POLYPHONY™

ELECTRONIC MUSIC & HOME RECORDING

May/June 1981

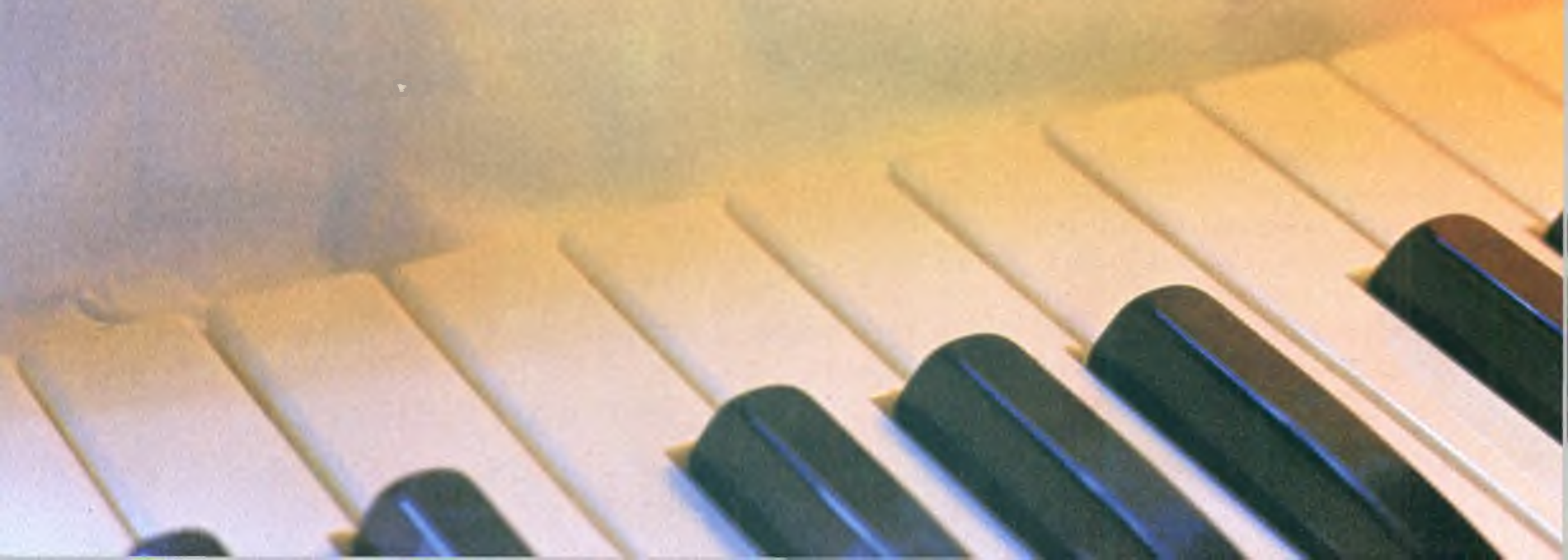
ISSN:0163-4534

$2.50

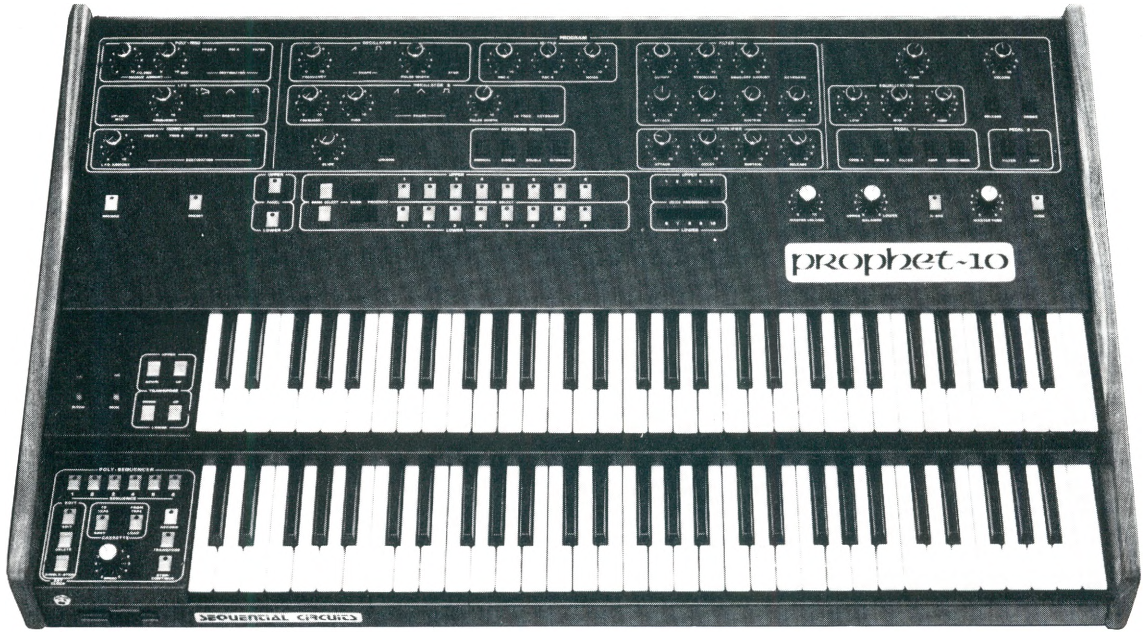
EXPANDED TECHNIQUE

- SOFTWARE
- HARDWARE MODS

FOR SYNTHESIZER



THE ULTIMATE KEYBOARD



The Prophet-10 is *the* most complete keyboard instrument available today. The Prophet is a true polyphonic programmable synthesizer with 10 complete voices and 2 manuals. Each 5 voice keyboard has its own programmer allowing two completely different sounds to be played simultaneously. All ten voices can also be played from one keyboard program. Each voice has 2 voltage controlled oscillators, a mixer, a four pole low pass filter, two ADSR envelope generators, a final VCA and independent modulation capabilities.

The Prophet-10's total capabilities are too numerous to mention here, but some of the features include:

* Assignable voice modes (normal, single, double, alternate)
* Stereo and mono balanced and unbalanced outputs
* Pitch bend and modulation wheels
* Polyphonic modulation section
* Voice defeat system
* Two assignable & programmable control voltage pedals which can act on each manual independently
* Three-band programmable equalization
* Program increment footswitch
* Programmable volume control and a master volume control
* Octave transposition switches
* Upper & lower manual balance control
* A-440 reference tone

The Prophet-10 has an optional polyphonic sequencer that can be installed when the Prophet is ordered, or at a later date in the field. It fits completely within the main unit and operates on the lower manual. Various features of the sequencer are:

* Simplicity; just play normally & record exactly what you play.
* 2500 note capability, and 6 memory banks.
* *Built-in* micro-cassette deck for both sequence and program storage.
* Extensive editing & overdubbing facilities.
* Exact timing can be programmed, and an external clock can be used.
* Ability to change programs automatically in the sequence.
* Transpose facilities for instant pitch changes.

The Prophet-10 comes complete with a high quality flight case, two voltage pedals and two footswitches. It's now available; see your local dealer.

Play the Prophet-10 today—It's your ULTIMATE KEYBOARD.

For more information write to: SEQUENTIAL CIRCUITS, INC. 3051 North First Street Dept. K San Jose, California 95134

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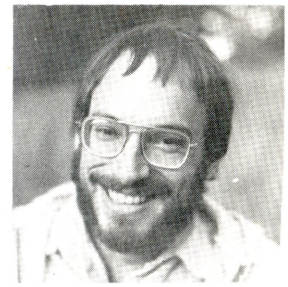
EDITOR'S note



Articles...they're the essence of any magazine. One of the best things about Polyphony is that, unlike most magazines that assign particular stories to staff members, our articles come from our readers (that's you!). The great variety of articles that come across my desk are a never-ending source of amazement - everything from the simplest pickup tricks to complex synthesizer modules.

There are many good reasons why you should write for Polyphony. First, it's a very satisfying feeling to be a published author, and to know that something you've learned is being passed along to your fellow musicians. Second, there are some material rewards. We pay at the rate of $25 per printed page, which may not be enough to send you on a vacation in Hawaii, but at the very least it establishes you as a professional and should help cover the expenses involved in preparing the article...this may even allow you and a friend to take in a movie, or buy some LPs.

Third, there are many intangible rewards which you will only find out about once you've been published (such as job offers or meeting new people). The nice thing about these intangible rewards is that they always come as a surprise, when you need them the most or when you least expect them.

As for how we select articles, you've probably noticed that each issue of Polyphony concentrates on a particular theme. When an article arrives, we first send out a form letter of acknowledgement. The article then gets placed on file under the appropriate subject heading (modification, synthesizer module, video, recording technique, or whatever). As the theme for an issue takes shape, we delve into the files and dig out those articles most suitable for that issue. Sometimes, I'll assign additional articles to help round out the issue.

As a result, some articles get published almost immediately; on the other hand, some take quite a while before they appear, as they await an issue into which they can logically fit. I know this drives some of you nuts to have us sit on an article for six months, but since most of the articles we receive aren't all that topical (a good article on composition, for example, will be just as valid six months from now as it would be today), it helps us tremendously to have a good stock of articles on file.

As we plan the future, there are certain themes we'll be exploring: Signal processors, guitar electronics, synthesizer modules, electronic percussion, and so on. I'd also love to run an issue on composition techniques; but all this depends on how many articles we receive on these various topics. So, if you have a favorite modification, or technique, or module - whatever - we'd like to hear about it. You can always query first to make sure we don't already have something like what you propose on file; or, perhaps we can add some suggestions that will make your article more useful to our readership. And don't make the mistake of thinking your idea is too simple or too unsophisticated! Some of our most popular articles have been preceeded with a letter along the lines of "This is probably obvious, but..."

The one real problem I have as editor is trying to figure out how to tell someone that their article has been rejected. In many instances, the problem will simply be that the article doesn't seem quite suited to our readership; in these cases, I've helped several writers place their articles in other magazines, which is certainly a good way of dealing with the situation for all concerned. Another problem is when someone sends in a well-written article that I feel will only appeal to a small percentage of the readers; these often have to make way for articles of more general interest.

But the important point to remember is that rejection of an article is NOT a personal rejection. As one who has had many articles rejected by many magazines, I'll easily confess that it does sting a bit when you've put a lot of work into something, only to hear "...is not quite suited to our needs at the present time". However, those are the rules of the game. A baseball player is happy to get on base one out of every three times at bat; if you can maintain the same percentage as a writer, you're in good shape.

* * * * *

Speaking of informative and useful, this issue welcomes two new contributors to our pages. Many of you are familiar with Jim Aikin's record reviews (and other articles) that have appeared in Contemporary Keyboard over the years; we've happy to publish his latest effort, a very complete and useful article on synthesizing special effects. Whether you're just getting into synthesis or are a master of the modules, I'm sure you'll find something of interest in what Jim has to say.

This issue also marks the debut of Details, a semi-regular feature on circuit design subtleties involving audio electronics. We are most fortunate to have Dennis Bohn handling this column, who edited National Semiconductor's Audio Handbook and has also written for magazines such as Popular Electronics. Dennis not only knows his stuff, he has a sense of humor and an ability to make complex subjects understandable to the average reader that makes him a natural for Polyphony.

Craig

re-view

by Robert Carlberg

Don Slepian - **Computer Don't Breakdown** (D&J 011028)
Marvelously rich synthetic voicings in suites whose complexity owes more to classical than pop. What's the opposite of minimalist? A masterwork.

Steve Tibbetts - **Steve Tibbetts** (Frammis BZZ-77)
Steve Tibbetts - **Yr** (Frammis 1522-25)
Big productions are Tibbetts' bag, and he carries them off extremely well. "Steve Tibbetts" moves easily through folk, Irish, Cajun, soft- and hard-rocking music with a pivot of guitar and percussion. "Yr" is full of backward drums, tape feedback, speed changes, more guitar, and some vigorous synthesizing. Both show considerable skill and taste.

Joe Sample - **Voices in the Rain** (MCA 5172)
Sample's usual exuberant instrumentals, with strings and a couple vocals. Occasionally borders on schlock, but it's always irresistibly happy.

Soft Machine - **The Land of Cockayne** (EMC 3348)
Softs go easy listening, with orchestra. Quite a change for them.

Hugh Hopper/Alan Gowen - **Two Rainbows Daily** (Red Rouge 1)
Wayside mailorder described it thusly: "Hopper was bassist with Soft Machine during their creative heyday, and during his reign with them developed a unique fuzz-tone and style of composition. Gowen (Soft Heap, Gilgamesh) provides the various keyboard work." I would only add, flexible melodies and rhythms make the kind of music coming out of Canterbury, England one of the most satisfying styles around.

Eberhard Weber & Colours - **Little Movements** (ECM 1-1186)
Pensive and evocative jazz with Charlie Mariano's sweet soprano sax, Weber's always-lyrical bass, the most imaginative John Marshall percussion in years, and Rainer Bruninghaus' arresting piano and synthesizer.

Leon Lowman - **Syntheseas** (Syntheseas 009017)
Four-tracked synthesizer over the "Drum Drops" drum recordings. Unfortunately, Lowman not only sticks to the 16-bar/break/16-bar pattern of the "Drops", but adds his own bass line/dual rhythm lines/lead line formula to boot, for a very safe, preppy, and predictable result. I tried to like this album, I really did.

Conrad Schnitzler - **Consequenz** (KS 004)
According to the notes you're supposed to add your own vocals to these cliche free electronic rhythm tracks, and then send Conny a cassette. Personally I don't think they need it.

John Duesenberry - **4 Movements for Tape** (Opus One 60)
The "Boston School of Electronic Music" sound is a direct descendant of '50s tape music, itself a descendant of '20s and '30s quasi-random serialism. The intentionally disorienting lack of any melodic or tempo continuity is partially countered by Duesenberry's interesting voice changes in the prepared piano and synthesizer. You still can't dance to it, though.

Tod Dockstader - **Quatermass** (Owl 8)
In 1958 Edgar Varese coined the term "organized sound" to underscore the non-musical aim of his "Poeme Electronique". Dockstader's 1964 composition continues with the same term and style. The electronic tones and effects are by turns mournful, exhilarating, frightening, boring, and fascinating, but never quite "musical". Owl has long since gone out of business; Aeon Imports seems to have the only remaining copies.

Bruno Spoerri - **Iischalte - Switched on Switzerland** (CBS 80-418)
Oom-pah-pah beer drinking songs on dry cliche synthesizer.

Joy Division - **She's Lost Control/Atmosphere** e.p. (Facus 2)
Monorhythm electrobeat with bass, drum, drone keyboards and very humble vocals. Some nice drum processing but that's about the only sophistication.

Denis Wize - **Consciousness Program** (Om 1)
Fragments of songs, nature recordings, unrelated instrumental tracks and who-knows-what-else are collaged into a 40 minute "Revolution No. 9". Lacks maturity and any sense of polish but the energy is admirable.

Steven Halpern - **Spectrum Suite** (SRI 770)
Whether or not you subscribe to Halpern's holistic theories, he plays some beautiful pentatonic slow improvisations. Side one is solo Rhodes, side two adds organ, guitar, and electric flute.

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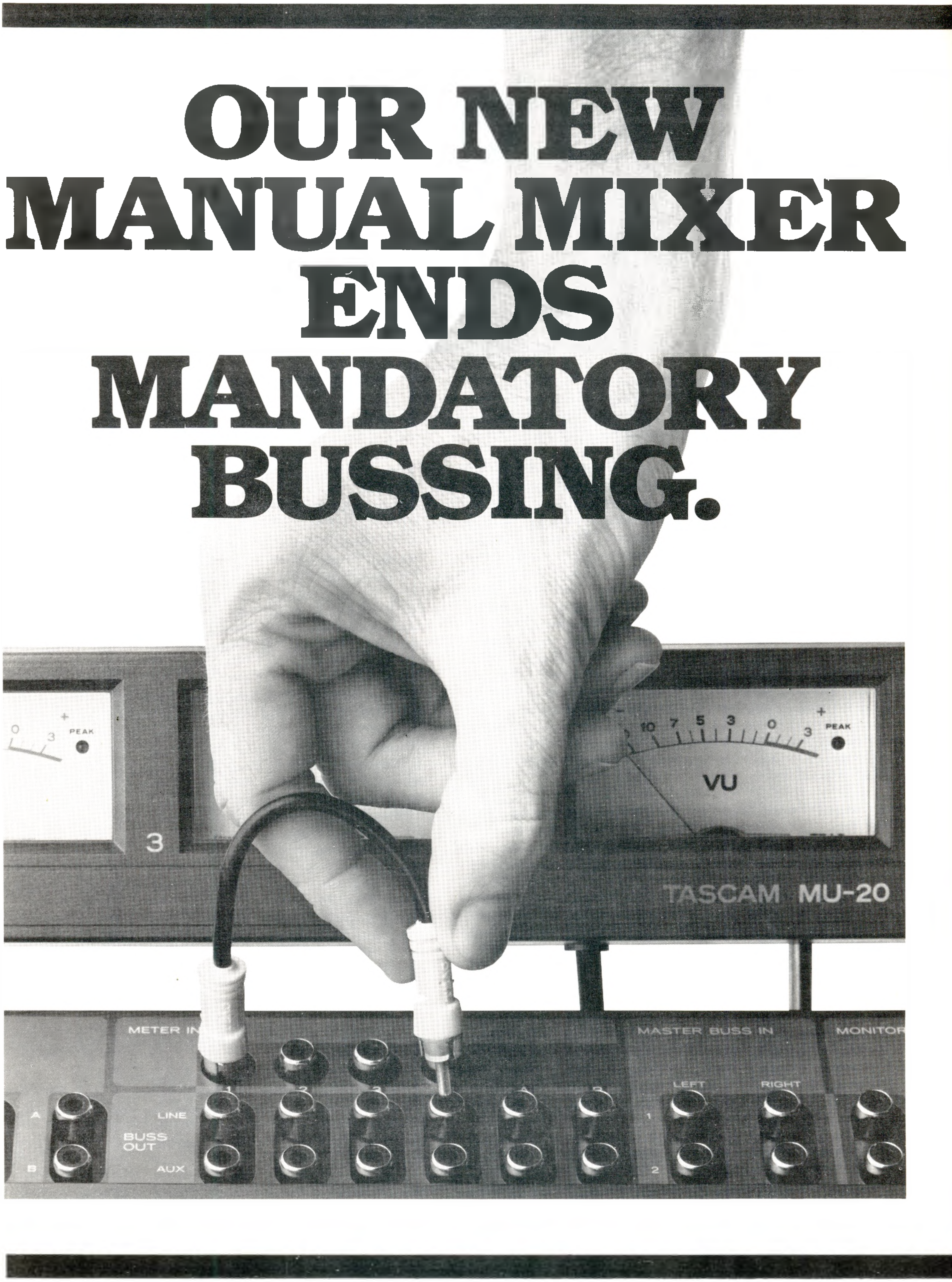
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MASTER BUSS IN
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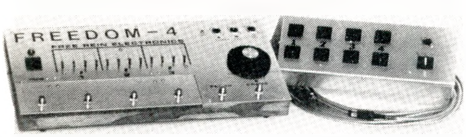
CURRENT EVENTS

'Tell Them You Saw It In Polyphony'

Another Parts Source. Toleco Systems (PO Box 401, Kingston, WA 98346) stocks parts such as the NE5534 ($3.50), NE5532 ($5.00), SAD1024 ($10.00), and National's 1980 Edition Audio Handbook ($6.00). Send SASE for complete listing.

Looooooong Digital Delay Announced. Imaginearing Audio (5558 S. E. International Way, Milwaukie, OR 97222) has introduced the Echo Recorder Delay. The ERD programs delay time (1.2 milliseconds to 16 seconds) from a calculator-style keyboard, includes "backward tape"/ repeat functions, a control voltage input for the master clock (2:1 range), and can also operate as a 16 second solid-state tape recorder. This unit allows for effects such as "Frippertronics", but without the need for stringing tape between a couple of tape recorders. List price is around $2000.

I. A. has also announced a low-cost ($99 list) version of their Alphatone III tuner called the Alphatone Jr. Designed mainly for guitarists, the Jr. has slightly less range and no transpose pot.

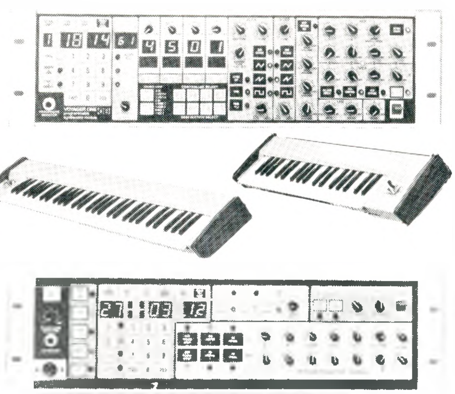


See the Light. The Freedom 4 from Free Rein Electronics (Box 10661, Denver, CO 80210) is a foot-operated, 4 channel, 3 scene lighting controller. Includes automatic fade times up to 10 seconds, momentary flash effect, control from internal clock or external audio input, and many other features. Available in kit or assembled form; write Free Rein for further information and current pricing.

E-H Rock -N- Roll Contest. Every Saturday until at least the end of August, Electro-Harmonix will continue to hold their rock and roll contest. The action takes place from noon to midnight at the E-H Hall of Science (150 West 48th St., New York, NY); call (212) 944-2392 for additional information.

New Lead, Poly Synths. Octave Electronics (928 Broadway 7th Floor, New York, NY 10010) has announced a new line of innovative products, comprising two synth electronics modules and two control keyboards.

Both modules have 32 program memories with tape dump/load, footswitch controllable program selector, computer interface, and rack mountable format. The Voyetra 1 lead synth module ($1595) also includes a built-in sequencer, sophisticated patching capability, envelope follower for external triggering and synchrosonic applications, and other features. The Voyetra 8 poly synth module ($3695) includes eight voice capability, arpeggiator, program parameter trims for real time control of stored parameters, and several other features.

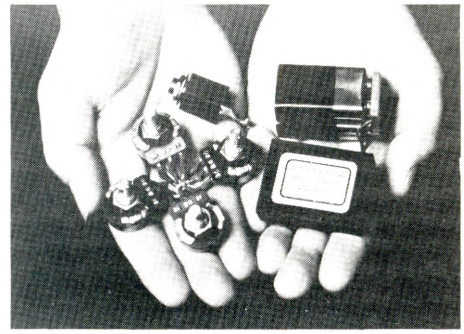


The VPK-3 ($695) is a three octave mono keyboard with velocity/pressure sensitivity and XY joystick; it is designed to mate with the Voyetra 1. The VPK-5 is a 5 octave poly keyboard for the Voyetra 8 with the same basic features as the VPK-3.

In other news, Octave has also revised their Cat SRM II and Kitten II synthesizers to provide greater resistance to dirty keyboard contacts, more patching capabilities, and better stability from totally redesigned internal circuitry.

Hold that Recorder. TEAC (7733 Telegraph Road, Montebello, CA 90640) has introduced two floor standing consoles, one for 40-4 or 80-8 multitrack recorders, the other for the 35-2B mastering deck. List price for either console is $449.

Tick, tick, tick. Metone's (2107 E. 7th St., Los Angeles, CA 90021) Model 23 metronome lists for $29, and covers a 40 to 220 bpm range through its built-in speaker.



For the Active Guitar. A/DA (2316 Fourth St., Berkeley, CA 94710) now distributes the Little FEANC from Zeta Systems. Designed for on-board mounting in most electric guitars, the FEANC includes a Fuzz, Equalizer, Amplifier, Noise gate, and Compressor in a 1.5" x 2" by 0.5" package.

Two New Guitar Amps. Road Electronics (2107 E. 7th St., Los Angeles, CA 90021) has announced the SL120 lead amp with switchable channels and the L120, a single channel version. Both models feature 3 band active EQ, FX loop, master volume control, headphone jack, and 60 Watt RMS power rating.

Lasers, Anyone? If you're interested in lasing around, check out New Renaissance, PO Box 5452, Seattle, WA 98105. This bimonthly publication for lighting and laser artists/technicians costs $25 US, $35 foreign air mail.

DETAILS: Mother lied to you

by Dennis Bohn

The most fundamental building blocks of all op amp circuits are the non-inverting and inverting gain stages illustrated in figure 1. For review purposes, let us examine what we know: The non-inverting amplifier has a positive gain of **1 + R1/R2**, and the inverting amplifier has a negative gain of **R1/R2.** This means, for example, if R1=R2 and the input is +1 Volt, then the output of the non-inverting amplifier equals +2V, and the output of the inverting amplifier equals -1V. Right?

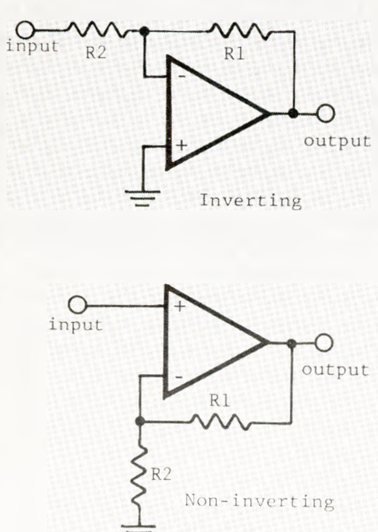


Figure 1: Op Amp Gain Stages

Right. We also know that the phase shift of the non-inverting amplifier is 0 degrees, and the phase shift of the inverting amplifier is 180 degrees. Right?

Wrong.

The phase shift of the inverting amplifier is 0 degrees, not 180 degrees as you have been taught. Don't bother running to your favorite reference books to look this up to prove to me I am wrong. They are wrong - which is what this column is all about. Read on brave souls, nothing is sacred!

The problem here is a failure by teachers and authors to distinguish between phase shift and inversion, two very different critters. (Don't feel bad, I earned my Bachelor and Master Degrees at one of the most acclaimed engineering schools in this country and they taught me the same thing.)

Inversion simply means that the output of the op amp follows the input exactly, but in the opposite direction: +1V in, -1V out. **Phase shift** is another thing entirely. If an op amp circuit exhibits phase shift, then the output either lags or leads the input by so many degrees, which translates into time delay. Put 1V in and wait to get 1V out; positive or negative, it doesn't matter. Referring to figure 2, instead of a nice clean sine wave input, let's add a noise spike to the positive going peak. The output of the inverting gain stage follows the input exactly but in the opposite direction, resulting in the figure shown. If you hooked up a dual trace scope to the input and output of the circuit, this is what you would see. If, however, the circuit exhibited

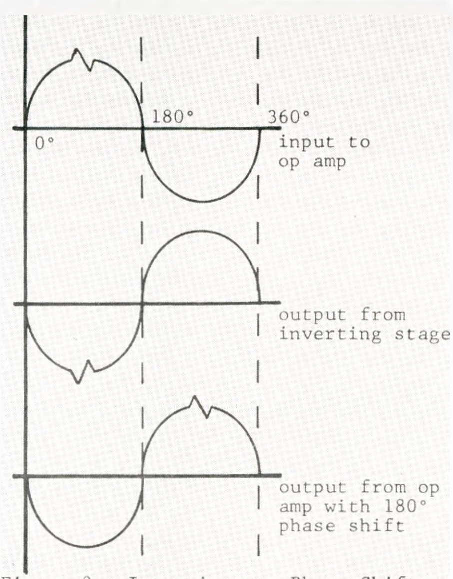


Figure 2: Inversion vs. Phase Shift

180 degrees phase shift, then the output would look like the bottom diagram. See the difference? One happens right now, and the other is delayed one half cycle. Big deal. You bet.

So, why are all the textbooks wrong?

I don't know. Probably sloppy writing and inattention to details. Details are everything if you are going to master electronic fundamentals, especially if you're dealing with a sensitive field like audio electronics. The most obvious way to confuse this whole issue further is to take a sine wave oscillator as a source, hook it up to an inverting gain stage and examine its input vs. output on a dual trace scope. Voila! It appears that the output is 180 degrees out of phase with the input...or is it? It certainly is inverted with respect to the input, but is it also 180 degrees out of phase? No, but you couldn't prove it with this test set-up. You see, the problem comes about as a result of looking at steady-state sine wave signals. Inversion and 180 degrees out of phase are the same thing - if you don't care about beginnings and endings. That is, the first and last cycle. Normally, we don't; so you can go for years without needing to draw a distinction between the two. Then, one day you need a time delay circuit (e.g. an all-pass filter), and it all becomes clear - or obscure - depending on your focus.

Is the horse dead yet? Probably, so I will quit beating it. Just file this little jewel of wisdom away in your "I-know-something-you-don't" pidgeonhole, and bring it out to impress your friends at a party...assuming you have exceedingly dull friends, or go to equally dull parties!

PRACTICAL CIRCUITRY

TRICKS WITH THE SN76477

THOMAS HENRY

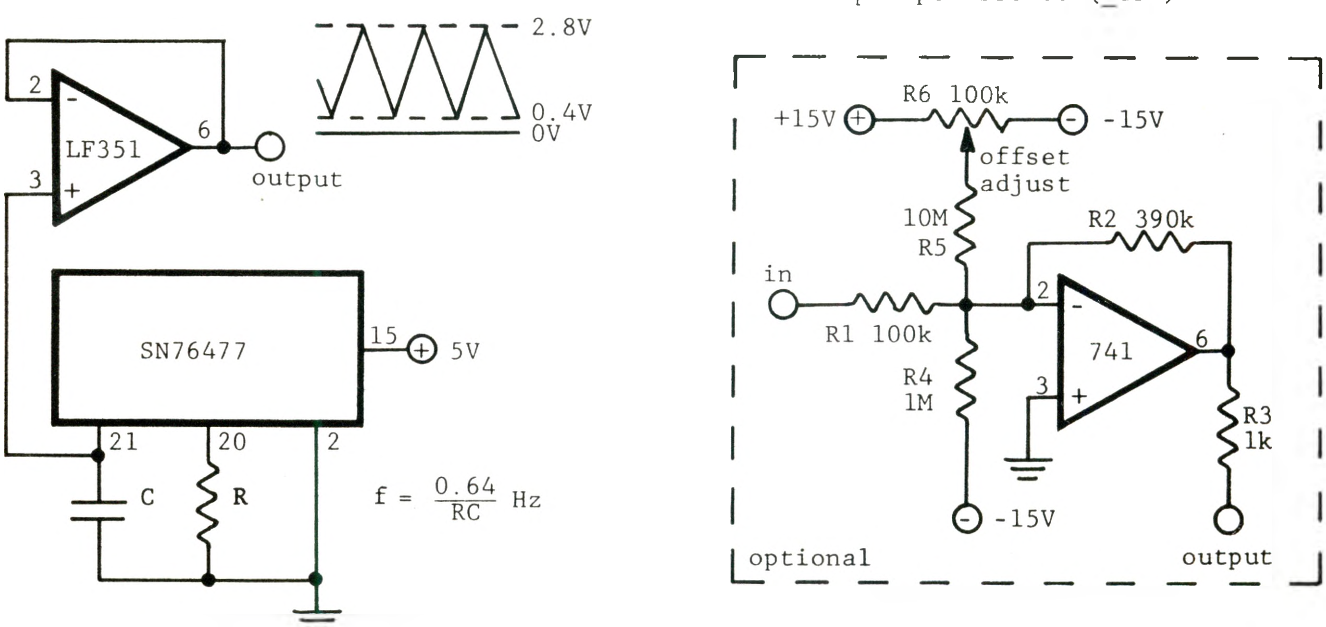
I think that anyone who has ever played with the SN76477, Texas Instruments' complex sound generator, has gone through two phases. The first phase is "Wow, does this thing ever do a lot!" And it does. The chip certainly represents a triumph of large scale integration, incorporating many different sound functions in one 28 pin package.

Well, that euphoria probably gave way to dejection. Yes, in this second phase you probably discovered that the VCO didn't have a very large sweep range, and was temperature dependent. And the noise source was rather static and didn't really have a great variation of possible sounds. Most importantly, you probably found out that despite containing all these neat functions, the chip was basically organized in a fixed manner. That is, it contains lots of sub-circuits, but they are all interconnected, internally, in a certain fashion, and rearrangement of them seems impossible. You probably drew the same conclusion I did: The chip was suitable for pinball machines and kiddie games, but wasn't really adapted for serious synthesizer work.

Now it's time for phase three, wherein we discover how to separate the functions, get a broader range of sounds from the noise source, and do all sorts of other neat things. Most importantly, our applications will be suitable for much more than kiddie toys...like serious synthesis. In this installment we will discuss how to isolate output structures; next time we'll examine the noise source in detail, and then we'll close out this particular series by integrating all these ideas into a "Super Controller Module" suitable for use with the best synthesizers. I'm really fired up on this, and I think you'll be pleased as well!

I'm going to assume in this article that you're already familiar with the basic layout of this chip (if not, refer to Craig Anderton's article on the SN76477 in Synapse magazine's Summer 79 issue, or check out the data sheet Radio Shack provides with their SN76477s). This will save referring to the spec sheet throughout the article.

Fig. 1 Power supply connections to op amps assumed (±15V)



Tapping the LFO Triangle Wave. Ordinarily, the only LFO waveform accessible at the chip output is a square wave; however, figure 1 shows how we can obtain a triangle wave from the LFO. We simply tap the waveform off of the timing capacitor, making sure that we buffer it sufficiently to prevent loading down the cap. The LF351 is an ideal buffer, since in the configuration of a voltage follower (unity gain buffer), it has an input impedance of thousands of megohms! Other bi-fet family op amps (LF356, TL071, etc.) are equally suitable.

Note that the output goes from about 0.4V to about 2.8V, for a total swing of 2.4V (these figures will vary somewhat from chip to chip). The optional circuit shown beefs up the signal to a standard 10V peak-to-peak, referenced to ground, with an output impedance of 1k. R4 sets the approximate ground reference, while trimmer R6 allows for precise adjustment. This trimmer may not be necessary in less precise applications.

Since we have not interfered in any way with the internal mixer or output stages, a square wave version of the same frequency is available at the output proper of the chip (pin 13). So we get two waveforms for the price of one!

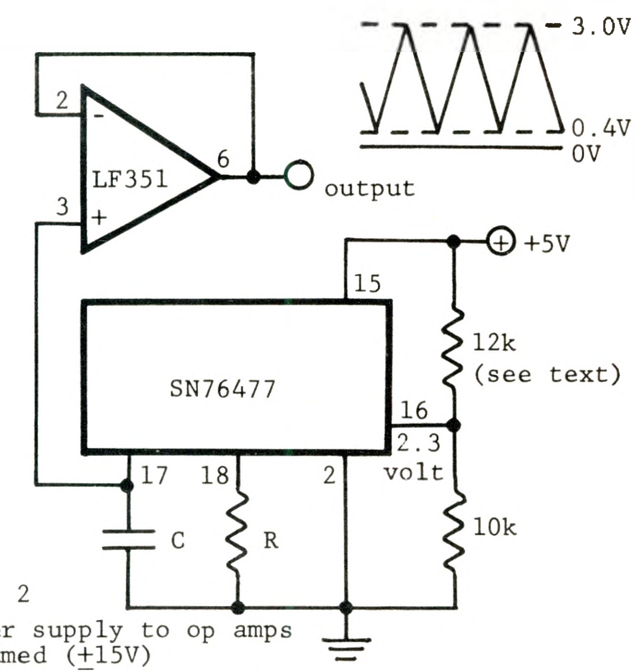


Fig. 2
Power supply to op amps assumed (±15V)

Tapping the VCO Triangle Wave. Figure 2a shows how to pull this same trick on the VCO. This time the buffered output goes from about 0.4V to about 3.0V, which is slightly greater in amplitude than the LFO output. The signal may be amplified and level shifted with the same optional circuit from figure 1, for approximately the same results. You may wish to slightly reduce feedback resistor R2 to compensate for this small difference in amplitude.

One problem with the VCO circuit is that the amplitude decreases as the control voltage to pin 16 decreases, meaning that amplitude decreases for increasing frequency. The internal square wave is unaffected. This being the case, if you plan on using the VCO triangle output it is probably best to apply a fixed control voltage to pin 16 and leave it at that value, thus making the VCO into a manually controlled oscillator. Control the frequency by using a pot at pin 18. Figure 2b shows a voltage divider applying a fixed voltage of 2.3V to pin 16. Experimentation has shown this to be the best value.

Tapping the Noise Source. Why stop now? Figure 3 shows how to tap the noise output. The buffered output goes from 0 to about 5V (with the noise filter wide open), which may be suitable for many applications. However, to make the noise source compatible with standard gear, the optional circuit shown is recommended. With the added stage, the signal is now ground referenced with an amplitude of 10V p-p. Note that the output impedance is a standard 1k. The 600k resistor specified is ideal case: 560k works almost as well.

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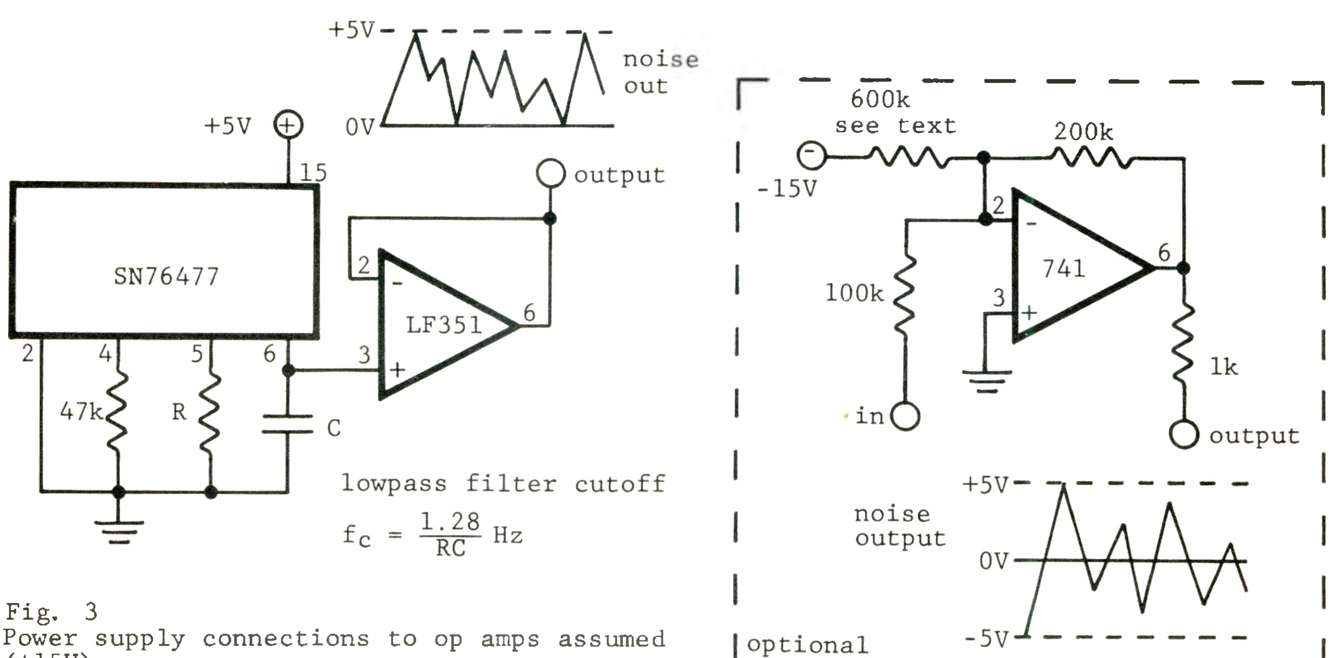
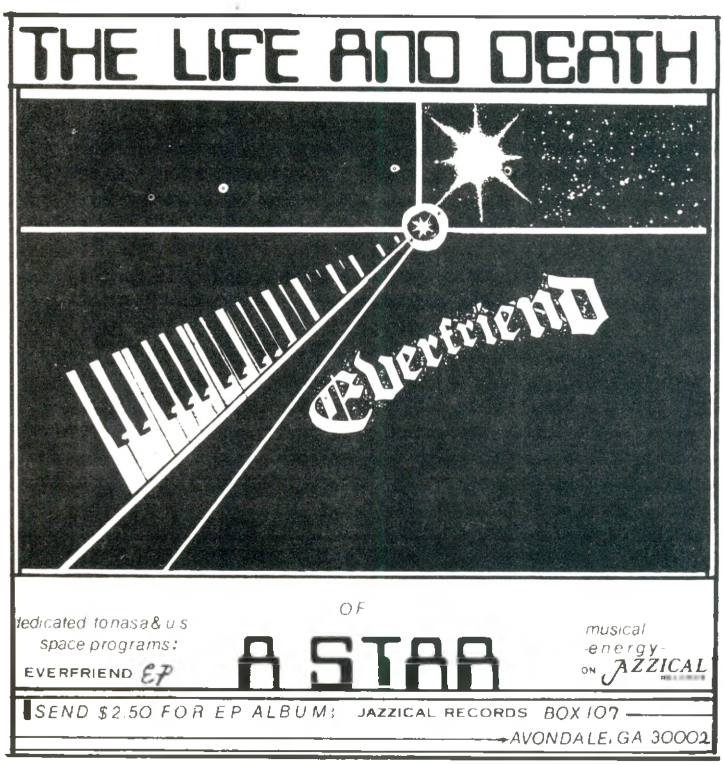


Fig. 3
Power supply connections to op amps assumed (±15V)



Tapping the One-Shot. Not so obvious is how we can tap the one-shot output (see figure 4). A negative going edge at pin 9 initiates the one-shot, while a resistor at pin 24 and a capacitor at pin 23 set the time constant. Note that we can tap the capacitor's charge cycle at pin 23 and get a triangle going from 0V to about 2.5V, or we can take a 5V pulse out at pin 8. Strictly speaking pin 8 is really the envelope generator output, but since we have no capacitor connected to it to charge and

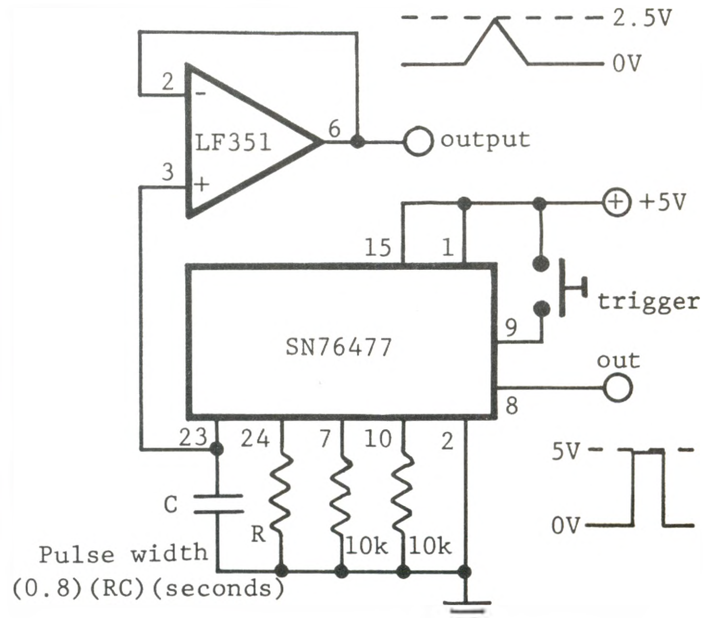


Figure 4 Power supply connections to op amps assumed (±15V)

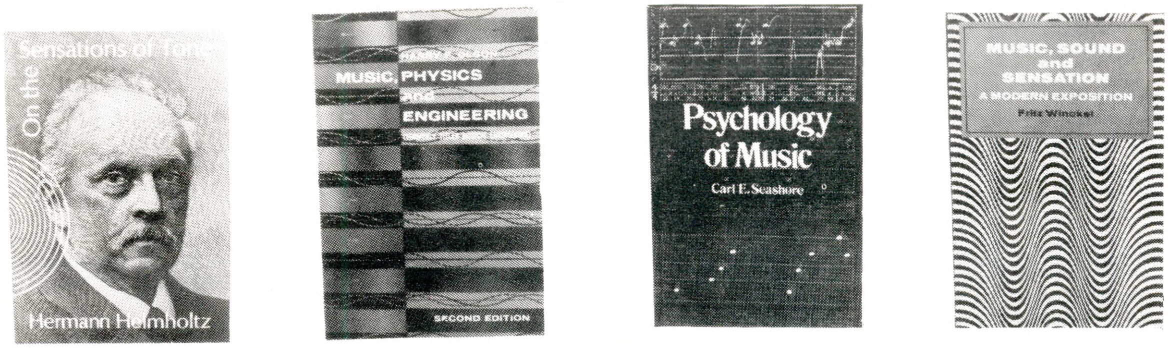
discharge, the envelope generator opens and closes quickly. In other words, the envelope happens to be a pulse! The 10k resistors at pins 7 and 10 provide paths for what would normally be the charge and discharge currents of the envelope generator.

Summing Up. So far we've managed to isolate four different functions of the chip: Two oscillators, a noise source, and a one-shot. Now that these various outputs have been tapped, we are free to mix and combine them in any way we want. In other words, we have finally broken free of the internal signal routing. This versatility is exploited in the "Super Controller Module" coming up shortly.

We're running out of space, but not ideas. This article has just scratched the surface, and I'm sure there are countless more ideas just waiting to be found. Do you have any? If so, drop me a line c/o Polyphony. Next issue, we'll move on to the noise source...and if you thought all white noise sounded the same, you're in for quite a surprise!

Advertiser's Index

VOLUME 6 INDEX



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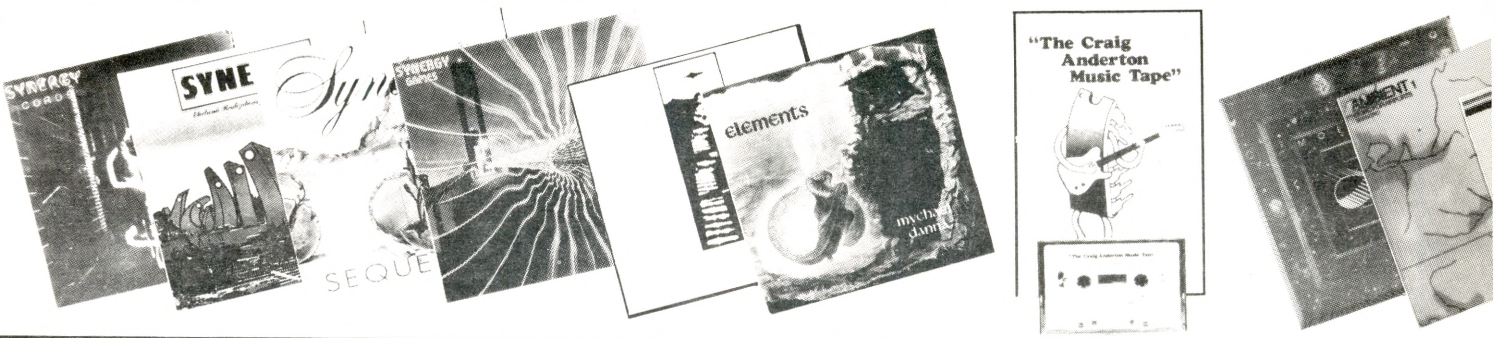

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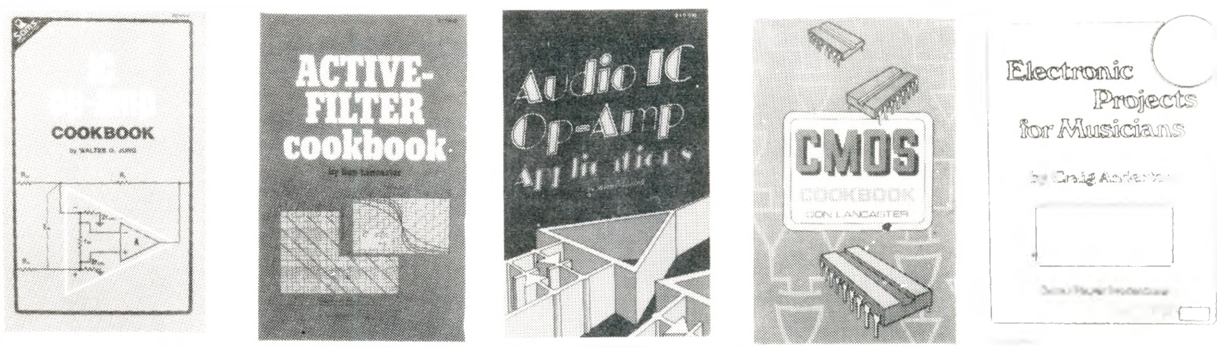

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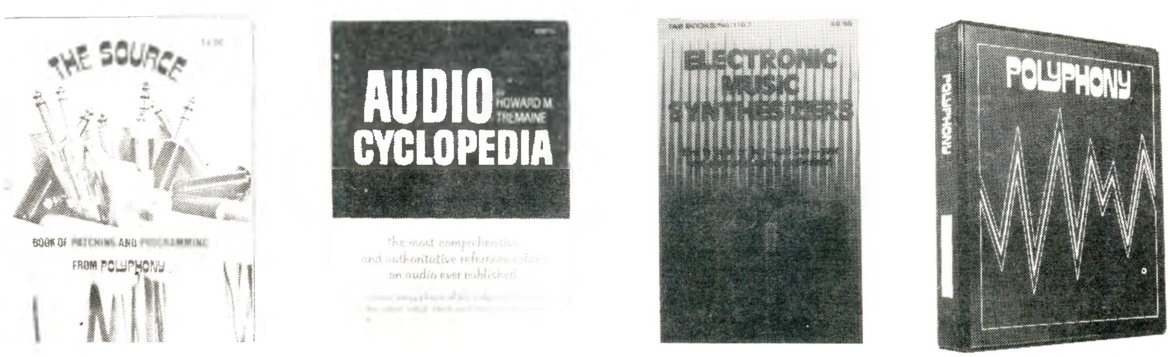

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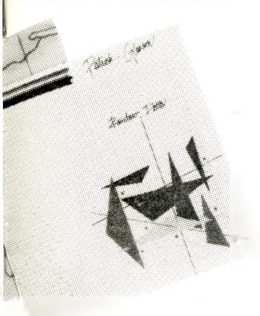

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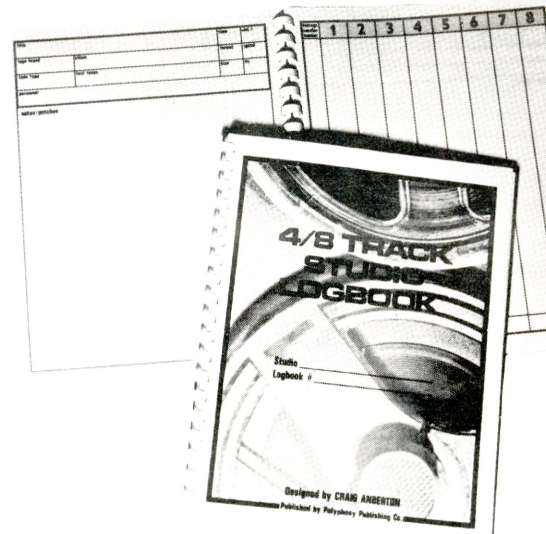

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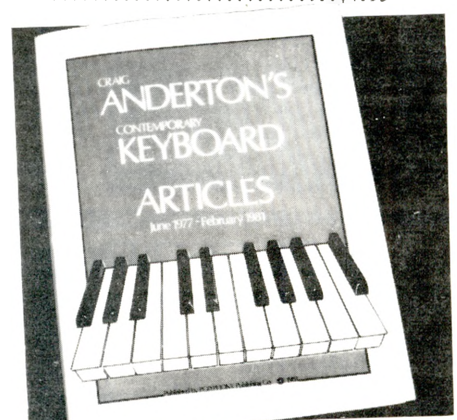

For those of you who have been asking for Craig Anderton's Contemporary Keyboard reprints (June 1977 - February 1981) here it is. Article topics include tips, technique, theory, maintenance and projects, such as, Design and Build: Keyboard Mixer, Keyboard Pre Amp, Multiple Identity Filter, Combo Organ, Tremolo, LED Control Voltage Meter, Expansion Oscillator, Noise Generator, and more.

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ON LOCATION: SWEDEN

by Ralf Andersson

Late last year, the Swedish Radio Company and the Electronic Music Studio held a three day international music festival at Circus Hall in Stockholm, Sweden. One reason for choosing this locale was the hall's excellent acoustics for electronic music; it is one of the few venues capable of handling the loud volume levels sometimes required by electronic music, and thus enhances the appreciation of the music. This year in particular, international electronic music played a large part in the overall program. This is good, since it is important for musicians in a small country such as Sweden to closely follow developments from abroad in order to obtain inspiration for our own productions. This does not mean, however, that Swedish music played a subordinate role. The festival was an important forum for the Swedish composers at which to have their works performed, and also to meet their audience. This year several works were performed for the first time, but this aspect was not the most important one for the festival - the quality of the music was most important.

Last year's festival was distinguished by some important foreign guest appearances; this year was no exception, as Stockholm was being visited by composers from Bourges in France. This is the home of a very active studio, around which there is a group of composers called G. M. E. B (Groupe de Musique Electronique de Bourges). These composers were all trained at the GRM in Paris, the studio that was started by Pierre Shaeffer. In a way, these composers are still faithful to the traditions of musique concrete. The GMEB also sponsors an important annual electronic music festival (this year's festival celebrated their 10th anniversary), as well as an electronic music competition which attracts a large number of entrants from the whole world. One of the winners of this year's competition, Jean-Claude Risset, was featured at the Circus Hall with his completely computer produced work, "Songes". There were several Swedish composers at the festival, of which perhaps the most famous is the classical composer Sven-Erik Back. He performed the work "Annus Solaris" with tape and a solo singer, Kerstin Stahl.

Ragnar Grippe, another Swedish composer who had been working a lot at IRCAM in Paris, surprised many people with his work "Orchestra". A bit more modern in sound than some of the other compositions, I think this type of music would appeal more to the younger generation of composers.

There was only one female composer performing at the festival, Marja Vesterinen from Finland, but I think she is one of the best. Her piece was called "Half Synthetic Boxtrot", and was a parody on a commercial pop concert that used both classical and popular music. It was a tape composition of an imagined live concert where the musicians, the presentation man, and the public together represent a musical unit. Very nice.

My opinion is that the art of electronic music is increasing today in Sweden; one indication was the fact that Swedish Radio Company (the only network broadcasting studio in Sweden) broadcast every evening from the festival.

ENVIRONMENTAL MUSIC:

Our senses are bombarded daily with thousands of impulses from the environment (sound, light, heat, motion, etc.). Every physical environmental change sends forth impulses, whether obvious or subtle.

While the universe may seem to move randomly, modern quantum physics tells us that all physical phenomena occur in strict accordance with basic natural laws. But are these laws truly cold, mechanical, and random? Or is there a guiding Intelligence behind all creation, whose actions seem random because we cannot intellectually grasp their logical pattern? Of course, various schools of religion and philosophy have been chewing on that one for centuries. One thing we all can agree on, though, is that - like it or not - the world is in motion; and, we can use that motion to electrically or mechanically do things... like trigger synthesizers. And, if there is a higher order present in the seemingly random pattern of the environment, then we can expect some semblance of this order to be embodied in any music we realize this way. (As an aside, if the universe is indeed truly orderly, then we need new concepts of what we now commonly call random and chance occurances.)

In recent years some modern composers, such as John Cage, have pursued music based on "random" processes (as in Cage's I Ching and some computer-derived music). But, the techniques used have mostly related to the physical writing out of music that is to be later played by humans (or computers) in a more or less "conventional" (caveat emptor!) way. If, however, you want to go totally "organic" and have the environment itself perform the music, you need to construct some special interfaces. The examples that follow are intended as starting points for advanced experimentation, though all circuits are fully functional as presented.

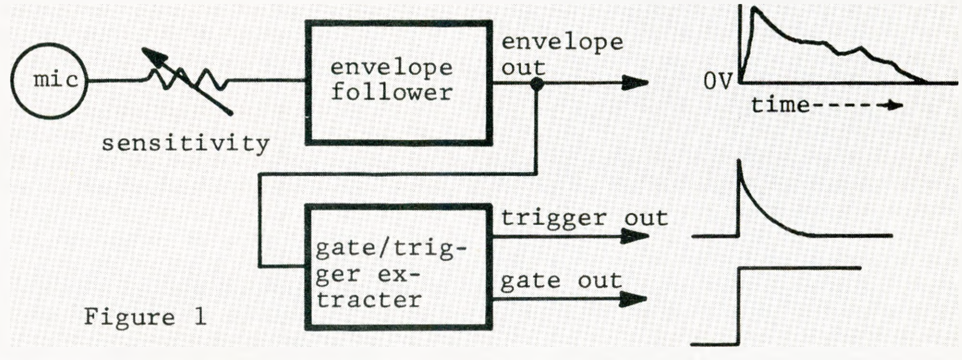


Figure 1

Audio Interface. In this fairly familiar patch (see figure 1), an audio signal enters an envelope follower/trigger module where it is rectified, filtered, and converted to a DC control voltage that is directly proportional to the amplitude envelope of the audio signal. Usually there is also a gate trigger available whose threshold of firing may be adjustable from the front panel. Remember that in this type of patch the envelope output is also useful as a trigger signal, and in some cases can be preferable to a gate output. Also, don't get locked into using this patch to only trigger an event; it is just as valid to use the envelope/trigger output to interrupt or modify a patch already in progress. In addition to the obvious microphone input, the outputs of televisions and radios can provide control signals reflecting the presence of radio waves in the immediate atmosphere.

Light Interface. Figure 2A shows a simple but effective light interface. Light striking the photoresistor produces a positive-going control voltage (about 0 - +8V DC) at the output, which can

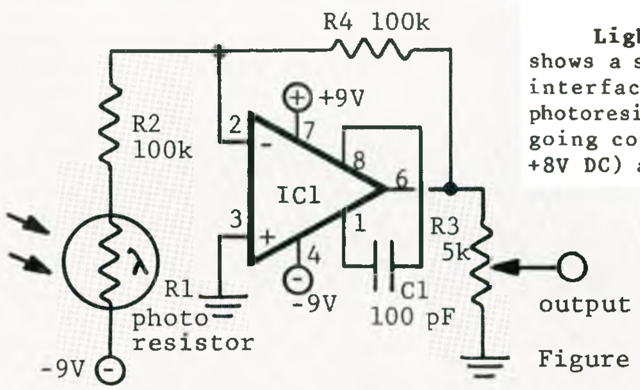
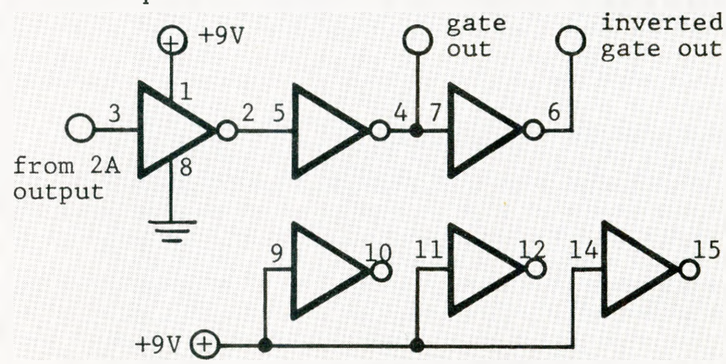


Figure 2A Light Controller

IC1 = 748 or 301 op amp
Photoresistor = Radio Shack 276-116 or equivalent



Each inverter = 1/6 CD4049

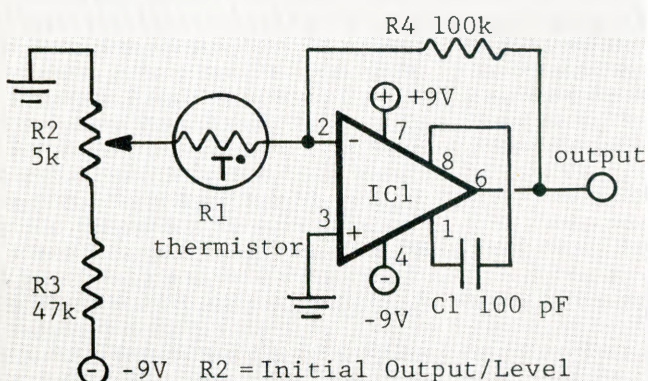
Figure 2B Sharp Rise/Fall Time Gate Extractor

Translating Surroundings into SOUND

by Tim Fluharty

either control or trigger modules. If your application requires sharp-edged light triggers, you can add on the inverter circuit shown in figure 2B, which produces a steep gate and its inversion. It may be helpful to mount the photoresistor inside a cardboard tube, painted flat black on the inside, to achieve a useful directionality to your light sensor. Otherwise, ambient light fields may interfere with your application.

Heat-Sensing Interface. Figure 3 shows a circuit using a thermistor (temperature-dependent resistor) to detect heat changes in the environment; it produces a control voltage output that ranges from about 0 to +8V DC. This particular thermistor



R2 = Initial Output/Level
R1 = Globar Thermistor, model FS234
IC1 = 301 or 748 op amp

Figure 3 Heat Controller

has a negative temperature coefficient (or tempco, as it's called) which means that as it heats up, its resistance value decreases (the reverse is true for positive tempco thermistors). The Globar FS324 is about 100k Ohms at room temperature, and about 8 or 9k Ohms after five minutes in close proximity to a hundred Watt light bulb. One problem with the thermistor is that any current flowing through it causes it to heat up somewhat, which can affect the accuracy; also, thermal inertia prevents a very fast reaction time. As the result, the circuit works best when you want gradually changing control voltages. If you use this circuit to detect the heat of sunlight (as I do), best results are obtained by using a magnifying glass or other lens to focus the sun's rays on the actual thermistor. For other applications, the thermistor should be attached to the heat source.

Water Level Sensors. Just about every simple water level sensing circuit uses two metal terminals, with the presence of water (a good conductor) between the two terminals completing the circuit. Thermistors can also sense water level, since in many cases the thermistor will undergo a distinct temperature change (i. e. cool faster) when placed in contact with water (keep thermistor leads insulated from the water).

Motion Sensing Interfaces. The photoresistor circuit in figure 2A can also be considered a motion detector if the motion modulates a light source. The wide range and fast reaction time of the circuit makes many unique applications possible. My favorite motion detecting device, however, is the mercury tilt switch. A tilt switch consists of a small bubble of glass with switch contacts imbedded in its walls, and a small blob of mercury inside the glass. Tilting the switch a certain way makes the mercury flow between the two contacts, thereby shorting them out. Most often I connect a voltage to one side of such a switch, and use the other side as a gate trigger output. These devices are quite sturdy, so you can use them again and again; for very little cost their potential for application is huge...simply attach them to anything that moves.

Exploring the Possibilities. In reality these are just more modules for your synthesizer system, so you can treat their function abstractly, as we sometimes do in synthesis - but I don't think our original goal was abstraction. Since we don't want our environmental signals to lose their identity, care is necessary when composing with them. In my experience, making sure that the control source and the sounds produce a coherant whole creates the most stunning results. In other words, the actual structure of the sounds produced (frequency, harmonic content, amplitude contour, etc.) should on some (hopefully many) levels directly relate to the method and/or source of the control signals. It is up to the composer to perceive the relationships involved and use them to best advantage. This may sound murky, but, as I said, careful thought is required.

Here are a few quick examples to tweak your imagination: literal electronic wind chimes...a sequencer gently pulsed by the motion of waves or ripples on a lake...a "chord egg" controlled by heat sensors...an array of light or heat sensors feeding a computer's input port...the possibilities are vast. Happy interfacing!

For more information:

ABC's of Thermistors by Rufus P. Turner
Howard W. Sams books #20765

Solar Cells and Photocells by Rufus P. Turner
Howard W. Sams book #21175

* ERRATA * ERRATA * ERRATA * ERRATA *

March/April 81 issue, "Practical Circuitry", Figure 4: Change CLOCK IN to CLOCK OUT. Figure 5: The output of the tape recorder channel 1 feeds the rhythm generator's CLOCK IN. Please make these corrections to your issue. Also in the March/April 81 issue, "Modifying the GR-500", Bob Loney, from the service department at Roland, informs us the replacement of the bridge with all brass disables the infinity sustain unit. This may not be what you want.

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SWITCHIT: keyboard assign-

As I mentioned in a previous article (**SHAZAM**, Polyphony Nov/Dec 1978) the best thing about a PAIA 8700 based polyphonic system is that, unlike all other microprocessor-based keyboards, the system is completely user-programmable. This allows the musician to create custom software for a particular application, whether that application is a custom operating system for permanent use or simply a strange piece of code for a one-time-only effect. I am constantly working on short pieces of code to do this or that special function, and while most of them are not useful in a wide variety of applications, **SWITCHIT** is a fairly useful program with some interesting built-in tricks.

I first wrote about the idea of **SWITCHIT** in the **SHAZAM** article as a program which would allow one to assign the entire monophonic keyboard to a user-selected voice channel. The idea was to be able to switch patches rapidly by essentially switching from one synthesizer to another. This is certainly not as efficient an approach to instant patch switching as you would find in Oberheim's OB-1 or PAIA's Proteus I, but I did have a separate synthesizer voice available for each voice channel and couldn't afford a programmer, so it proved the most expedient method available to me. I wouldn't suggest that you run out and buy four synthesizers to try out this program, but if you already have the hardware, this bit of code can really come in handy (especially in live performance - imagine being able to play your minimoog, Odyssey, and Cat from one keyboard, rapidly switching back and forth between them and then playing them polyphonically during the next number).

How It Works. Conceptually, **SWITCHIT** acts like a "software rotary switch" that routes the pitch control voltage and gate outputs from a standard monophonic keyboard to any one of several different synthesizers. **SWITCHIT** works by examining the 8700 computer keyboard (not the synthesizer keyboard) to determine which channel is selected. The program as printed below assumes a maximum of 4 channels (4 separate voices), so the only keys used on the computer keyboard are 0-4. Pressing one of these keys deselects whichever channel had been previously selected, and sends the keyboard's CV and gate signals to the newly selected channel. The keyboard operates with low note priority and allows you to slur notes without retriggering.

Required Hardware Support. The number of voices is determined by how many QuASHes (QuaSHi?) you have and many synthesizer voices you have to hook to them. While this program supports 4 voices, you can specify as many as 24 voices or as few as 2 voices by altering the number compared to at address $000E.

Applications. The really nifty feature of **SWITCHIT** is, if you are holding down a note and select a new channel from the 8700 keyboard, the old note you were playing will be sustained on the previously selected channel. This holds true for all channels, so it is possible for the program to hold a chord while you continue to play on the remaining channel. This feature is really powerful (as you'll find once you start playing with it); one application is to hold one voice while going off to play another, then hold that voice while returning to play on the original voice, and so on. **SWITCHIT** also simplifies multitracking, since you can place numerous synthesizer voices on a single track and cross-fade between voices for a smoother effect.

It can also be useful to provide more voice channels than you have hooked up (by changing address $000E). This allows you to hold as many notes as you have synthesizers while going to another keyboard. For example, if you have 3 synthesizers attached to your QuASH, set $000E to 04. Play a note on channel 0, hit keypad 1 on the 8700 and then play a note on channel 1, hit keypad 2 and then play a note on channel 2, and finally hit keypad 3. All notes on channels 0-2 will be held while you go off and play piano or whatever.

To clear all channels, release all keys on the synthesizer keyboard and run your finger across the bottom row of the computer keyboard. Each note will decay away, which gives a pretty interesting effect for a finale if you had many of the channels on hold.

The Program. The program itself is pretty straightforward; before running it, though, remember to initialize the MUS-1 system variables, $00E8 - $00EA (I use

-ment algorithm for the PAiA 8700

by Bob Yannes

$40, $20, 04).

CHANL ($0030) is the location which stores the currently selected output channel. The channel assignment is always determined from this value, so, if no keys are pressed on the 8700 keyboard, the channel assignment in CHA will be used. CHANL is updated whenever a new key is pressed on the 8700 keyboard. The new key information is processed so it can be used as a pointer to the appropriate QuASH channel, using the routines and protocols of the MUS-1 PROM (i.e. key "0" on the 8700 corresponds to QuASH channel $09FF via NTBL position $00DF). KTBLMAX is my mnemonic for the highest position in KTBL, which is the first position filled with synthesizer keyboard data. The program is very simple and should provide a good skeleton for those of you out there who want to add more sophistication (such as transposing, glide select, and rapid switching between **SWITCHIT** and **POLY**). At the very least, **SWITCHIT** proves that programs need not be long and complicated to do something useful, so don't be afraid to try your hand at a few short programs and send whatever you come up with to <u>Polyphony</u>. Happy switching!

```
SOURCE FILE: SWITCHIT
0000:           ********************************
0000:           *                              *
0000:           *           SWITCHIT           *
0000:           * KEYBOARD ASSIGNMENT ALGORYTHM*
0000:           *              BY              *
0000:           *          BOB YANNES          *
0000:           *                              *
0000:           ********************************
0000:           *
0000:           * SWITCHIT ALLOWS ALL KEYBOARD ACTIVITY TO BE ASSIGNED
0000:           * TO A SINGLE OUTPUT CHANNEL, PROVIDING A TYPE OF PRESET
0000:           * CAPABILITY.
0000:           *
0030:           CHANNEL EQU  $0030
0021:           INIT    EQU  $0021
002B:           NOTE    EQU  $002B
0F00:           DECODE  EQU  $0F00
0820:           DISPLAY EQU  $0820
00D0:           NTBL    EQU  $00D0
00E7:           KTBLMAX EQU  $00E7
0000:           *
0000:A9 0F              LDA  #$0F     ;INITIALIZE CHANNEL
0002:85 30              STA  CHANNEL  ;POINTER.
0004:20 21 00           JSR  INIT     ;CLEAR ALL.
0007:20 2B 00   TOP     JSR  NOTE     ;PLAY NOTES.
000A:20 00 0F           JSR  DECODE   ;SCAN 8700 KBD
000D:C9 04              CMP  #$04     ;GREATER THAN 3?
000F:B0 0C              BCS  SKIP     ;YES, SKIP NEW PTR.
0011:85 30              STA  CHANNEL  ;NEW CHANNEL SELECTED.
0013:8D 20 08           STA  DISPLAY  ;SHOW IT.
0016:A9 0F              LDA  #$0F     ;FIX
0018:38                 SEC            ;CHANNEL
0019:E5 30              SBC  CHANNEL  ;POINTER.
001B:85 30              STA  CHANNEL  ;CHANL IS POINTER.
001D:A6 30      SKIP    LDX  CHANNEL  ;GET CHANNEL.
001F:A5 E7              LDA  KTBLMAX  ;GET SYNTH KEY.
0021:D0 04              BNE  ON       ;IF NOT 0, SKIP.
0023:B5 D0              LDA  NTBL,X   ;TURN OLD
0025:29 BF              AND  #$BF     ;NOTE OFF.
0027:95 D0      ON      STA  NTBL,X   ;STORE NOTE.
0029:4C 07 00           JMP  TOP      ;START OVER.
```

re-view

(continued from page ....5)

Ilhan Mimaroglu - **To Kill a Sunrise/La Ruche** (Folkways 33951)
"To Kill" is subtitled "A Requiem for Those Shot in the Back", and consists of obituaries and autopsies read over some fascinating electronic effects. The flip side is a lament for, basically, cello and tape - "modern" music at its best.

William Hoskins - **Galactic Fantasy/Eastern Reflections** (Spectrum 106)
Hovers between music/sound effects, academic/popular, '50s/'80s, elaborate voicings/very dry synthesis. Side one is neo-orchestral, side two neo-Japanese. Very individual and it gets under your skin.

Gil Trythall - **Luxikon II/Echospace** (Pandora 801)
"Luxikon II" offers different scales and runs over various S/H rhythms - multi-textured and unique. "Echospace" presents thirteen phrases drawn from a six-note chord - like a "best of" six-and-a-half Terry Riley albums.

Terry Riley - **Shri Camel** (CBS 35164)
Another Riley hypnotic organ with electronic echo album, except this time using just intonation for an Indian flavor.

Peter Davison - **Salamat Siang - Music on the Way** (Avocado 101)
Free-flowing flute and reed improvisations over gently undulating Serge drones. There's also some harp, cello, and some wonderful non-drone synthesizing.

Brian Eno/David Byrne - **My Life in the Bush of Ghosts** (Sire 6093)
Takes Eno's use of vocals as pure sound to a logical extreme, fitting pre-existing speech to Byrne's funky instrumentals. Technically fascinating.

Tangerine Dream - **Thief Original Soundtrack** (Elektra 521)
Elaborately-voiced synthesizer chords with sequencer, drums, and screaming guitar. Whereas Schmoelling's classical training dominated "Tangram", Froese's R&B roots show here.

Everfriend - **Life and Death of a Star** (Jazzical Records EP)
Bill Rhodes plays neo-classical piano-flavored synthesizer in the style of Larry Fast or Mannheim Steamroller, and with the same degree of competence. Side 1 is a dramatic Holst-like tone poem; Side 2 is a suite for harpiscord patch.

For re-view send your electronic music tapes or albums

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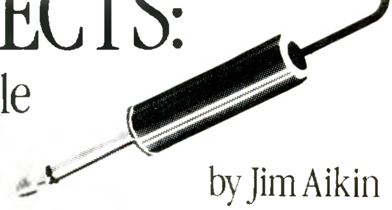
MODULAR SYNTHESIZER EFFECTS:

Flora & Fauna of the Patch Cord Jungle



PART I

by Jim Aikin

One of the best-known bits of folk wisdom in modern America is the cocktail party observation that human beings only use 10% of their brain capacity. I've never believed it - those billions of neurons have got to be doing something. Nature just doesn't evolve complex anatomical structures unless they fulfill some function. But if we apply this observation to the field of electronic music, we'll find ourselves on firmer ground. It is undeniable that most synthesizer players only use 10% of the potential of their instruments; the other 90% goes unimagined, unheard, wasted.

Using a synthesizer for lead lines with a little pitch-bending, or for string and brass chords, misses most of the beauty and potential of the instrument. The other 90% comes under two headings - dynamic alterations in tone to give shape to the part you're playing on the keyboard, and synthesizer effects. Since this article is about synthesizer effects, we'll say no more about dynamic alteration than that you can use any of your front panel controls at any time to give your music an added dimension of expressive nuance.

But even if you're making optimum use of your front panel controls, you're still missing a lot. What about the front panel controls you don't have? There's a lot going on in the innards of a typical synthesizer that you, the player, don't have access to, so we have to give the designers of the current generation of instruments some of the credit for that 90% wasted potential. There are a few instruments, mainly modular synthesizers, on which you do have access to more of the patch-points in the tone generating circuitry. If you aren't fortunate enough to own a modular synthesizer, you can still hire a technician to tap into your current instrument and give you access to the functions you want. Or if you're construction-minded, you can build your own outboard modules and interface them with your current gear.

The purpose of this article is not to tell you how to overcome the limitations of your hardware, but will instead be devoted to discussing some unusual patches that can be realized on modular synthesizers (and some non-modular ones) to create interesting and musically useful sound effects. We won't be talking about adding signal processors to your instrument; most people know how to use devices like phasers or wah-wahs. We'll also assume you know how to do simple effects like filter sweeps and cranking the LFO up to 30 Hz to add buzz to a tone.

A Little Synthesizer History. If you're wondering why you have to go to the trouble of modifying your instrument or buying or building extra modules to get at that wasted 90%, a little history might help put things into perspective.

Electronic (or at least electrical) musical instruments have existed since the beginning of the 20th century, but except for a few hot items like the Hammond organ, they were mostly curiosities destined for museums, not musically viable tools. The revolution pioneered by Bob Moog and Don Buchla, which gave rise to today's synthesizers, had most of its impact because of one central concept - the concept of voltage control. Before this, if you wanted to change the operations of an electronic module, you had to do it by hand, by physically turning a knob. But now for the first time you could change the operation of a module, and thereby make a change in the sound, by applying an electrical signal to its control input. If you could get the incoming control voltage to behave in an appropriate way, you could make the module do just about anything it was capable of doing. The manipulation of tone colors was automated (an ominous note), but the immediate result was that electronic sounds could be produced with greater ease, accuracy, and complexity than ever before.

Voltage control implies that the synthesizer is, in theory at least, a general-purpose machine. By connecting the various modules with patch cords in various configurations, you can drastically alter the nature of the output, just as you alter what a computer does by feeding it different programs. All you need are sufficiently flexible control-voltage-generating modules. In contrast to the synthesizer, instruments like the piano and violin have hardware that's dedicated to performing a specific task - making one sound in particular in an efficient and pleasing manner. The synthesizer is to the piano what the computer is to the pocket calculator.

At least, that's the theory; in practice, things don't work out quite so neatly. The early synthesizers were powerful general purpose machines, but they were expensive, slow and cumbersome to use, and difficult for musicians with no training in electronics to understand. In order to package these new instruments so that they could be mass-marketed to musicians, synthesizers had to become everything they were not - they had to become inexpensive, quick and easy to use on stage, and capable of producing instant gratification when a total layman walked into a music store with money hanging out of his pocket and demanded a demonstration from a salesman who knew no more about synthesizers than he did.

The instruments we have today conform, by and large, to the formula first foreshadowed by the minimoog more than ten years ago. They have an oscillator or two, a resonant lowpass filter and a VCA controlled by simple envelope shapers, an LFO for producing vibrato, octave switching, a pitch-bend device, and that's about it. Sometimes there are some extra goodies like oscillator sync or sample-and-hold, but it doesn't take too jaundiced an eye to see these as "selling points" that don't really contribute to the overall flexibility of the system. Designers keep recycling the same old elements, with minor cosmetic variations. Great.

But, let's not be unfair to the instrument designers. They would probably claim, with some justification, that they have to design instruments this way in order to sell them. Even the capabilities their instruments do offer are often woefully under-utilized by musicians (such as the rumors of user-programmable Prophet-5s coming back to the factory for servicing after a year or two with the factory-programmed presets still intact). In other words, musicians spend all that money on an instrument and never even try to discover what it will do. Instrument designers are aware of this. They have to know what musicians want, in order to stay in business...which means that we'll only get musically powerful, flexible synthesizers when we demand them by proving at the cash register that no pushbutton substitute will do.

But as I mentioned above, you don't have to make do with what your instrument was designed to do. You can give it some hardware help and modifications. Why should you, you ask? What can you do with a few extra patch points? Read on.

Imitative and Non-Imitative Synthesis. The most basic distinction we can draw in synthesis is between imitative sounds (those that more or less closely mimic some naturally occurring sound) and non-imitative sounds (those that only a synthesizer could make). Both have their uses. But although we'll touch a bit on imitative synthesis, ultimately imitative synthesis offers less of a field for exploration and creativity than non-imitative synthesis. One of the main reasons for using a synthesizer is to create sounds that no acoustic instrument could ever make, and all you have to do to bring these sounds into being is conceive of them - the hardware will do the rest.

Imitative Synthesis. There are two simple rules that will help you immensely in improving your imitative synthesis: Listen to the sound you want to duplicate, and think about how that sound is created by the acoustic instrument that normally generates it. Quite often, visualizing the physical process of playing the acoustic instrument will give you important information (this is particularly true in the case of percussion instruments). Sometimes, textbook descriptions will prove quite helpful (for example, a description of the overtones produced by a clarinet). This all comes under the heading of thinking. But even more important is to physically listen to the sound over and over until you hear what it really sounds like. We all have mental conceptions of how instruments sound, and there is sometimes a surprising divergence between what we think something sounds like and what it actually sounds like. So listen. Once you've analyzed the sounds and put together a patch to simulate it, you'll have to use your ears to tell you when you've got it right.

Percussive Synthesis. Let's apply the above principle to a snare drum sound. You may think you know what it sounds like, but go listen to one anyway (a recorded example will do). What is the general pitch area of the sound? How long does it last? How does it fall away after the initial crack? When you think about how the sound is made, you'll see that there must be at least three separate components - the crack of the stick against the head, the resonance of the vibrating head and the vibrating air inside the drum, and the rattling of the snares against the bottom of the drum. In order to synthesize this sound, you'll have to have modules capable of doing all three thing simultaneously.

In his April 1981 column in Contemporary Keyboard magazine, Roger Powell goes extensively into the mechanics of synthesizing snare drum, bass drum, and cymbal effects. Rather than repeat that information here, we'll cover some aspects of percussive synthesis that were not included in his column.

For example, if you listen closely to a real cymbal, you'll find that its sound is at its most complex right at the beginning. The metal disc quickly settles into a somewhat simpler, more repetitive oscillation. If you listen to a cymbal in a quiet room, in fact, you'll discover that as its vibrations die out, it decays into a small cluster of infinitely ringing pitches that vanish one by one.

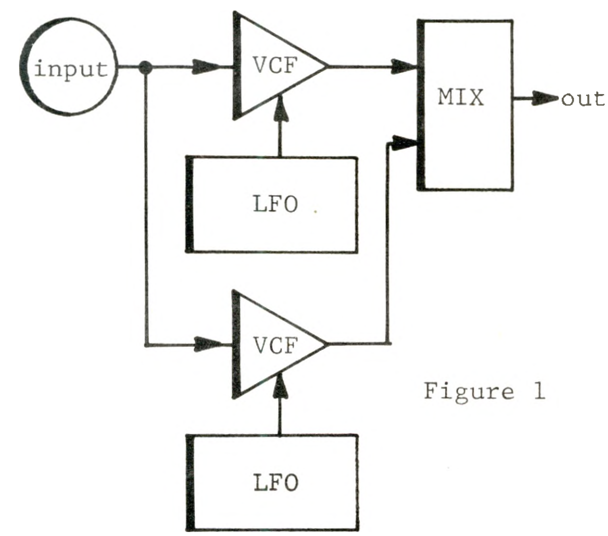


Figure 1

Since you'll probably be mixing your electronic cymbal in with other sounds, it isn't necessary to duplicate this behavior in exact detail. All that's necessary is to eliminate some of the high-frequency content as the sound decays. The easiest way to do this is to modulate the oscillator with some envelope voltage in addition to the noise, so it will drop somewhat in pitch, and modulate the filter with the same envelope to roll off some of the highs. For a hi-hat, use a quick attack with 500 ms or so of decay; for a crash cymbal, a longer decay time would be more appropriate.

Another hi-hat trick involves re-triggering. By using a repeating trigger source (such as an LFO or sequencer clock) to trigger the cymbal sound, you can make a hi-hat that will behave the way it would on a rhythm track. Lengthening the envelope will open the hi-hat, so if you've got a voltage-controlled envelope generator you can use one of the outputs from a multi-stage analog sequencer to open and close the cymbal automatically in a regular rhythm.

If your crash cymbal still sounds too synthetic, you might try running it through two separate filters hooked up in parallel and remixing the outputs of the filters afterwards (see figure 1). Ideally, these two filters would be in addition to the one you're using to roll off the highs during the decay. By modulating each of the filters with its own very slow sine wave LFO and setting the two LFOs at slightly different speeds, you can add a touch of lifelike animation. It would be easy to overdo this effect; a 12 dB/octave filter with no resonance and a slight amount of LFO modulation is all you need. On the other hand, you might try grossly overdoing it and see what it sounds like. It won't be a cymbal anymore, but it will be a more startling-sounding event that might be made to function musically the way a cymbal would.

There are other ways to achieve this type of animation (see figure 2). One of the easiest is to take two versions of a sound - filtered and unfiltered, for example - and run them through separate VCAs. Modulate both VCAs with the same slow LFO triangle wave, but invert it on its way to one of the VCAs. This will create a sort of monaural cross-panning effect. It will be subtle, because you're listening to two versions of the same sound; only the harmonic spectrum will change slightly. Of course, you can use the same patch to pan between two wildly different sounds, but that wouldn't be imitative synthesis anymore.

Another sound that can be synthesized pretty easily is bells (see figure 3). The key to believeable bell sounds is the fact that a bell has a pronounced resonance at a sixth below the fundamental. Tune your first two oscillators a major sixth apart, and then tune a third oscillator (and a fourth, if you've got one handy) to some other mildly dissonant interval, making a chord such as G-E-A or G-E-Eb. If you've got a ring modulator or wave multiplier, you can send a couple of the oscillators through it and mix its output back into the signal path to fatten up the sound. You can add a stick tap sound, but you might want to consider whether your bell is being struck by a clapper on the inside or a wooden mallet on the outside. The high-pitched clank of a clapper will be more definitely pitched than a drumstick. One way to simulate this would be with two oscillators, one of which is swept downward by the envelope while the other stays at the same pitch. A mallet will make a woody thock sound that you can reproduce with a lower-pitched oscillator and quite a bit of filter resonance - provided that you've got a separate filter for this. You don't want resonance on the main body of the bell sound, just a long smooth decay on a lowpass filter to roll off the high frequency harmonics and leave the fundamental pitches ringing. Additionally, a parametric equalizer or a fixed filter is highly recommended for shaping the tone quality of the bells, because real bells seem to have strong resonant peaks.

I had good luck adding a not quite realistic but still nice-sounding touch to high-pitched silvery bells by introducing some delayed vibrato that appears just as the bell sound is fading out. If your instrument doesn't offer vibrato delay, you can create the same effect by routing your vibrato LFO through a separate VCA on its way to the modulation input of the oscillators, and opening up this VCA very slowly with an envelope generator that's set to a long attack time. Just make sure that this envelope generator resets to zero every time it gets a new trigger. Otherwise, your second bell sound in a series will be drowning in vibrato.

(to be continued....................................)

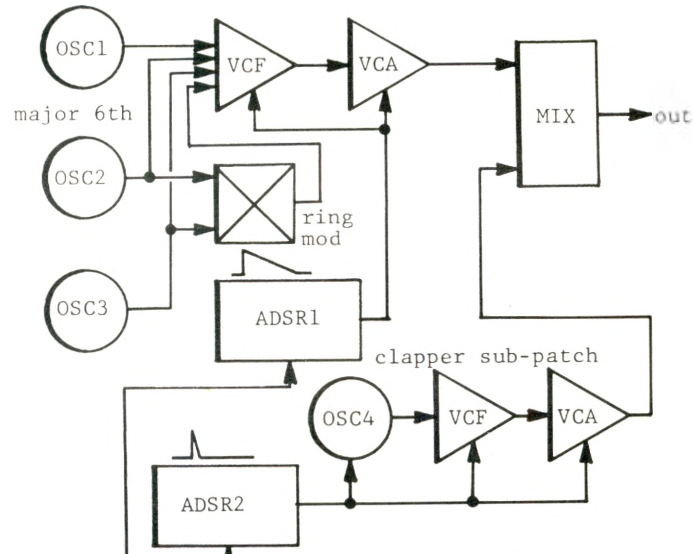


Figure 3: Bell

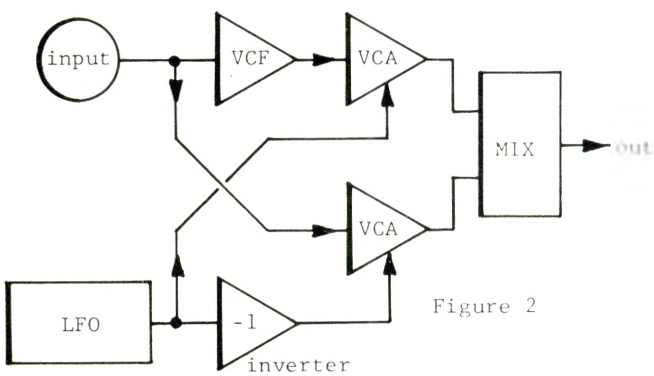


Figure 2

END Part I

CONCLUSION in the July/August 1981 Polyphony

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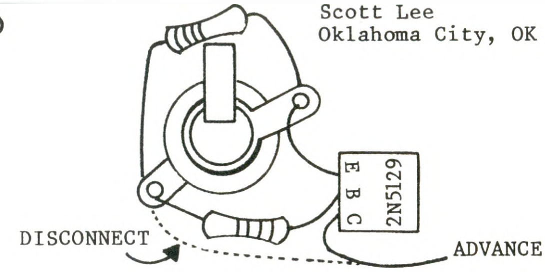

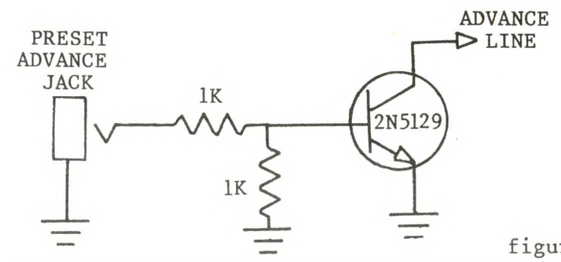

figure 1

CYBERSEQUE allows Proteus I players to manually sequence through up to 16 different voices or notes. Here's how it works: The gate output feeds the "advance preset" input, which means that depressing any key advances Proteus to the next voice stored in memory. For example, each programmed voice could be identical except for changing the Osc 2 Fine Tune control, which would allow for melodic sequences. Or, the LFO speed or frequency could change each time you press a key. Yet another option is to set up each voice as a separate drum sound, and sequence through the desired rhythms at the desired tempo by depressing the same key over and over again.

Since the gate output of Proteus I is positive and the advance preset accepts a negative going pulse, the gate needs to be inverted and differentiated. In order to do this, I built in an inverter around the "advance" jack on the rear panel using one transistor and two resistors (see figure 1). I then made a patch cord with a .01 uF capacitor in series with the hot line to connect the "gate out" and "advance preset" jacks. (See figure 2)

A related modification involves changing the preset advance rate from fixed to variable. This simply involves replacing C3 with a .22 uF capacitor and replacing R4 with a 500k pot (I installed the pot where the low level output jack used to be on the rear patch bay). With this modification, you can sync the advance rate to a particular rhythm or use Proteus I as a variable speed sequencer.

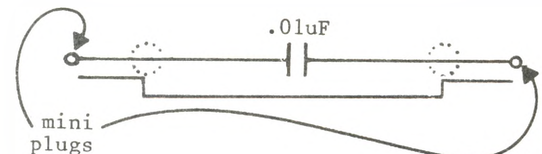

figure 2


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