Fast on 'Games', composing for 'live plus tape', using the CA3280. recording vocals, ADSR circuits.

▬ #0506: March/April 80: Computers in Music: real time audio processing hardware, Powell sequencer system, Max Mathews, advanced STG software, PortaStudio, phase modulation, Volume 5 index.

▬ #0601: May/June 80: Gary Numan, Microcomputers in Real Time Audio, Build a Digital Audio Delay Line, writing Documentation, Richard Hayman Composer/Performer Home Recording: Applying Harmonizing and Pitch Transposing Techniques by: Craig Anderton.

▬ #0602: July/August 80: Peter Gabriel, digital VCO project, Dream modules, optimum level settings, dynamic phrasing, patches.

▬ #0603: Sept/Oct combined with Nov/Dec 80: alternate controllers, add voices to Casio M-10, voltage controlled quadrature oscillator project, cordless patch bay, recording rules, patches.

▬ #0604: January/February 81: Special Construction Edition; Build: Audio Circuit Breaker, Pulse Width Multiplier, Magnetic Harp, 50 Watt/Channel Stereo Power Amp, Quad Sequential Switch, DOD Mods, patches.

▬ #0605: March/April 81: Portable Music Issue, reviews of Remco's FX, E-H Mini-synthesizer, Casio's VL-Tone, plus mods for the M-10, GR-500, mini-amp, and the Korg X-911. Introducing; Practical Circuitry and On Location, new columns.

▬ #0606: May/June 81: Synthesizer: Hardware Mods and Software. Modular Synthesizer Effects, Environmental music, Keyboard assignment for the 8700, new columns; Details, Practical Circuitry, and On Location. Volume 6 index.

▬ #0701: July/August: Guitar Electronics: Modify: Fender Amp, MXR Phase 100, GR-500. Input/Output Structures, $5 Analog Programmer, Sample and Hold technique, Modular Synthesizer Effects, new column: Applied Synthesis, Marketing Your Records.

▬ #0702: Sept./Oct.'81: Harald Bode Interview, Live Plus Tape - New Technique, Xenharmonics, Kraftwerk Live - Review, Psycho-Acoustic Experiments, Practical Circuitry - Super Controller, Applied synthesis - Brass, Construction Tips For Beginners.

▬ #0703: Nov./Dec.'81: Dave Rossum interview, Applied Synthesis: Strings,Details: Series-parallel/Sum-Difference. The Sound Gizmo and Pro-One Reviews, Practical Circuitry: VCO Deluxe.

▬ #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.

▬ #0903: Remote MIDI Keyboard Project part I, Casio 202 Mods, Easy Firing ADSR, Low Budget Sequencers, Alternative Keyboard Designs, Winter '84 NAMM Report.

▬ #0904: Wendy Carlos Interview, '64 Sounds Part I, Fostex 2050 Review, Synthesizer Delay Line, DSX to Drumulator Adaptor.

APPLIED SYNTHESIS

NEW from POLYMART - Bill Rhodes "APPLIED SYNTHESIS" ..... a no nonsense guide to the mechanics of electronic music for orchestral synthesis.
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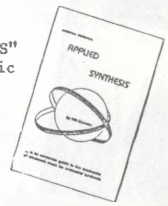

HOT MUSIC HARDWARE: NAMM ON VIDEO

MIDI, computers, digital sampling, synchronization, synthesizers, new stringed instruments ... although closed to the public, you can go behind the scenes at the largest music industry trade show in the U.S. with the Summer '84 NAMM-ON-VIDEO. Hosted by Polyphony editor Craig anderton, this 1 hour VHS video includes demos of the latest gear, interviews, commentary, and background on what changes in the industry mean for musicians. Send $49.95 (plus $2.50 shipping/handling) to POLYMART.

ALSO available: The Winter '84 (January) NAMM-ON VIDEO (featuring the Emulator II, Kurzweil 250, Chapman 'Stick", Yamaha DX7, and Tom Coster with the Moog Liberation) for $49.95; or order both tapes for a special package price of $79.95 (plus $2.50 shipping/handling).

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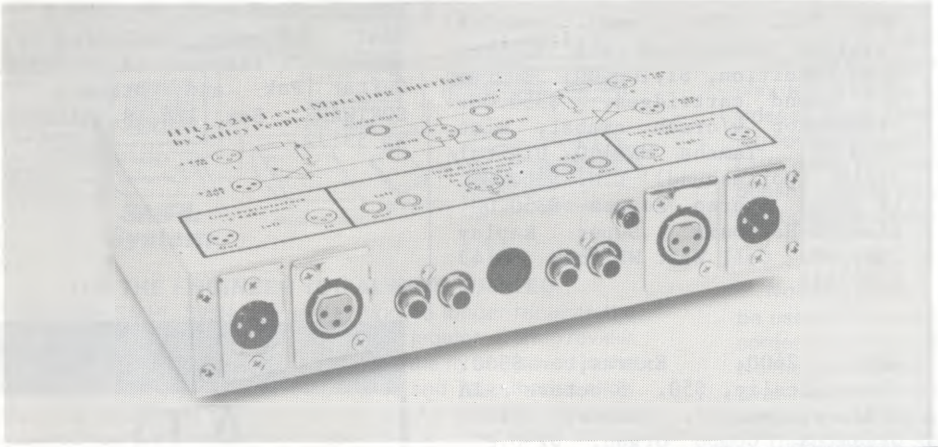
CURRENT EVENTS

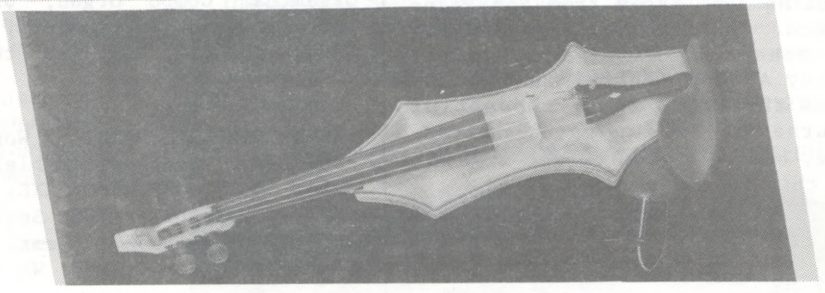
Show. The New York Guitar & Music Expo, September 7-9 at Madison Square Garden (exposition rotunda), features demos of new equipment and exhibits by leading music industry manufacturers. For more information call Gerald Martin Associates Inc. at 914/723-2581.

Sync. The TLS4000 synchronizer from Studer Revox America (1425 Elm Hill Pike, Nashville, TN 37210) can control and slave one tape transport to SMPTE time codes, reference frequencies, video composite signals, and bi-phase signals. A local control unit accesses the different operating modes. $5190 list.

Super Replay. The "Super Replay" from E-H (27 W. 23rd St., NY, NY 10010) has a four second sample time, 12-bit sampling, dynamics, and click track to simplify playing with long sample times. $675 list.

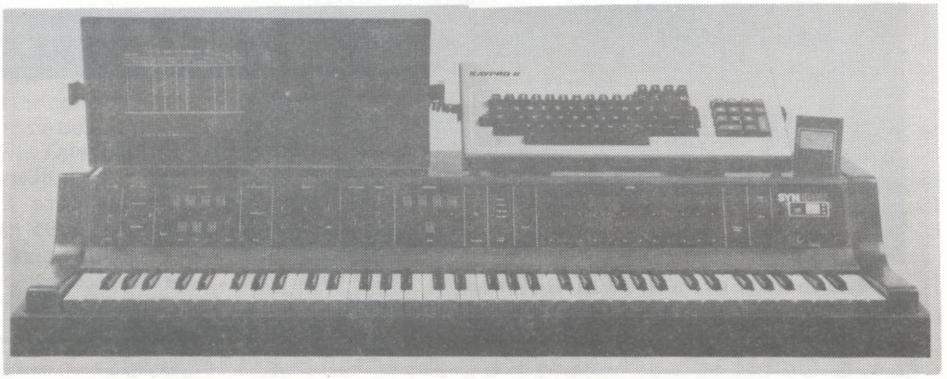


Audio interface. Valley People (2820 Erica Place, Nashville, TN 37204) has announced the two-channel HH 2 X 2B for matching -10 dBv gear (i.e. semi-pro audio equipment) to +4 and +8 dBm (i.e. pro level) gear, in either direction.



Electric violin. The Raad Violin (Raad Instruments, 109 Vaughn Rd., Toronto, Ontario, Canada M6C 2L9) is claimed to maintain the dynamic, transient, and frequency response of quality acoustic instruments. Each instrument is individually voices and spectrally balanced; volume and tone controls are available by skillful bow manipulation.

New keyboard. The Synergy II Plus/GDS (DKI, 105 5th Ave., Garden City Park, NY 11040) is the latest descendant of the Synergy I and General Development System. $7500 list includes a Kaypro computer.



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re-view

Cont. from pg. 29

part separately, you can sing along with sustained violin notes, you can just barely blow or bow, etc. Is this music or a masters thesis?*

Crusaders **Ghetto Blaster** (MCA 5429). Dripping with strings and session vocalists, these overwrought funk tunes say the Crusaders juggernaut is coasting.

Trans-Millenia Consort **Plot Zero** (TMCR 2002). The TMC is actually Pauline Anna Strom from San Francisco. She draws a large variety of sounds from her synthesizer (many ADSR-triggered), and organizes them into long, thoughtful journeys. Nothing earth-shattering, but it's good to see a woman in this male-dominated field.*

Joan La Barbara **As Lightning Comes, In Flashes** (Wizard 2283). There's something about La Barbara's "experimental" vocal work that I find incredibly pretentious. Unlike Group 87, the unusual sounds she comes up with (and some are great) are simply thrown out with no thought given to presentation. She should record herself on an Emulator and let Strom play her.*

* Denotes records available from New Music Distribution Service, 500 Broadway, New York, NY 10012.

Music equipment

PAIA Encoded Keyboard, 8700 Computer, Linear DAC, QuASH, Drum Card, Software. Package deal or separate. Best reasonable offers. Call Bob (717) 7550332.

EML 101, 200, and Catstick Joystick controller all in very good condition, $1,100.00. E-Drum w/5 sound cartridges, $350.00. Drumulator w/crash cymbal, mint $600.00. Yamaha MK-100 Digital synth (portasound) L.N. $300.00. LT Sound Stereo Reverb $350.00, Electro-Harmonix Super Replay $395.00. Call Walt Whitney (314) 429-2858.

ARP 2600, Extras, $900. Chorus/Leslie, $50. 5 octave PAIA 8782 w/computer, extras, $200. Organtua Combo Organ, $250.00, parts, books instruments, more. (707) 778-6802, PDT. Keep trying.

LASER DISPLAY DATA. Worldwide sources. Synthesizerable! For sale:)B-DX, ARP 2600/AXXE, Synare III, s. circuits 800 Sequencer, Crumar Pedalbass. Remaissance! Box 687, Mercer island, WA 98040.

Recordings

Rough order of Magnitude: The release of a new experience! Synthetic music on cassette from SYNTHETIC FOUR MUSIC. $6.95 to: SYNTHETIC FOUR MUSIC, 6049 Butternut Dr., West Olive, MI 49460

Misc.

LISTS of Actual Electronic Buyers for your business, for info send 20c stamp: GAGco., 415 East Austin, Luling, TX 78648.

UNIQUE COMMODORE 64 Audio/Music Disk software including "64 Sounds" (featured in POLYPHONY), Guitar Pak and others. JAL SOFTWARE, Box 128, S. Milwaukee, WI 53172.

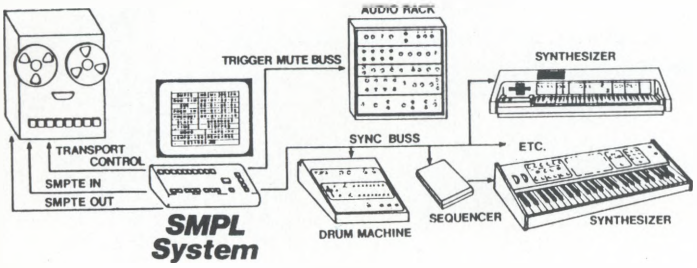
AD INDEX

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.

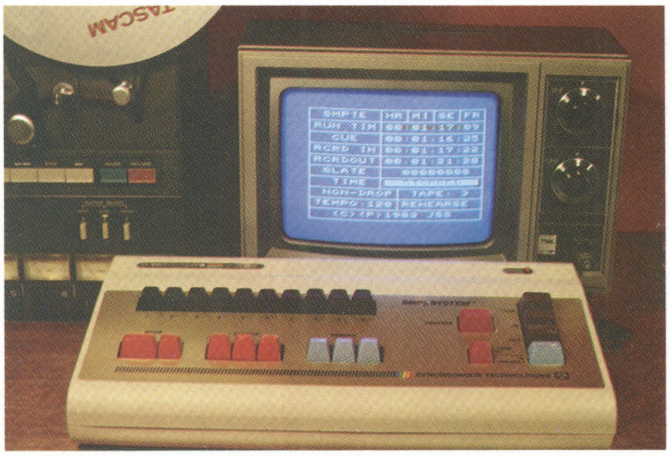
IT'S A COMPLETE, LOW COST SYSTEM

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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be SYNTHABLE

The software wizards stuck a 9-foot concert grand onto a tiny silicon chip . . . a world-class speaker is the way to hear it . Because a system designed only for "traditional" sounds can't live up to the powerful levels and complex timbres of electronically-created music.

That's why we created the 380SE.

Total Transparency—and Psychoacoustic Satisfaction, too.
The 380SE is a clean and powerful three-way speaker system. Electronic reeds and strings, flutey and brassy tones, percussive accents, special effects . . .all sounds at all levels come through with exacting sonic accuracy. The 380SE illuminates subtle variations in pitch and level, whether handling one note at a time or a full synthesized chorus.

Attention to Detail
The digital wizards must master every detail of their technology. A speaker designed for electronic music gives them the freedom to concentrate on sound creation rather than sound reproduction.

So we paid attention to every detail of the sound system. That's why the 380SE is constructed entirely from our own high-quality components. With continuous power handling of 360 watts. Full range inputs. Bi-amp and tri-amp connectors. Four bridging connectors. Mid- and high-frequency level controls, flush-mounted where you can get right to them.

And as you can see, we didn't overlook the visual details. The 380SE's appearance is visual confirmation of its class. The 380SE's performance proves its ability to handle electronic music.

That's what being synthable is all about.

For complete technical data, call or write:

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So. San Francisco, CA 94080
(415) 588-2538
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Edmonton , Alberta T5S 1K8
(403) 489-5511