

# POLYPHONY<sup>TM.</sup>

*Jan./Feb.*

1980

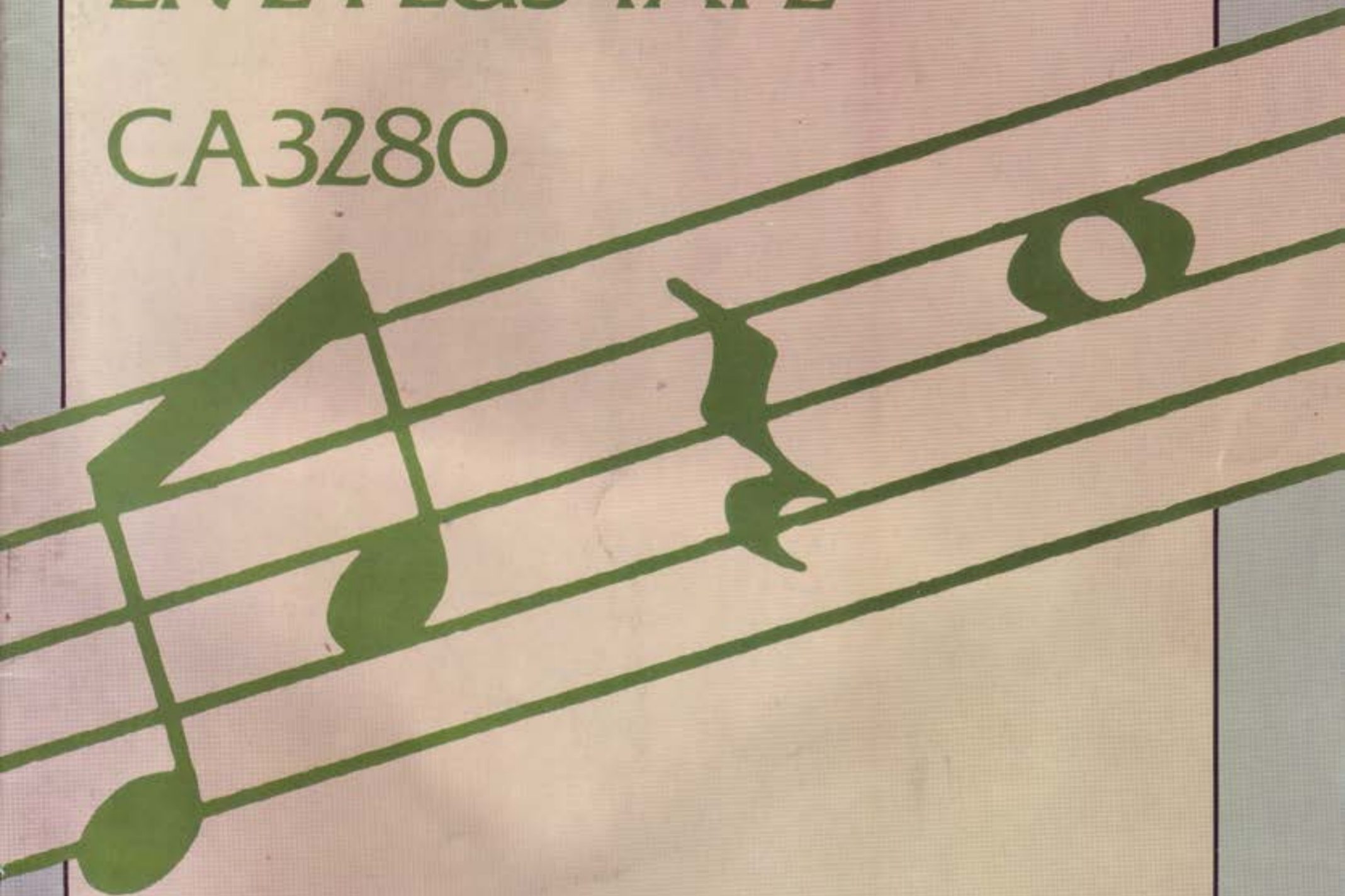
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ISSN:0163-4534

*ELECTRONIC MUSIC & HOME RECORDING*

LIVE-PLUS-TAPE

CA3280



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# SWT ANALOG DELAY



## INTRODUCING... TWO-CHANNEL ANALOG DELAY UNIT FOR AMBIENCE SYNTHESIS AND DELAY EFFECTS

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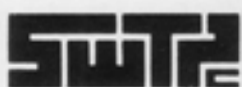
2 dimensional. Without the mixture of direct and delayed sounds that a large hall provides, almost all music reproduced in the home is lifeless. Quadraphonics has not proved to be the solution to this problem. The recent development of bucket-brigade semiconductor technology has made it possible to offer a reasonably priced delay unit that can transform your listening room into a concert hall. Using your present stereo system, the 2AS-A, and whatever you have in the way of 2 additional speakers and 2 channels of power amplification—you have all the parts to put together an ambience system that is capable of creating the kind of 'space' you enjoy music in. You don't need state-of-the-art componentry to enjoy an ambience system. The secondary power amplifiers and speakers can be of very modest perfor-

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POLYPHONY (ISSN 0163-4534) is published bimonthly at 1020 W. Wilshire Blvd., Oklahoma City, OK 73116, by Polyphony Publishing Co. Entire contents copyright © 1980 by Polyphony Publishing Co. All rights reserved. No portion of this publication may be reproduced in any manner without written permission from the publisher. Controlled circulation postage is paid at Oklahoma City, OK 73125.

ADVERTISING rate card and deadline schedule is available upon request. Contact Marvin Jones at (405) 842-5480.

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January/February 1980

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Digital Delay Project, Wireless Transmission,  
Moog Mods, Patches, Projects, and lots more!

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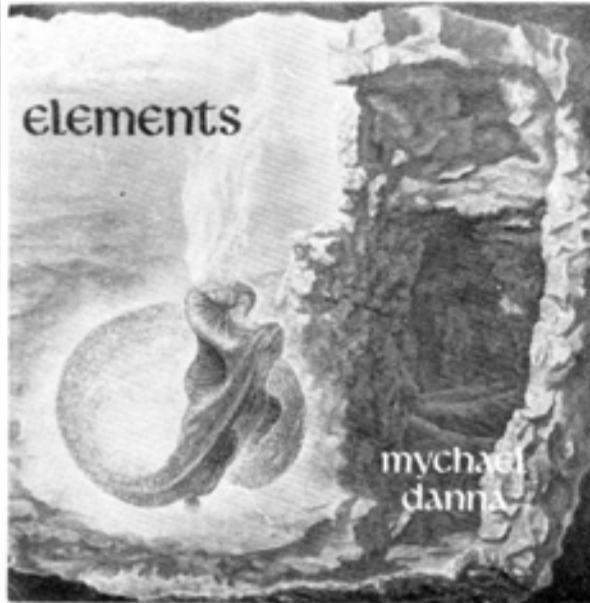
♦♦♦♦ All of this is really only the tip of the iceberg, as you'll see when you receive our latest catalog. It's free; just send us your name and address, we'll take care of the rest. If you're in a hurry, enclose 41¢ in stamps for 1st class delivery.

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## ELEMENTS!

Mychael Danna



### A Synthesizer Synthony

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POLYPHONY REVIEW JULY/AUGUST, 1979

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J.F. IKON, N.Y.

"..A YOUNG COMPOSER WITH A REMARKABLE FUTURE, IF THIS DEBUT RECORD IS ANY INDICATION.."

CANADIAN COMPOSER, SEPTEMBER, 1979

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## Letters

### Quotable Quotes

"Besides, mechanical switches contribute no noise, distortion, or crosstalk."  
by Craig Anderton

In or out of context, this quote from page 34 of the September/October 1979 issue is one of the most amazing things I've ever heard.

Leon G. Byerley III  
Tucson, AZ

### Circuit Search

Can you recommend periodicals and publications that feature circuit theory, design and construction? I would like to build a linear to exponential voltage converter for controlling oscillators and amplifiers. Can you advise on where I can get such a design? I've seen the converter in Jan/Feb 79 Polyphony, but would like to experiment with other types.

Roderick Allen  
Honolulu, HI

For those interested in a lot of design and construction information, we would recommend *Electronotes Newsletter*, 1 Pheasant Lane, Ithaca, NY 14850. They have published numerous circuits with exponential converters. If you write, I'm sure they can recommend specific issues which contain the circuits you are after. Also, you should check out the *Analog Devices Nonlinear Design Handbook*, available from Analog Devices, PO Box 280, Norwood, MA 02062. I'm not sure of the price. If there is sufficient interest, Polyphony can offer this book through PolyMart. Let us know. And don't forget the many electronics books already offered through our PolyMart!

Polyphony

### Harmoni-Controller?

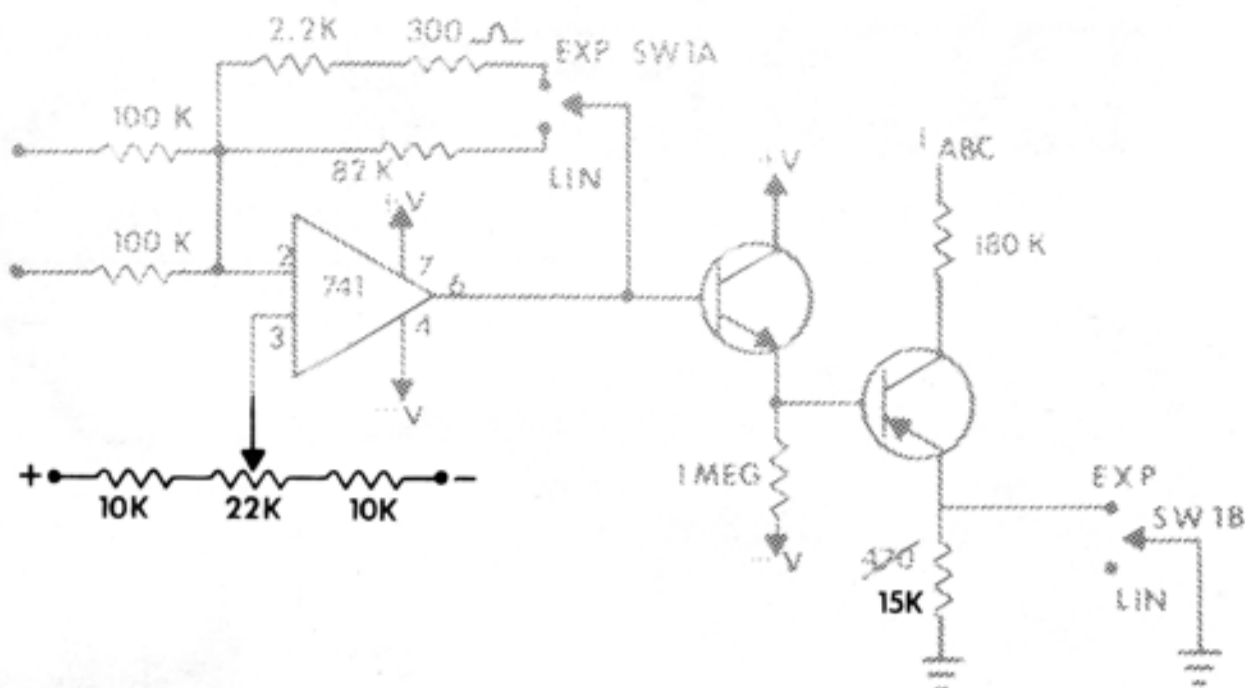
Can anyone out there discuss the electrification of a harmonica? What can a harmonica player do beyond just blasting away into a microphone? Can the output be processed by a synthesizer to obtain unusual sounds? Suppose a pressure switch were substituted for the vibrating reed so you close a switch when you blow or draw on a specific hole. If this could happen, you could conceivably connect to an electronic organ and get all the special effects such an instrument provides. I would very much appreciate hearing from anyone who has worked on such a harmonica project so I don't have to 're-invent the wheel' as mentioned in the September/October Polyphony editorial.

Harold Bolton  
1010 Briarcliff Dr.  
Arlington, TX 76012

# VCA Circuit Changes

I have completed building the Super VCA (January/ February 1979, page 24). For the audio frequency channel - very, very OK! On the contrary I have found some trouble in the linear/ log voltage to current converter. For proper operation in the linear mode, I have changed the emitter resistor of the PNP from 470 ohms to 15K. Another problem involves finding perfectly matched transistors. With the modification suggested (741 op amp, pin 3) it is possible to trim just for zero signal feed-through. This can produce a linearity loss in the linear mode, so it is a good procedure to first match the transistors and then adjust the 2.2K trimmer.

Bellotto Luciano  
Chivasso, Italy



# Budget EQ Errors

I have thoroughly enjoyed building and using the equalizer circuit published in your September/ October issue. A few minor problems came up during construction that I thought I would bring to your attention in case you haven't already caught them. The most serious of these is that the circuit, as printed, does not produce the stated +15 dB of boost/cut. Analysis of the circuit indicates a maximum of about +6 dB, which is exactly the way the circuit behaves. I believe the problem may be that the values of R4 and R5 were misprinted. Something on the order of 12K or 15K for these resistors will produce the +15 dB variation. Two other minor points are that the "cut" and "boost" labels on R6 are reversed (which isn't such a minor problem if you solder the caps directly to the pot, as I did!) and that the polarity of the output cap appears to be reversed. Your new and expanded format is very impressive; keep up the good work.

Ian Fritz  
Albuquerque, NM

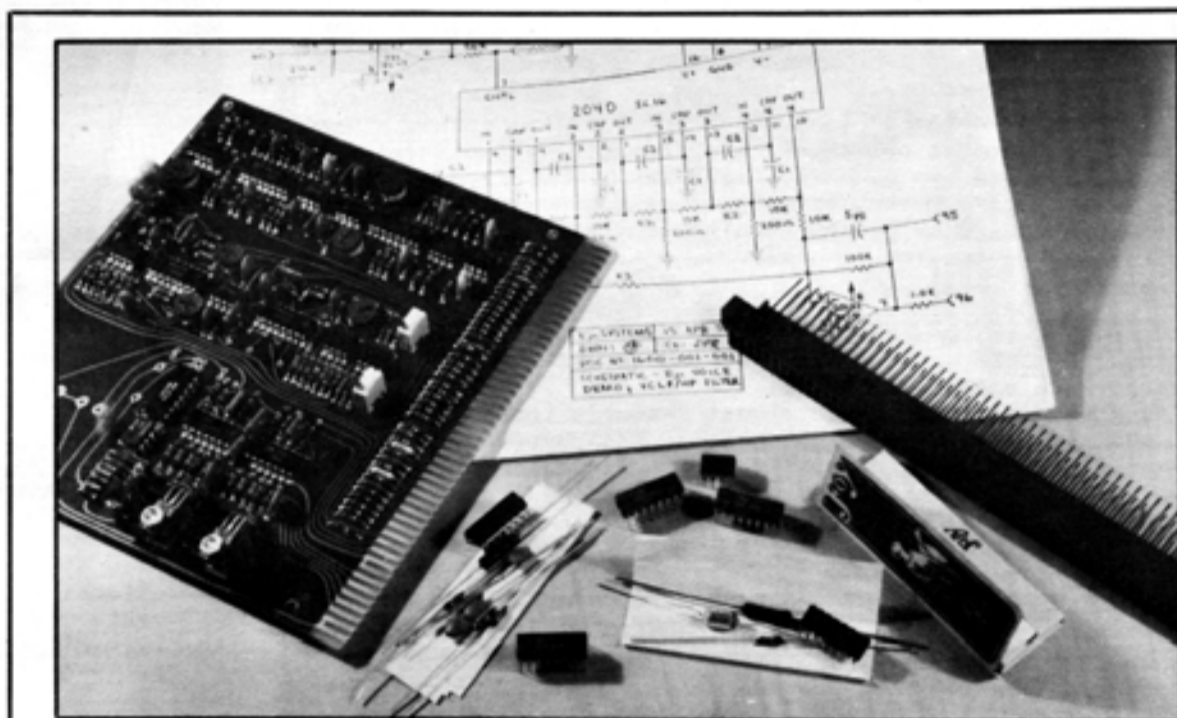
Thanks for letting us know of our error. When we redrew the schematic provided by Craig, the values of R4 and R5 were improperly labeled as 2.2K rather than the 22K values Craig had listed. Sorry about any inconveniences caused by our mistake.

## OOPS!

John Blacet has notified Polyphony of a few revisions to his "Percussive Noise Voice" which appeared in the November/ December 1979 issue. A 10K current limiting resistor should be placed in the line between pin 20 of the SN76477 and the wiper of the 1M SLF control. Also, the polarity is reversed on the electrolytic caps between pin 21 and ground and pin 23 and ground. The negative leads should go to ground. Please mark these changes in your magazines for future reference.

The price of the A/DA Power Plug-5 mentioned in Industry Notes last issue should be \$109.95, not \$149.98 as listed. An even better deal!

Also note that the untitled Yamaha CS-60 patch by Bill Boydston in our last issue is used to simulate a "Hammond Organ".



# Roll Your Own

Whether you're designing a custom monophonic synthesizer or a large computer-controlled polyphonic system, the Eμ Systems Voice Board is the ideal low-cost building block. It supplies a complete high-quality synthesizer voice on a single circuit board. Detailed documentation facilitates construction and control interface.

For those wishing to start from scratch, we offer the SSM ICs; each a basic synthesizer function on a single chip.

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### Voice Board Features:

- Two VCOs with PWM, linear and exponential FM, and hard sync.
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# INDUSTRY REPORT

'Tell Them You Saw It In Polyphony'

Polyphony Pub. Co.

January/February 1980

Volume 5-Issue 5

## NEW POLY MACHINE

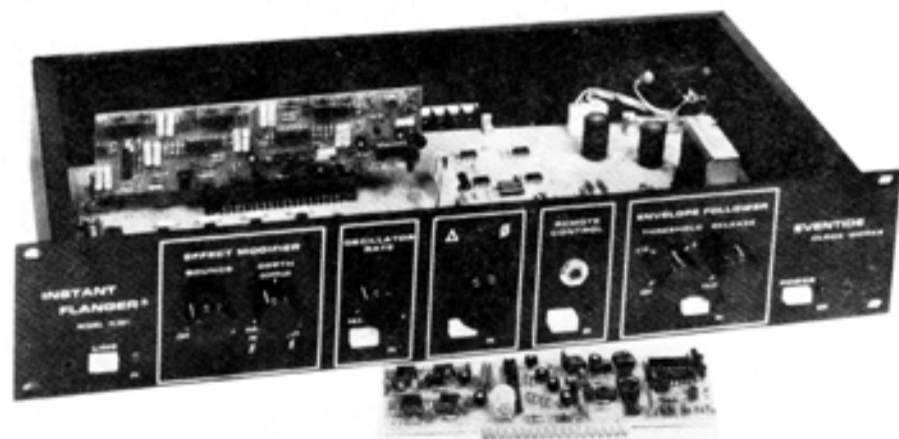


Sequential Circuits, Inc. introduces the Prophet-10, the most complete keyboard instrument available today. The Prophet-10 is a true polyphonic programmable synthesizer with 10 full voices and two manuals, each with 5 voices. Both sets of 5 voices have their own program, allowing two completely different sounds to be played simultaneously. Each voice has two voltage controlled oscillators, a mixer, a four pole low pass filter, two ADSR envelope generators, and independent modulation capabilities. A plug-in polyphonic sequencer with built-in cassette is available as an option. The sequencer operates on the lower manual and can be retro-fitted if not purchased with the original unit.

An extensive list of additional features includes: pitch bend and modulation wheels, octave transposition switches, assignable voice modes (normal, double, single, or alternate), voice assignment LED indicators, automatic tuning, programmable volume control and master overall volume control, a program increment footswitch, three band programmable equalization, two assignable and programmable control voltage pedals which can act on each manual independently, polyphonic modulation section, upper and lower manual balance control, an A-440 reference tone, and stereo and mono balanced and unbalanced outputs. And last, and most important, the Prophet-10 has the incredible Prophet sound.

First introduced at the June 1979 NAMM show, the Prophet-10 has generated considerable interest from many prominent musicians. The Prophet-10 is definitely the ultimate keyboard. For more information, contact Bob Styles, Sales Manager at Sequential Circuits, Inc., 3051 North First Street, San Jose, CA 95134, (408) 946-5240.

## PHASE & ANALYZE



Eventide received so many requests to bring back the Instant Phaser that they have developed a plug-in card for the Instant Flanger, which turns the unit into an Instant Phaser with even higher quality than the classic Eventide PS101. The BPC101 Phaser Card is interchangeable with the SDC-1 Flanger card. It uses electronic phase-shift networks to generate frequency cancellations in the audio signal rather than the bucket brigade devices used in the Instant Flanger. The Phaser Card requires simple calibration to work with the individual flanger; thereafter the phaser and flanger cards may be

interchanged with no further adjustments. The cost of the BPC101 Phaser card is \$233. The FL201 Instant Flanger may be purchased with either the SDC-1 Flanger Card or the BPC101 Phaser Card for \$615, or with both for \$848. Other options for the Instant Flanger remain the same. The BPC Phaser Card is available from stock.



The success of the real time audio spectrum analyzer which Eventide introduced for the Commodore PET computer has led to the introduction of similar units for the Radio Shack TRS-80 and Apple computers. The VTU02 (for the TRS-80) and the AIB232 (for the Apple) divide the audio spectrum from 20 Hz to 20KHz into 31 third-octave bands, and displays these bands, with their relative amplitudes, on the computer CRT. The units can be used for measuring sound and noise levels, for optimizing the equalization of a hi-fi or public address system, for checking the frequency response of audio components, and for speech and sound pattern recognition (useful for voice control systems).

Each analyzer is designed to interface with its host computer with a minimum of fuss. The VTU02 plugs into the TRS-80 expansion port (and provides an equivalent port for further expansion), and the AIB232 has an interface board which fits into one of the Apple interface slots. The AIB232 analyzer can make dynamic use of color, as the color of each bar of the display is under software control - one or several of the bars can change color in real time.

Because of the capabilities of the computers, great flexibility in the manipulation of the analyzed data is permitted. Data can be stored, and compared with past, future, and other channel information. Programs to access the analyzer are written in BASIC, and three are provided with each unit: Interactive Operation, Minimal Operation, and Self Test. The cost of the PET and TRS-80 analyzers are \$595 each; the Apple analyzer goes for \$545. For more information on the analyzers or Phaser cards, contact: Eventide Clockworks, Inc., 265 W 54th St., New York, NY 10019.

## RECORDING SUPPLIES

Polyline Corp. announces that it has merged with its divisions, Recording Supply Co. and Pro Audio Specialties Co. The recording industry supplier manufactures plastic reels and boxes, and through its divisions offers audio and video tape and accessories, and stocks a selected line of Switchcraft brand audio connectors. Separate catalogs - available free of charge to anyone - will still be used for different product lines.

The merger was accomplished, according to John Kaiser, President of the firm, "to eliminate any confusion among our customers that the multiple names may have caused, and also to improve service to them." The official name will now be that of the parent firm, Polyline Corp.

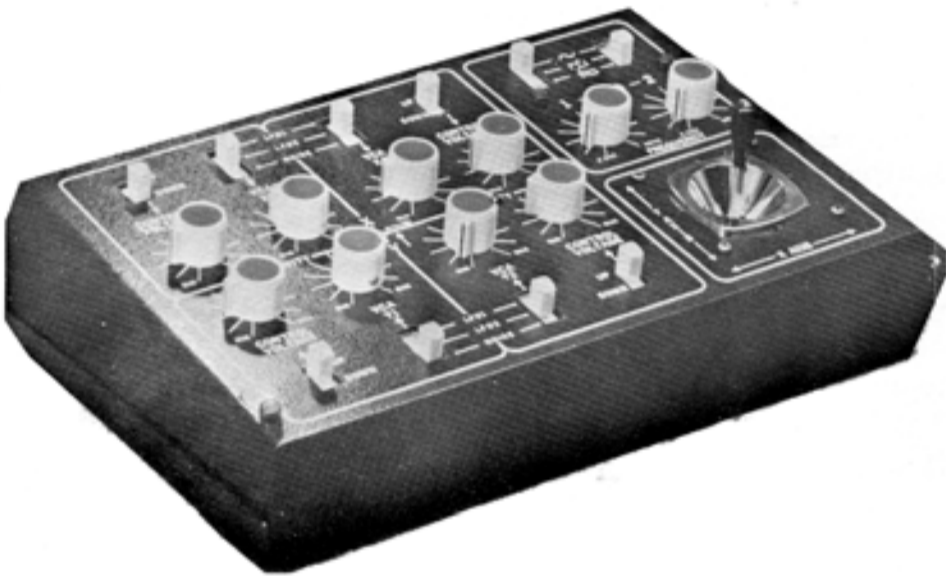
The company and its divisions have long prided themselves on stocking all items sold, resulting in same-day or next-day shipment of practically all orders. "We feel that the merger, which led to combining all our records, will speed up the

processing and shipping of orders even more," adds Mr. Kaiser. For more information or catalogs, contact: Polyline Corp., 1233 Rand Rd., Des Plaines, IL 60016, (312) 298-5300.

## NEW COMPANY...AND PRODUCT

Octave Electronics, Inc., manufacturers of Cat Synthesizers, has merged with Plateau Electronics, Inc., a prominent New York City musical instrument repair and modification facility. The new administration is comprised of Carmine Bonanno, President; Frederick Romano, Vice President; Bob Whitmore, Chairman of the Board; and Ms. Patricia Fries, General Manager. Former Octave principles Al and Ken Iorio are no longer affiliated with the new corporation, their interests having been assumed by John Williams, Jr., a Tulsa based venture capitalist.

The merger involved the movement of the Octave manufacturing facility from their former 3000 sq. ft. plant to the 9000 sq. ft. Plateau factory in Manhattan at 928 Broadway, 7th Floor, New York City, NY 10010, (212) 673-4205. Octave-Plateau plans to continue manufacturing its line of CAT and KITTEN synthesizers, and is planning a new line of synthesis related equipment to be introduced in the spring of 1980.



The most recent release from Octave-Plateau is the Catstick, a spring loaded joystick that can be used with any patchable voltage controlled synthesizer. The Catstick has four identical sections - one for each of the joystick directions. Each section allows the joystick to turn on one of two LFOs (provided in unit) and add a control voltage offset. The joystick returns to zero modulation when released by springing back to its vertical position.

The Catstick is recommended as a replacement for ribbon controllers, pressure sensitive controllers, and sliders on footpedals since it allows four different modulations (one for each of the joystick directions) to be controlled with one hand. This allows the performer to open up an entirely new perspective on synthesizer control and often allows modulation styles not available by any other means to become an important part of basic technique. For further information, write to Octave-Plateau at the address given above.

## LASER ART

A new bimonthly forum for lighting and laser artists and technicians has been started and is called New Renaissance! International Journal of Light, Laser Artists, and Their Works. Features include performance news and reviews, projects, plans, schematics, new techniques, materials and products, pertinent interviews, laser and electrical safety, books and other data sources, and interfacing with the existing performing and recording arts. Subscriptions are \$25 per year. For more information or subscription information, contact: New Renaissance!, 5267 11th Ave. NE, Seattle, WA 98105.

## POSITION OPEN

Ball State University (Muncie, IN 47306) has announced an opening for a Graduate Assistant or Doctoral Fellow in Music Theory and/or Composition, Recording Technology, or Music Performance. Responsibilities include supervision of the Central Recording Services for the School of Music, as well as

the possibility of teaching one course in Recording Technology. Pay has been set as \$3000 (assistant) or \$3450 (fellow) per academic year. Applicants should have a background in recording and sound reinforcement. Submit resumes to: Dr. Cleve Scott, Director, Electronic Systems for Music Synthesis, School of Music, Ball State University, Muncie, IN 47306. Submit applications to: Dr. Arnold E. Burkart, Coordinator, Graduate Programs in Music, School of Music, Ball State University, Muncie, IN 47306.

## GUITAR SYNTH

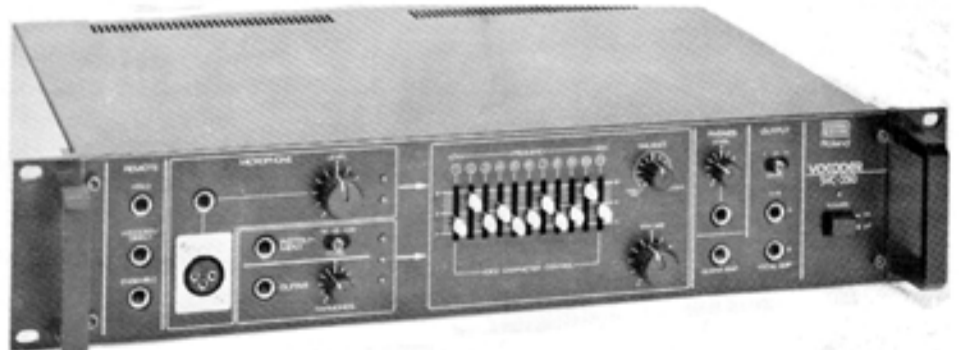


Korg introduces the X911, the first guitar synthesizer with pre-programmed preset control and separate variability for each preset function. The guitarist just plugs in ... with NO modifications to the instrument. This synthesizer has eleven mixable voices, and each voice is user-variable in an important parameter. Five of the presets are for 'synthesizer' voicings with separate envelope generator and variable filter controls. The remaining six presets are for 'instrument' voicings, allowing bass, double reed, woodwind, brass, string, or any combination of these effects.

The X911 includes an advanced pitch to voltage converter, with excellent tracking accuracy and pitch stability; envelope follower functions; VCO with two sub-octaves and eleven mixable voices, each separately articulated, for explosive sound capabilities - at a fingers touch. Other features include footswitch operated portamento, infinite sustain, variable interval, and synthesizer cancel functions. It also allows direct, "fuzz", and processed guitar sounds to be produced (as well as processed through the envelope generator and filter) for exciting polyphonic effects. All switching is solid state, and a three position octave select switch extends playing range. External control voltage inputs are provided for pitch and filter modulation; interfacing jacks allow use with external synthesizers and sequencers.

The suggested list price for the X911 is \$550. For more information, contact: Unicord, 89 Frost Street, Westbury, NY 11590, (516) 333-9100.

## RACK VOCODER



At the recent AES Convention in New York, RolandCorp US continued its push into the professional and studio markets with the expansion of the Roland Rack Series of products. The Roland SVC-350 Vocoder is the first truly sophisticated vocoder to be priced within the range of musicians or engineers. The primary function of the vocoder is to process the spoken or sung human voice and use this information to trigger another musical signal, giving the instrument the ability to "speak".

The vocal synthesis is accomplished by processing the continued on page 20...

The people who publish **The Audio Amateur** are pleased to announce a **NEW** publication. . .

# Speaker Builder

*premiere first issue out February 15, 1980*

IF ONE HALF THE CASH you spend on your audio system should be invested in your speakers, why not build them yourself? Nearly 100,000 Americans will do so this year—and you can too! Your dream speaker just may be possible *only* by doing it yourself. There's a lot of help around already and now this new quarterly publication from the publishers of *The Audio Amateur* promises an assortment of articles that are comprehensive and a mix of both simple and advanced projects about all types of speakers.

- ★ Bass Reflex
- ★ Horns
- ★ Electrostatics
- ★ Transmission Lines
- ★ Infinite Baffle
- ★ Specials: Ribbon, Air motion transformers and many others.
- ★ All the basic data on passive and electronic crossovers.

There will be kit reports on building the many speakers and enclosures now available in kit form and a round-up of suppliers of drivers, parts, and kits.

We have articles in hand that range from the ultimate (650 Lbs each) to very simple extension speakers; from time delayed multi-satellites to horn loaded subwoofers. There will be modifications of many stock designs as well as resurrections of great classic designs out of the past.

We'll be doing basic articles on the design theory behind each of the great classical speaker formats. And you'll find lots of reference data on design formulas, crossover coil winding guides and much more. **Speaker Builders** will have a lot to say to each other in the column on tips, photos of systems, in the letters exchange as well as swaps of gear and data in the columns of free classified ads.

Standard format 8½ x 11" on good book paper, with clear diagrams and photos and all the data you need to build each project successfully and without undue hassle, **Speaker Builder** will be reader-centered and reader supported and NOT a thinly disguised marketing medium catering to advertisers. Ad ratios will never exceed 40% (*the national average is over 60%*). Guarantee: if you are not satisfied with **Speaker Builder** the publisher will refund the unused portion of your subscription.

The price is \$10 per year, and if you get your subscription into our office before February 10, 1980, the price is only \$9.00—or two years for \$16. This introductory rate will be withdrawn absolutely on February 10 so take advantage of this special offer while you can! On February 10, 1980, the price goes up to \$10 for one year, \$18 for two years.

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# Coping With Shattered Illusions

BY: BARTON McLEAN

## Problems & Solutions Concerning Live-Plus-Tape Composition.

The agony of reconciling acoustic instruments with electronic tape in the same composition has plagued composers since the electronic medium began in the early 1950's. A multitude of interesting works have been created since then, a testament to the continuing need for interpretive renewal, for the performance ritual to be maintained, and as insurance that the composer's work will not fade away (as in a strictly tape composition) for lack of performers or publishers to champion it.

However telling these reasons may be, many of us have, at one time or other, come to an impasse on dealing with the coexistence of "live" and "canned" materials in one composition. This article will be confined to abstract non-commercial live-plus-tape composition, since it is here that the issues about to be raised are most clearly focused. The basic problem as I see it is in the realm of "illusion."

What is illusion and how does it operate in musical composition? Its essence can be found in the atmosphere surrounding the work as well as in the soul of the work itself. By atmosphere I mean (for example) the concert hall setting, musician's seating and tuning ritual, entrance of the conductor, as well as the acoustic ambience of the hall itself as it reinforces and resonates. The second aspect of illusion is what the composer creates uniquely and strongly to project a specific image in the listener's mental realization of the work. All art is involved with illusion in that it transports the receptor's mind to a specific and defined universe within its own laws. Illusions create the framework, provide the listener expectation, and is the unique image of a work of art. Why the term "illusion?" Because the art work can be said to exist in the receptor's mind even without reference to performance, recording, or score. Thus, a physical act of performance can be transferred later into a mental image of that performance. Take recordings for example, and consider the tremendous amount of research allocated toward the elimination of tape noise, pops, clicks and distortion to ensure that the illusion projected is one of a real live performance.

A considerable number of acoustic instrument-plus-tape works have personally disappointed me in that they utilize tape sounds different from the acoustic sounds accompanying them (often purely synthesized tape material presiding). Unfortunately in this case the acoustic instrument or voice creates by its mere presence a powerful illusion of its own which conflicts with that of the tape. What are some of these conflicting aspects? An important part of the acoustic illusion finds the performer overcoming odds before the eyes of the audience (for example in projecting his sound against a large empty hall space or in the technical prowess of the performer). Also crucial is human gesture, spontaneity, and the assumption by the audience that anything can go wrong at any time (a string can break, etc.). The electronic tape composer, on the other hand, has none of these built-in factors to work with. Technical prowess, hall ambience, lack of performance accidents and the rest are all guaranteed by the act of tape composition, thereby eliminating the possibility of transferring the illusional characteristics of acoustic performance to tape. The problem surfaces when, as stated above, the two media are mixed. It seems that illusions are delicate to handle and easily shattered, as when that previously mentioned orchestral recording is subjected to

a gash in the record surface, immediately projecting the listener out of the orchestral-performance illusion into the "canned" sound system illusion. And in its doing so we become aware that it is easily possible to project a live performance illusion through a recorded medium provided that the latter does not intrude. It follows, therefore, that the biggest danger in the composition and performance of acoustic instrument-plus-tape is the intrusion of the sound system illusion upon the live-acoustic or vice versa.

Although I do not claim to have found a solution that will work for everyone, I would like to describe a series of works written by me for single instrument and tape entitled "Dimensions" in the hope that they may shed light of the reconciliation of the "acoustic" with the "tape" illusion in one piece. The term "illusion" implies, in addition to the abovementioned criteria, fooling the listener into perceiving an image that is greater than the constituent parts (the Oxford Dictionary defines illusion as "Sensuous perception of an external object, involving a false belief or conception..."). A good example of this is the transition section of a late classical symphony, where its motivic identification with the "A" theme combined with the blurring of the cadence between the "A" theme and the transition often creates in the listener's mind an illusion of no transition at all. It is all handled so naturally that we are at the "B" theme without perceiving the process of arrival, the trick being to "hide the seams".



~~~~~BARTON McLEAN~~~~~At Home Studio~~~~~

A recurring illusion-creating device in a considerable amount of 20th century electronic tape (only) music is the setting up of sound events which are drawn from recorded "live" sounds (music concrete) and then the creation of a synthetic analog to that event, blurring the distinction between the two so that they may appear as an organic whole.

S 5  
Tp a

S 5  
with expressive liberty

S 5  
Tp b

1'57"      2'10"      \*      2'20"

Tp ch 1

Tp ch 2

Piano

\* The effect will be of the sound travelling from one area of stage to another

2'26"      2'48"

Tp ch 1

Tp ch 2

Piano

Up through the first half of p. 7, as much differentiation as possible must be made between each measure. Unless otherwise marked by accent all notes should be as even as possible, with a semi-staccato touch.

One only needs to hear the terror and beauty with which the synthesized sounds surround and merge with the female voice in Berio's *Visage*, or the way the taxi horns overlap and merge with their electronic equivalent in Appleton's *Times Square Times Ten* to appreciate this statement. In both instances the exact moment at which one can distinguish between the acoustic and the synthesized counterpart can not be known. It is this blurring of the distinction between the two that creates the illusion of one unified concept. Instead of our being conscious of two separate illusional forces competing with and weakening each other, we are fascinated by how they merge and interact. The live sound becomes its electronic equivalent and vice versa.

As this use of metaphor (that is--the idea of one event becoming another) has been employed effectively to reconcile synthesized and concrete sounds in purely tape composition, so it has also been used by myself and others in acoustic instrument-plus-tape works. In example 1, from my *Dimensions I* for violin and tape, the solo violin exists in the center box, the two tape channels appearing in smaller notation in the outer boxes. Every note you see represents a violin sound (although, since this is a performance and not a representational score, some synthesizer material exists also but is not indicated). Many of the tape sounds are somewhat modified (tape echo, equalization, etc.). The solid lines between the boxes represent solo violin start cues, and the broken lines, stop cues. It could be argued that the mere saturation of the work with violin material in itself does not guarantee a unified concept, since the performers will still sound "live" and the tape "canned". This is true, and so I have only considered this saturation as a first and necessary step. The second phase consists, in this page at least, of setting up an interplay between the two forces so complex in its coordination that it is often impossible for the ear to separate the two. Thus, the illusion is created of one "super-instrument". The ear is tricked into disregarding the differences between tape and live performance because of the creation of a more powerful illusion through metaphor.

In my *Dimensions II* for piano and tape a more complex situation exists. Although every single tape sound is derived from the piano, several are unrecognizable as such, particularly the "ethereal choir" idea which permeates the whole work. This sound event, produced by sustained stroking of low piano strings close-miked and highly processed with variable tape speed, some tape echo and modulation, acts as the "bed" over and through which the piano soloist emerges, fades and interacts. Since there is such a disparity between the acoustical qualities of solo piano and this main tape event, quite unlike my *Dimensions I*, I had to find a means of reconciling the two forces. At the first solo entrance this is done by implanting similar material in tape and solo piano; and by bonding them together spatially in a panning situation. This is done over the basic "ethereal choir" sounds. As can be seen by Example 2 the close interaction between tape and piano creates the illusion of a unified concept. Since this, the very first piano entrance, appears as bound to the tape, the illusion continues and projects itself throughout the work, allowing the piano to depart significantly from the tape material later on without breaking the illusion.

A second characteristic employed later on to bind the two forces together is the organic quality of the piano-tape interaction. In Example 3 the piano solo is constantly emerging from and receding back into the tape material. This creates the illusion of the solo part growing organically from the electronic material, thereby bound to the latter, a characteristic found throughout the work. This can be quite striking in performance, as when a pianist such as David Burge, to whom the work is dedicated and who has performed it throughout the U.S., completes the illusion by actually "becoming" the piece through gesture and performance presence, thereby completing the metaphor.

Thus, we have come full circle, beginning with explorations of how the performance illusion can be projected through the recording medium (as in orchestral recording), to the projection of the tape illusion through acoustic material (by employing similar material in both), through the

continued on page 20....

3

6'10" (1) (2) (both) 6'25"

*Tp ch 1&2*  
*Make as much contrast as possible between groups on this page. Try to avoid a blur.*

*Piano*  
*mf* *rit.* *a tempo*

*Tp ch 1&2*  
*Tape gets more & more frantic. etc.*

*Piano*  
*f* *mf* *rit* *a tempo* *ff*  
*p* *pp* *f*

The musical score is divided into three systems. The first system shows the Piano part with dynamics *mf*, *rit.*, and *a tempo*. The second system shows the Tape part with the instruction "Tape gets more & more frantic. etc." and the Piano part with dynamics *f*, *mf*, *rit*, *a tempo*, and *ff*. The third system shows the Piano part with dynamics *p*, *pp*, and *f*. Above the score, there are three groups of notes labeled (1), (2), and (both), with arrows pointing to specific musical phrases. Time markers 6'10" and 6'25" are placed above the first and second systems respectively.

# Operational Transconductance Amplifier

## USING THE NEW CA3280

BY James Patchell

What could possibly be more versatile than the CA3080 OTA? This amplifier can be used to make voltage controlled filters, amplifiers, oscillators, current sources and also balanced modulators, triangle to sine converters, high speed comparators and anything else limited only by the users imagination. It is hard to believe that RCA could come up with a better device. But they did and it is called the CA3280. It is very similar to the CA3080 except that overall performance such as noise and offset voltage have been improved and there is additionally a diode linearizer on the inputs to eliminate some of the bad input characteristics the CA3080 had. The latter will be the major topic of this article.

### THEORY

Before continuing with the CA3280 let's review a more familiar face, namely the CA3080 (see reference 1, at end of article). Basically the CA3080 is a voltage controlled current source. That is, the current from the output is proportional to the difference of the voltages on the input terminals (Figure 1a). The gain of this amplifier is called transconductance and in the CA3080 the gain is controlled by the amplifier bias current ( $I_{abc}$ ). This is all fine and dandy and works very well for small signals. You may have noticed that when you input a triangle waveform into one of the voltage controlled amplifier circuits that use a CA3080 and continue to increase the amplitude of the triangle slowly that a peculiar distortion begins to appear. The peaks of the triangle begin to get smashed down and at one point almost look sinusoidal (some people use this to make sines from triangles). This problem is usually solved by keeping the peak-to-peak signal swing to less than 30mV at the inputs. This causes other problems such as reduced signal to noise ratio and there is still significant distortion.

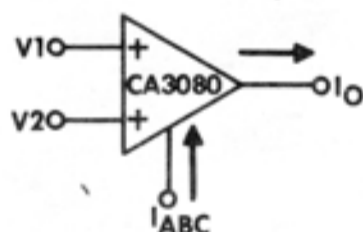
#### 1 Signal Analysis

$$I_O = G_m(V_1 - V_2)$$

$$G_m = \frac{I_{abc}}{2(V_T)}$$

$$V_T = .026 \text{ volts}$$

(a) Small Signal



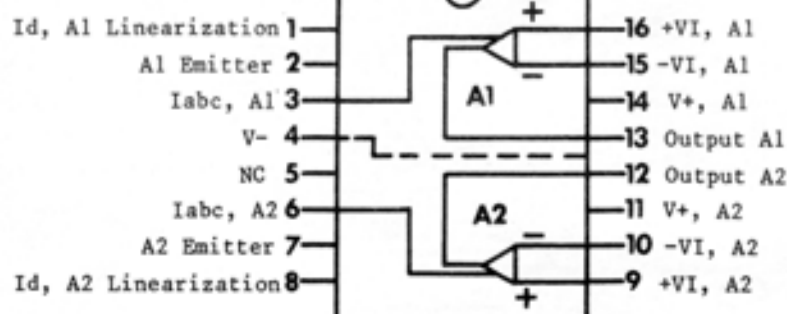
$$V_2 = -V_1$$

$$I_O = I_{abc} \left( \text{Sinh} \left( \frac{V_1}{V_T} \right) \right)$$

(b) Large Signal

In an attempt to solve these problems, let's analyze the sources of such problems. If you were to do a detailed analysis on the CA3080 you will find that the output current of the OTA is not at all related linearly to the difference of the input voltage but rather to the Hyperbolic Sine of the input voltage (Fig. 1b). This is due to the exponential relationship of transistor collector current and base emitter voltage. As it turns out the exponential characteristics can be cancelled out by a pair of diodes and some current sources, which has been done for us in the CA3280. If you wish to see a detailed derivation of this technique, one can be found in

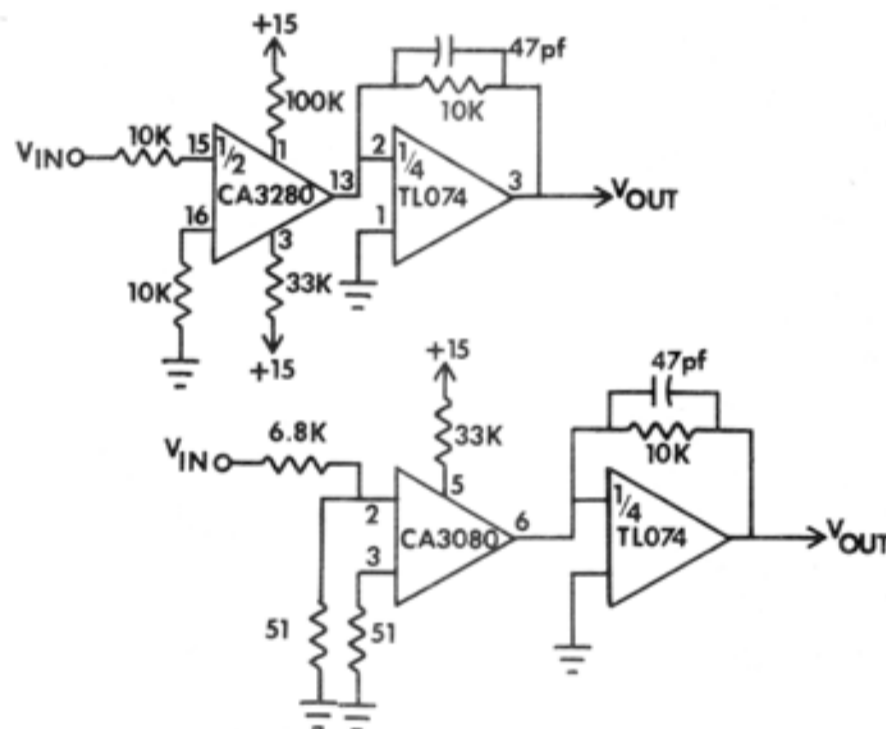
#### 2 Terminal Assignment



the ANALOG DEVICES NONLINEAR CIRCUITS HANDBOOK (reference 2) starting on page 214. The diodes, it turns out, will extend the useful input voltage range until the amplifier saturates.

Referring to figure 3a, we have two amplifier test circuits with OTAs in the inputs very much similar to a current (voltage) controlled amplifier. One circuit uses a conventional OTA (CA3080) and the other uses the CA3280. Both are run at the same bias current (1mA) and the overall gain from input to output of both circuits is the same ( $A_v = 1.4$ ). The distortion curves for both circuits are plotted side by side in figure 3b versus peak input voltage swing. At .5 volts peak the distortion is almost identical, but that's the only place. The CA3080 starts a steady climb at about 1.5 volt peak swing while the CA3280 is only going up a very small amount. When the circuit with the CA3280 is up to .4% distortion, the CA3080 is up to 3%. The distortion for both the CA3080 and CA3280 was mostly third harmonic.

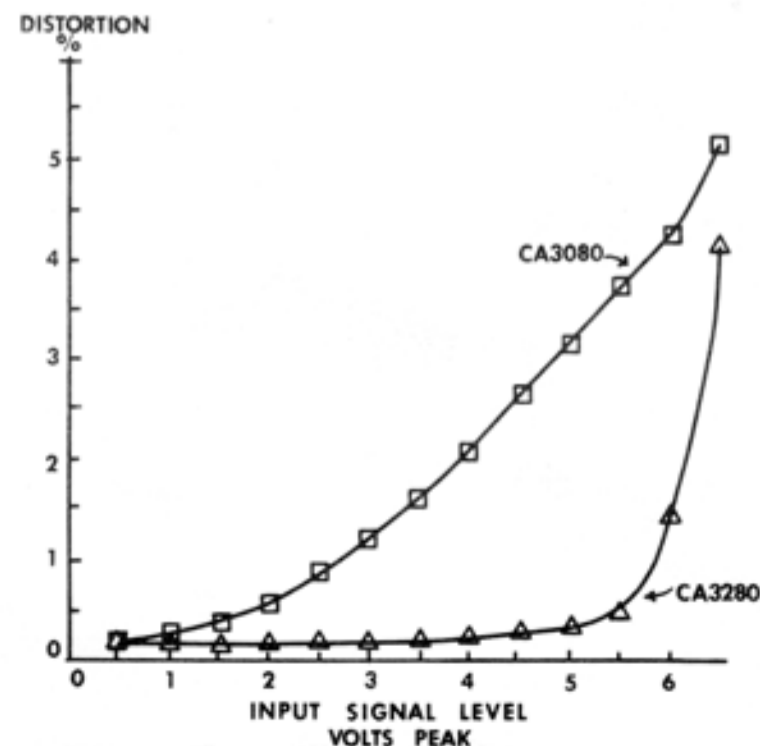
a.



3

Distortion Test Circuits

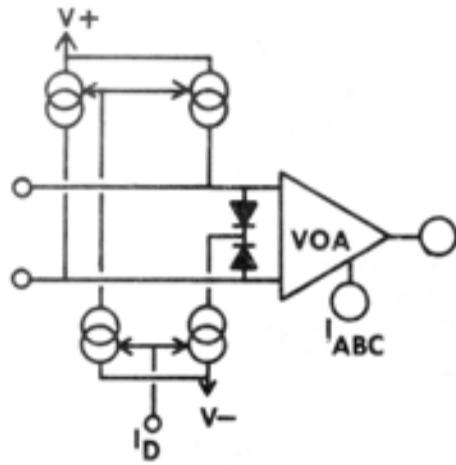
b.



# OPERATION

Now let's see how we can use this useful circuit. Referring to the block diagram of the CA3280 (Fig. 4) we can see the four current sources and two diodes that make up the linearizer circuit and VOA which is identical in operation to the CA3080. The terminals are still the same, in that there are the two differential inputs, the output and the amplifier bias current control input. We also have now a terminal called diode bias current ( $I_D$ ) to bias the diode network. We can think of  $I_D$  as controlling the small signal resistance of the diodes.

4 VOA showing linearization diodes and current drive

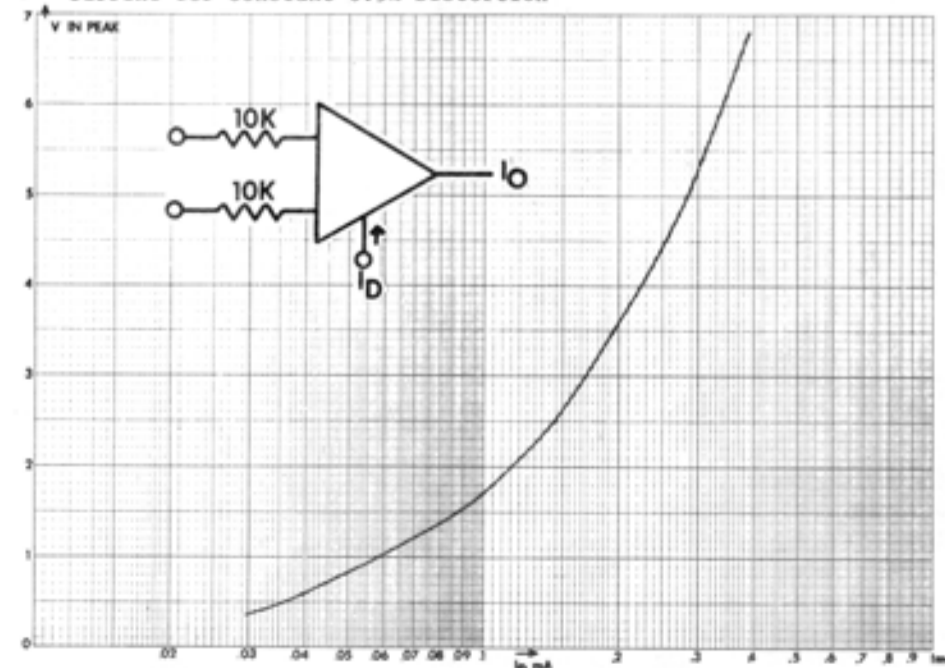


For our first application let's look at a simple voltage controlled amplifier circuit (Fig. 7). The circuit consists of  $\frac{1}{2}$  of a CA3280 and  $\frac{1}{2}$  of a TL074 (or any other op-amp). Selecting resistor values is rather easy using some very simple graphs that I have plotted. The first thing that you must know is the largest input voltage that you will be using. Figure 5 is a plot of peak input volts versus diode linearization current for constant .5% THD. The .5% operating point was chosen due to the "knee" of the distortion curve (figure 3b) residing at this point. So the first thing to do is to find your peak swing on figure 5 and locate the corresponding diode current. For example in my system I use a 5 volt peak signal. To give myself some head room I increase this to 6 volts. (This is completely arbitrary and is based only on my own subjective preferences. You may want to give yourself more or less head room depending on your application.) For a 6 volt signal the diode current should be no less than .35mA. The bias resistor can be found by

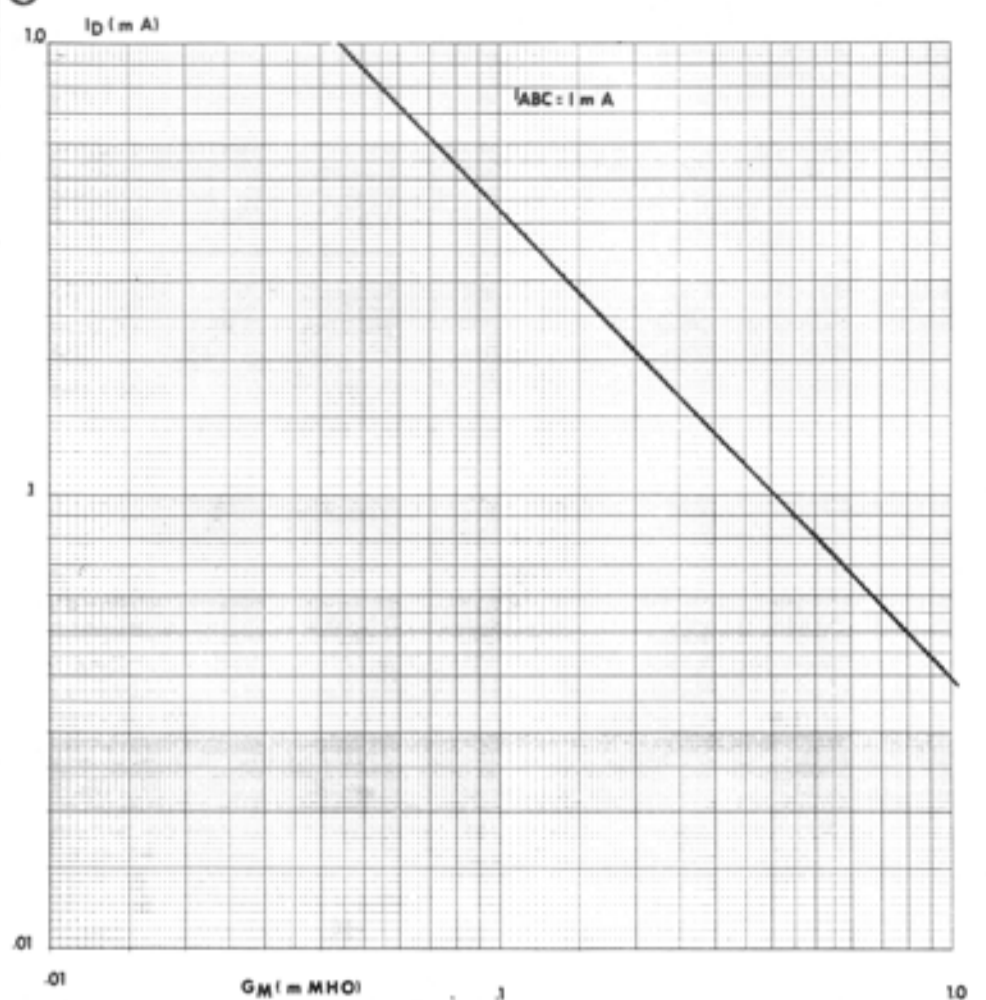
$$R_{bias} = \frac{(V+) - (V-)}{I_D}$$

where  $R_{bias}$  is the value of the bias resistor,  $V+$  is the plus power supply voltage,  $V-$  is the minus supply voltage and  $I_D$  is the current found from figure 5. In my example I use positive and negative 15 volts so, for  $R_{bias}$  ( $R_3$ , Figure 7) I calculate 85k ohms. Closest standard component value is 82k ohms.

5 Maximum Input Voltage vs Diode Linearization Current for Constant 0.5% Distortion



6  $G_m$  vs Diode Bias Current



Next we need to find the value of the feedback resistor ( $R_4$ , Fig. 7). In general we need to know the gain at the maximum amplifier bias current. Figure 6 provides a plot of  $G_m$  (transconductance) versus diode bias current for  $I_{abc} = 1$  mA. Find the diode current ( $I_D$ ) on figure 6 that you found on figure 5 and read the  $G_m$ . The value of the feedback resistor can be found by:

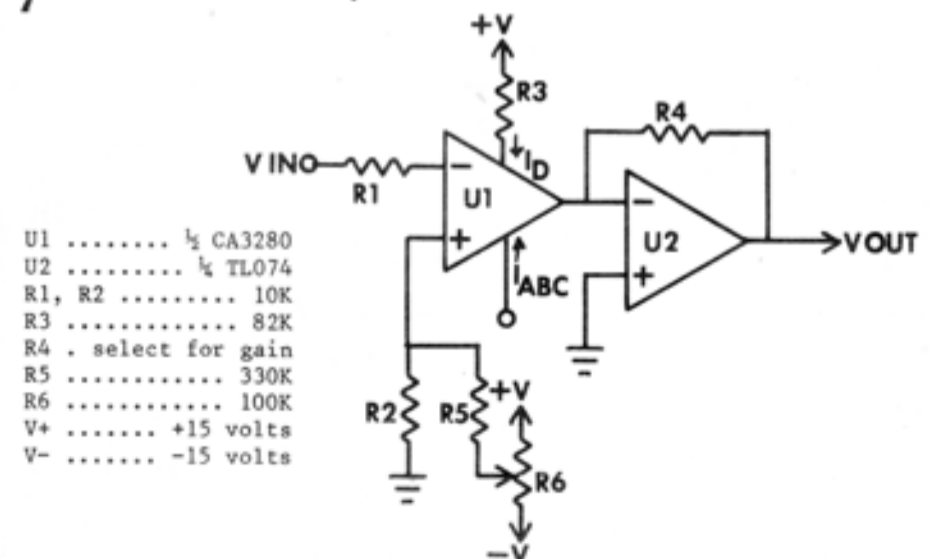
$$R_f = \frac{\text{Gain}}{G_m}$$

where  $R_f$  is the value of the feedback resistor,  $G_m$  is from figure 6, and Gain is the voltage gain desired at  $I_{abc} = 1$  mA. For example I desired a gain of unity at  $I_{abc} = 1$  mA. From figure 6 I find that at  $I_D = .35$  mA, the CA3280 has a  $G_m = .14$  MHOs (.00014). So this calculates out to

$$\frac{1}{.00014} = 7.14k \text{ ohms.}$$

The closest standard value is 7.5k ( $R_4$  of Figure 7).

7 Current Controlled Amplifier

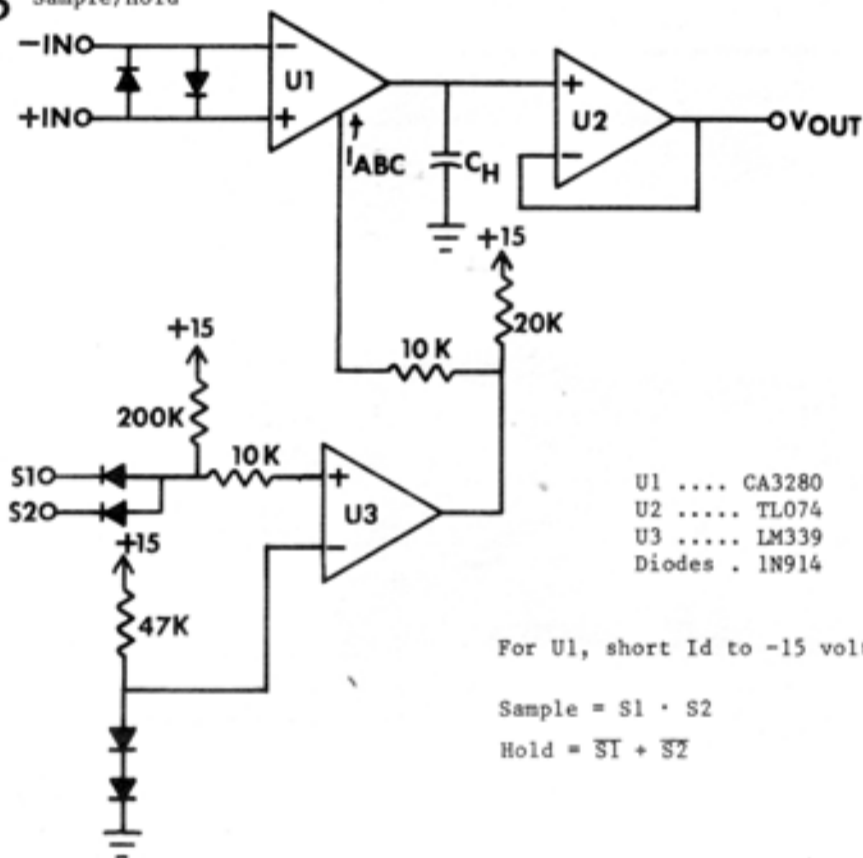


Let's see what we can do with a CA3280 other than make controlled amplifiers. Naturally you can use a CA3280 in any circuit that uses a CA3080. What you should watch out for are circuits that don't need the linearizer. In fact, in some circuits the linearizer will do more harm than good. The following are some typical applications of the CA3280.

# APPLICATIONS

In figure 8 we have a circuit for a simple sample hold function. It may look strange to some because there is no obvious analog switch present. When control inputs S1 and S2 are high, the output of U3 goes high supplying current to the OTA that essentially turns it "ON". This causes CH to charge at a rate set by the bias current and the difference of the input terminals. But you have probably noticed that as the circuit is drawn it will not work. What it needs is negative feedback from Vo back to the inputs. This is very easy to do. Just pretend that IN+, IN-, and Vo are opamp terminals. This circuit is really an operational sample hold circuit. You can have inverting, noninverting, and both types with gain. It's pretty hard to get more versatile. The circuit will hold when control input S1 or S2 goes low. When this happens the OTA can no longer supply a charging current to the holding capacitor. The OTA also has "O" transconductance and this will break the feedback loop. But U2 is a voltage follower so that Vo will remain at the voltage on the holding capacitor. The capacitor CH has to be selected for your particular application. A small capacitor will give fast settling time and also droops at a rather fast rate. Large capacitors give a slow settling time and a slow droop time. To minimize droop a FET input opamp should be used such as a TL074, CA3140, LF356, etc. Also, a high quality capacitor should be used such as mylar, polyester, polycarbonate, or polystyrene. This is also an example of a circuit that should not use the diode linearizer as it will only degrade the performance of the circuit. To eliminate the operation of this section of the IC, connect the diode bias pin to the negative supply rail.

## 8 Sample/Hold



U1 .... CA3280  
U2 .... TL074  
U3 .... LM339  
Diodes . 1N914

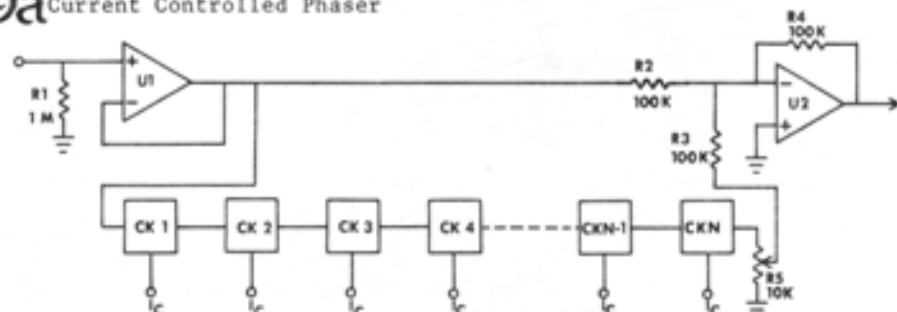
For U1, short Id to -15 volts.

Sample = S1 · S2

Hold = S1 + S2

Figure 9a and 9b are probably a little closer to home for us all. It is a circuit for an "N" stage current controlled phaser. CK1 through CKn are actually figure 9b cascaded as deeply as you wish. The circuit is very similar to one that appeared in the April/May 1978 Polyphony (reference 3) except, instead of FETs providing the control, the OTA does the job.

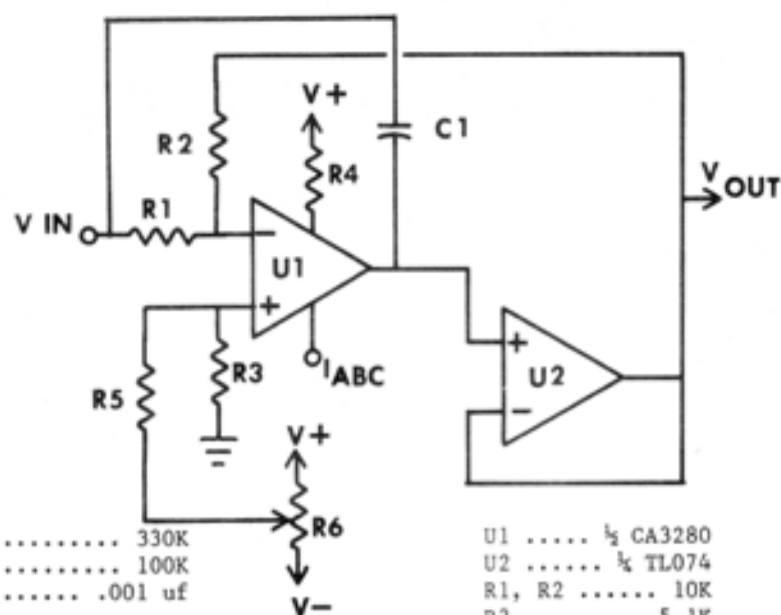
## 9a Current Controlled Phaser



U1 ..... 1/2 TL074  
U2 ..... 1/2 TL074

CK1 - CK"n" .. Figure 9b  
Power Supply . ±15 volts

## 9b Phase Shifter Block



R5 ..... 330K  
R6 ..... 100K  
C1 ..... .001 uf

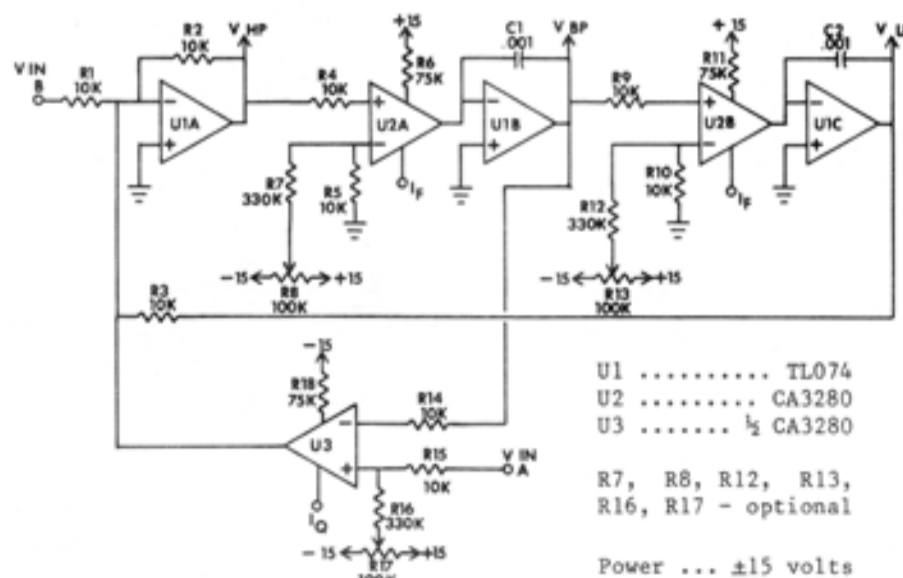
U1 ..... 1/2 CA3280  
U2 ..... 1/2 TL074  
R1, R2 ..... 10K  
R3 ..... 5.1K  
R4 ..... 68K

R5, R6 - optional

This is an excellent way to make a phaser - especially if you want precise control. To provide control for this circuit you will, of course, need some voltage to current converters. The sources described in the May/June 1979 Polyphony (reference 4) in the EXPERIMENTERS CIRCUITS column for the VCF circuits using the CA3080 will work just fine with the CA3280. You will have to add the extra current sharing resistors for each half of a CA3280.

Figure 10 shows a current controlled multimodal filter. Not only does it have current controlled frequency (U2A, U2B), but it also has current controlled resonance control (pole Q). There are two signal inputs. Vin B is best used at low resonance settings. It will provide unity gain at all three outputs in the passband of each output function. At high resonance settings, however, the gain at the resonant frequency is related to the pole Q so that under certain conditions you can overload the filter. In these conditions you should use input Vin A. As the bias current in U3 is made smaller, there is less feedback around U1A, U2A, U1B. This feedback controls the amount of damping. Less feedback and there is less damping and this gives a higher Q. If you attenuate the input by the same amount you decrease the damping, the gain at resonance will remain at unity. This is what is done by feeding the signal in at Vin A. You will note that at the LOW PASS and HIGH PASS outputs the passband gain will decrease directly as you increase Q.

## 10 Current Controlled Two Pole State Variable Filter



U1 ..... TL074  
U2 ..... CA3280  
U3 ..... 1/2 CA3280

R7, R8, R12, R13,  
R16, R17 - optional

Power ... ±15 volts

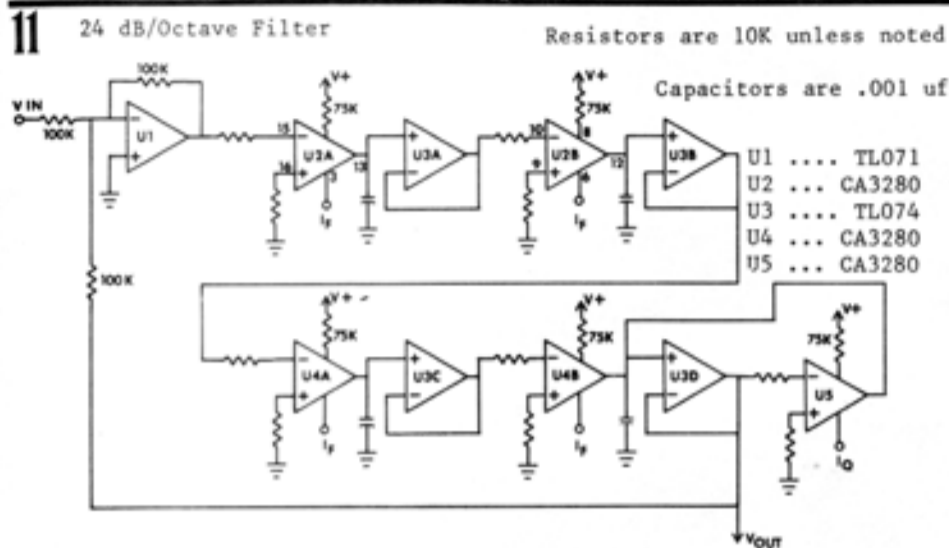
Figure 11 is a four pole (24 dB/octave) type filter. It is similar in function to the one in the May/June 1979 issue and can use the same current source that is described in that article. U5 controls the resonance in this circuit. Minimum resonance occurs at highest Iq and maximum resonance occurs at lowest Iq. A typical range would be luA to 1mA.

For the two filters the resonant frequency occurs at a frequency determined by the transconductance of the OTA. The transconductance is determined by the diode bias current and

the amplifier bias current. By using the plots of transconductance ( $G_m$ ) versus diode bias current for a constant  $I_{abc}$  of 1mA you can find the maximum resonant frequency possible. For example: for a diode current of .4mA the  $G_m$  is .11 MHOs. With a .001uF capacitor we find:

$$\text{Resonant Frequency} = F_o = \frac{G_m}{2(\pi)(C)} = \frac{.00011}{2(3.14159)(10^{-9})} = 17.5\text{KHz}$$

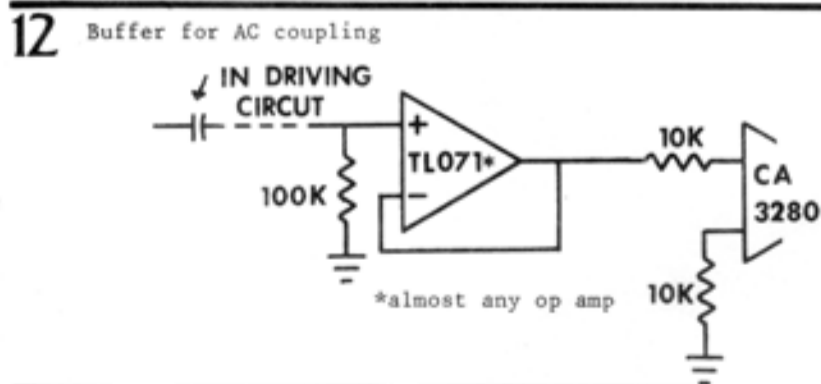
This is the maximum. Every time the amplifier bias current is cut in half, the resonant frequency will lower one octave.



Now for some general use notes. The CA3280 is a wide bandwidth device (depending on bias current). The power supplies on the circuit card on which it is used should be bypassed with about a 1uF tantalum capacitor. This is a good thing to do in any circuit but it is rather important in this case. Component leads around the CA3280 should be kept short. The most critical lead is the output terminal of the device. Bias currents on both control inputs ( $I_d$  and  $I_{abc}$ ) should probably be kept under 1mA. RCA has the spec on both of these greater than 1mA but performance above this level begins to fall off. Be sure NOT to short these terminals to the positive power supply or to ground. Attempt to keep your circuit boards CLEAN. Flux and other contaminants can cause degraded performance at low current levels.

It is a good idea to use high quality components around the OTA. It is not by chance that I use the TL074 or other FET opamps. The low input bias currents help to ensure that the OTA will operate over a wide range of control current. Also the FET opamps have a larger gain bandwidth product and a higher slew rate to help ensure low distortion and wide frequency response.

When the linearizer is used, be sure that the parallel combination of the resistor values are equal for each input on the CA3280. This is due to the fact that a rather significant current will flow out of the inputs under this condition. This also means that the input of a circuit such as figure 7 should be driven by a low impedance source down to DC (direct coupled). If the outputs of the driving circuit are AC coupled, it will be necessary to add an op-amp buffer such as that shown in figure 12.



Handling of the components should also be emphasized. The CA3280 should be treated as if it were a CMOS circuit. It should always be stored in conductive foam. In fact all ICs should be treated like CMOS. The danger to junction devices is not nearly as great as it is to MOS, but it is better to be safe than sorry and with prices going up, an IC saved is a penny earned. Generally static damage in junction devices can barely be noticed. Usually there is only a slight degrading

continued on page 20...

# Dream Module Contest

Polyphony Magazine in Conjunction with Blacet Music Research Presents a Contest to Test Your Imagination!

1st Prize: A Custom Assembled Phasefilter.

2nd-5th Prizes: 2 Year Subscription (extension) to Polyphony.



The purpose of the Dream Module Contest is to stir the imagination of Polyphony readers and to plumb their deepest fantasies... about synthesizers! Entries should be a description of a synthesizer module, an entire system, an effects box, or a microprocessor program. These should have some features that are not currently available. A reasonably brief description of what the module or system would do is really the key, although block diagrams or other electronic information would be welcomed for clarity.

The entries will be judged by the staff of Polyphony magazine and Blacet Music Research. We will look for the usual things: originality, practicality, neatness, humor. All the usual contest rules apply: All entries become the property of Polyphony Publishing and Blacet Music Research, winning entries will be published in future issues of Polyphony. So, put yourself into your favorite dream state, let the ideas flow, and pick a winner!

Contest closes March 28, 1980, so get your entries sent off to:

Dream Module c/o POLYPHONY  
Contest  
PO Box 20305 Oklahoma City, OK 73156

# Making The Moves

It's time for the annual Synergy article again. Records have often been likened to periodically issued magazines; thanks to Polyphony, Synergy album notes end up in a magazine. Due to an exceptionally busy schedule for me (that is, obligations to work on projects other than Synergy), the writing and recording of "Games", the most recent, was done in a more fragmentary way than usual. All work on the album was done in blocks of time amongst other projects, notably the Peter Gabriel fall 1978 American and European tours which ran from August 1978 until the last week of December 1978, the Hall and Oates "X-Static" album sessions which ran in various blocks from January to May 1979, Ian Lloyd's "Goose Bumps" LP, the new Boz Scaggs album, and some assorted shorter session projects. So, rather than the continuous six months or so that I usually allow myself to write and record the Synergy works, things were broken up considerably. On listening to the album from the perspective of several months, I think that this fragmentary nature of recording has evidenced itself in the album not exhibiting a single "character", but rather each piece or group of pieces done in the same few weeks seem to have distinct characters - mini LPs if you will. Anyway, enough aesthetic rambling; you can make up your own minds on the artistic merit.

First of all, some basic notes on pre-production. It has been asked: Why no guitar synthesizer this time? The simple answer is that Russ Hamm's one finished prototype and Pete Sobel, the guitarist who had played this one and only accurate and usable pitch to voltage unit on the Synergy "Cords" LP (1978) were both located in Vancouver B. C. the entire time that Games was in production working on a guitar oriented rock band LP that Pete was producing. Since I don't play guitar very well and the Russ Hamm guitar synthesizer is "only" a control device (interpret "only" as you want) I chose not to pursue any guitar work on this album.

As for writing the album, 1978-79 was a very strange time artistically and I was exposed to many areas of music that someone who normally works with all-electronic music does not usually encounter. These included exposure to some prevalent pop and rock trends from which serious electronic music is usually insulated. The absurd popularity of these trends, and their unusual mass appeal seemed to say something about the state of western music in the late 1970's and an attempt to interpret and expand on these "forces" led to the piece Delta One. The piece is an electronic cultural mirror, not an embracing of pop music in the late '70's.

Delta Two came from an old collection of compositional "bits" left over from the first Synergy album in 1974-75. I had always liked the potential contained in some of these fragments, but I also realized that I was evolving away from them stylistically. The growing fragmentary approach Games was taking on meant that this might be the last opportunity to use these pieces. They were fashioned into the short piece that leads off the album.

Delta Three, as explained in the album liner notes, was begun in the extra time that I had during sound checks on the Peter Gabriel tour. Since my equipment was a bit more complex than the rest of the bands, I would generally arrive at sound checks (those pre-show afternoon rehearsals and equipment checkouts) before the rest of the group. Most days, all the equipment worked fine and I was left with an hour to work on

my own material until the others arrived. I kept a cassette 'record' of pieces in progress. When I returned home these were fashioned into the completed suite.

Delta Four and Delta 3/D were begun as learning experiments in digital synthesis at Bell Laboratories in Murray Hill, NJ (5 minutes from my house; home of the transistor, telstar, talkies, and other goodies). To make a long story too short: In early spring of 1978 as I was nearing completion of Cords and deep in the middle of Peter Gabriel's second solo LP, I recieved a call from David Bowie (an extraterrestrial rock singer / songwriter / innovator) saying that Brian Eno, who had worked on his most recent album, was not able to join him on an upcoming four month tour - could I do the tour? Due to my commitments, including Peter Gabriel's upcoming 1978 tour, I had to turn down the offer, but I did suggest that David call my friend Roger Powell who might have some time in his schedule. As it turned out, Roger was able to do the tour. However, one project that he had been working on was Hal Alles Bell Labs digital synthesis project in association with Greg Sims, who needed continued music world input for software development. In effect what happened is that we swapped; Roger took my Bowie tour and I began working, slowly, with Hal and Greg on digital synthesis. Delta Four and Three/D were culled from digital synthesis sequencer program experiments that Greg was working on in the winter of 1979.

"Notes on the Recording of Synergy's Cords" (Polyphony September/October 1978, Volume 4 Issue 2) covers most of the basic Synergy recording techniques in detail. In brief review, the creative process is carried out at home in the Synergy Studio - an MCI equipped one inch eight track electronic studio. The bulk of the equipment is Moog and Oberheim with the addition of a Sequential Circuits Prophet 5. The rest of the manufacturers are listed on the LP cover. Two of the most important additions made during the production of the album were ambience enhancement devices in the forms of an Eventide Harmonizer and a Delta-Lab DL-2 Acousticcomputer. As good as the patches created by any synthesizer programmer may be, there is only so much "life" that can be extracted from an inherently ambientless instrument. The Delta-Lab has a particularly good design for "room" feel by the use of variable EQ feedback loops, some multi-tap outputs and control of the phase and location of feedback loops. Delta encoding of the program information is also used rather than PCM, giving excellent specs - even at maximum delay times. Pre-Harmonizing the send to this device gives spacious and less 'electronic' sounding ambience. It is possible to simulate more of the real-world location cues included in real ambience: time delay, level, phase, and doppler cues. More can be done with these devices towards creating interesting and musically relevant sounds than the purchase of more and more conventional modules which reaches a point of diminishing returns surprisingly quickly. Later, in mixing, the use of a high quality digital echo (such as the EMT 250) or a carefully EQ'ed plate or chamber creates a wonderful space for carefully constructed ambient patches.

The Synergy Studio has dbx noise reduction on the eight track, which doesn't offend my ears as much as it does some other people. I would sooner lick the tape transfer nonlinearities. My dbxs are actually the Teac DX-8 add-on, modified so the automatic Dolby switching circuits in the MCI



can directly control the DX-8. The units are completely compatible with the dbx 216 studio system at House Of Music on the 24 track machines.

Once I have sufficiently bounced and edited myself into a corner on the 8 track to the point where I feel that the final realization of the music could become compromised, I make a tape transfer over to 2 inch 24 track at House of Music studios, where I have been working for the better part of the last decade. Synthesizers and necessary outboard equipment are moved to House of Music and remaining overdubs and all mixing are done there. The gory details of recording an all electronic album under studio conditions are not much different than home experimentation on a 1/4" 4 track, only more refined. The mechanics stay essentially the same. Of course, professionalism means much more attention to detail and

30 ips 1/4 track mix mastering with no noise reduction. The drastically improved high end response on a properly aligned and biased Studer A80 2 track with a very high recording level (elevated to a standard operating level of +9 VU) makes for one hot mix. It's almost a return to the heyday of the 1950's live to stereo recording, except with today's better tapes and heads. A nice last gasp for analog recording.

The computer use (Apple II) on Games is about the same as on Cords - a very rudimentary sequencer-editor. However, since the album I have been working on a simple interface scheme to allow the Prophet 5 to interface with the Paia 8700 and use its software packages as well as those 650X machine programs developed on the Apple. There is one interface board that has to be made to allow fooling the 8700 into thinking it is writing to a DAC and 5 Quash channels, and for the Prophet to



maintaining a high level of quality control and a degree of critical self-editing. But, this falls more into the realm of good production and engineering techniques and should apply to any album - not just electronic music (except that when the artist is also the producer and engineer, the self critique balance must be maintained especially well). I could list the equipment used in preparing the album but people make records, not equipment. It's the creative and decision making processes that make an album; intuition and experience direct that. I don't think I could put it into words, even if I tried. A clear conceptual view of your musical goals is probably more important than all of the technique tricks ever written down.

One interesting technique I used in mixing the album was

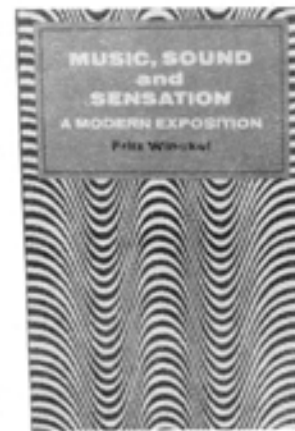
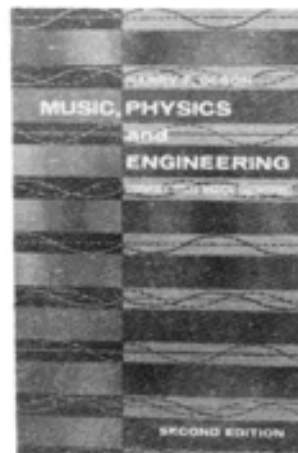
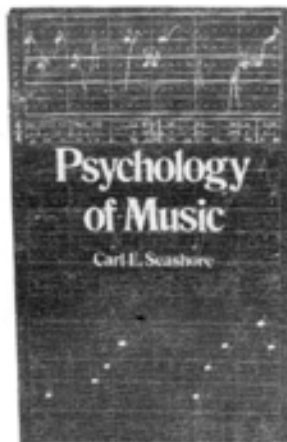
think it is just getting key closures. I tried to have it running for the Games sessions, but I didn't make it. It's almost done now though, and will be written up in a future article.

The Bell Synthesizer was written up in detail in the November 1977 issue (Volume 1 Number 4) of Computer Music Journal (published by People's Computer Company, Box E, 1263 El Camino Real, Menlo Park, CA 94025). My experience with the machine was the tip of one formidable iceberg - but a very exciting one. The machine is so general purpose that an incredible amount of software must be written just to set it up for a given task, but it is theoretically capable of so much. Time reduced what could be done to some small parts on Games (those two pieces seemed to take almost as much time as the rest of the album put together). Future refinements of what is musically relevant for 75% of most digital electronic music work will result in machines with far better setup time to musical time ratios at the expense of overall capabilities (such as performance vs modular analog machines). A first step in this evolution may be machines such as Peter Vogel's Fairlight CMI. As Peter Gabriel and I now have access to our own Fairlight (and have been using it on the forthcoming Peter Gabriel LP), I'll attempt to provide some additional insight on these ideas in a future article. My expectations are high, but there are still some very important limits to be considered.

One last comment - In the past I have always found it difficult to come up with titles for my pieces. They are born and executed as instrumental creations. To me they remain musical abstractions. In recording each album, I have always given them code numbers - Alphas for the first LP, Betas for the second, etc. but there has always been the request for titles. With the exception of Cords where Peter Gabriel helped me out with the titles, I have always cringed at hearing most of my awkward titles hung on those musical entities. This time I kept my Delta numbers. The numbers are assigned as each 8 track piece is begun, which explains the out of sequence numbering on the LP running order."/>



# POLYMART



The physical and Helmholtz's **Sens** physiological acou Test, provides an instruments. **Mu** synthesizer, is a instruments (plus like the Helmholtz

**#SENS** On The S  
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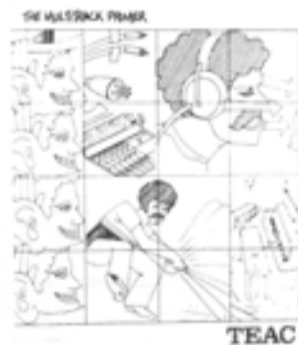
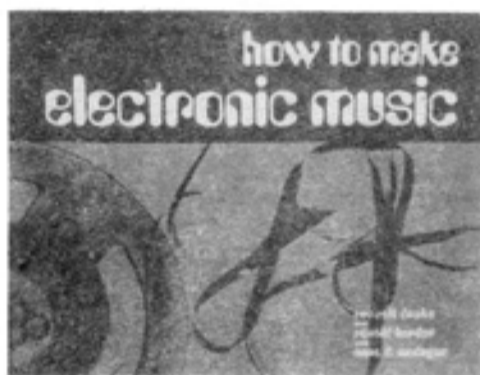


"The Craig Anderton Music Tape"



PolyMart offers tl symphonic synthe and **The Craig An** stack all the **Syn** denote issues in w

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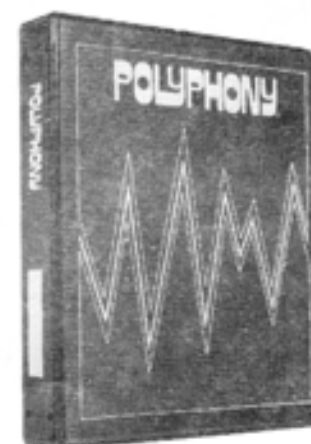
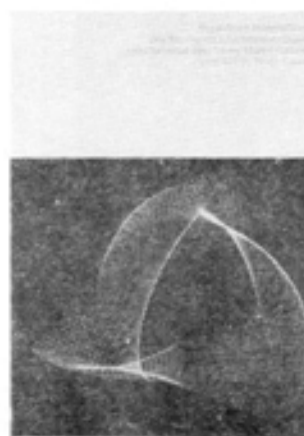
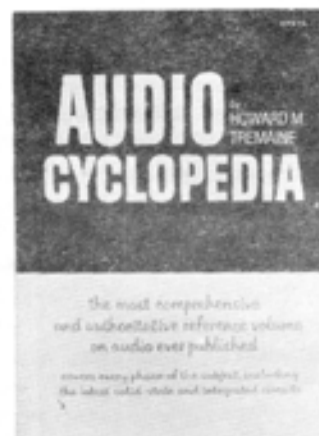
Synthesists must l books are a great v and Modugno is a s tape technique, co building, outfitting, computer control i **Home Recording** maximum results.

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**#BYTE** Byte Book



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**#OACB** Op-Amp C  
**#AFCB** Active Filte  
**#AUOA** Audio Op



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**#CYCLO** Auc  
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# Back Issues

The wide variety of practical applications and construction projects in past issues make a binder full of Polyphonys a frequently used reference to keep near your synthesizer, home studio, or workbench. Most back issues are still available for \$2 each ppd. Check the issues desired on this coupon and add the total to your PolyMart order (other side), or order by volume and issue numbers on the PolyMart form (0402, 0503, etc).

#0101: 1975: SOLD OUT

#0201: 1/76: glide footswitch, low-cost preamp, sequencer game, LFO trigger generator project, patches.

#0202: 2/76: SOLD OUT

#0203: 3/76: SOLD OUT

#0204: 4/76: music notation-timing, external inputs for Gnome, Programmable Drums, Equally Tempered D/A, low cost AR project, digitally encoding keyboards, patches, Vol. 1 & 2 index.

#0301: July 77: frequency divider project, random tone generator project, normalizing synthesizer controls, eliminating patch cords, computer control of analog modules, Chord Egg modification, adding pitch bending, patches.

#0302: November 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: February 78: computer controlled Gnome, using joysticks, build a bionic trumpet, octave controllers for bionic sax and trumpet, ultra-VCO modifications, voltage control the Mu-Tron Bi-Phase, oral joystick, patches.

#0304: April/May 78: Minimoog modifications, non-keyboard module use, phasing and flanging (theory and circuits), memory expansion for programmable drums, digitally addressed transposer project, polyphonic software (with software transient generators), patches, Vol. 3 index.

#0401: July/August 78: analog delay lines (theory and projects), composing for electronic music, note to frequency (and vice versa) conversions, build a trigger delay, software for computer composition, low cost VCO circuit, patches.

#0402: September/October 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.

#0403: November/December 78: multi-purpose keyboard software, Sohler keyboard and notation system, voice frequency to voltage converter project, proposals for tape exchange, VCA project, sequencer software- part two, frequency balancing in recording, Barton and Priscilla McLean.

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

#0501 May/June 79: using click tracks, PET music software, clockable sample/hold and noise source project, voice processing patches, VCF circuits, profile of John Cage, linear DAC.

#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.

#0503 September/October 79: SOLD OUT

#0504 November/December 79: SOLD OUT

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

## USING THE NEW CA3280

continued from page 15...

of the device but this can cut its useful life. I recommend the use of sockets because soldering irons do tend to accumulate a static charge.

### REFERENCES

- (1) Gary Bannister: "Experimenters Circuits: The CA3080"; Polyphony Nov/Dec 1978
- (2) Analog Devices: Nonlinear Circuits Handbook; Analog Devices 1974
- (3) Gary Bannister: "To Phase or Flange"; Polyphony April/May 1978
- (4) Gary Bannister: "Experimenters Circuits: VCF Building Blocks"; Polyphony May/June 1979
- (5) RCA: CA3280G, CA3280AG Dual Variable Operational Amplifiers; RCA File Number 1174.7

## Coping With Shattered Illusions

continued from page 11...

composer's reconciliation of the two by techniques explained in Examples 1-3, and finally to the performer's reconciling the live-acoustic with the tape illusion by his attention to the sonorous and organic qualities inherent in the work and by his performance-gestural attitude.

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### Discography

- Spirals, CRI (Composers Recordings, Inc.): American Contemporary Electronic Music, CRI SD 335. CRI: 170 W. 74th St., New York 10023.
- Dimensions II for Piano and Tape, The Sorcerer Revisited, Genesis (both electronic works). Orion Records, ORS 75192. Orion: 5840 Busch Drive, Malibu, CA 90265.
- Dimensions I for violin and tape: Advance Recordings: American Society of University Composers: from European-American Publishing Co., 195 Allenwood Rd., Clifton, New Jersey 07012.
- Dimensions II for Piano and Tape. David Burge, pianist. Composers Recordings, Inc. (above).
- Song of the Nahuatl (tape). Folkways FTS 33450. Folkways Recordings, 43 W. 61 St., New York 10023.7

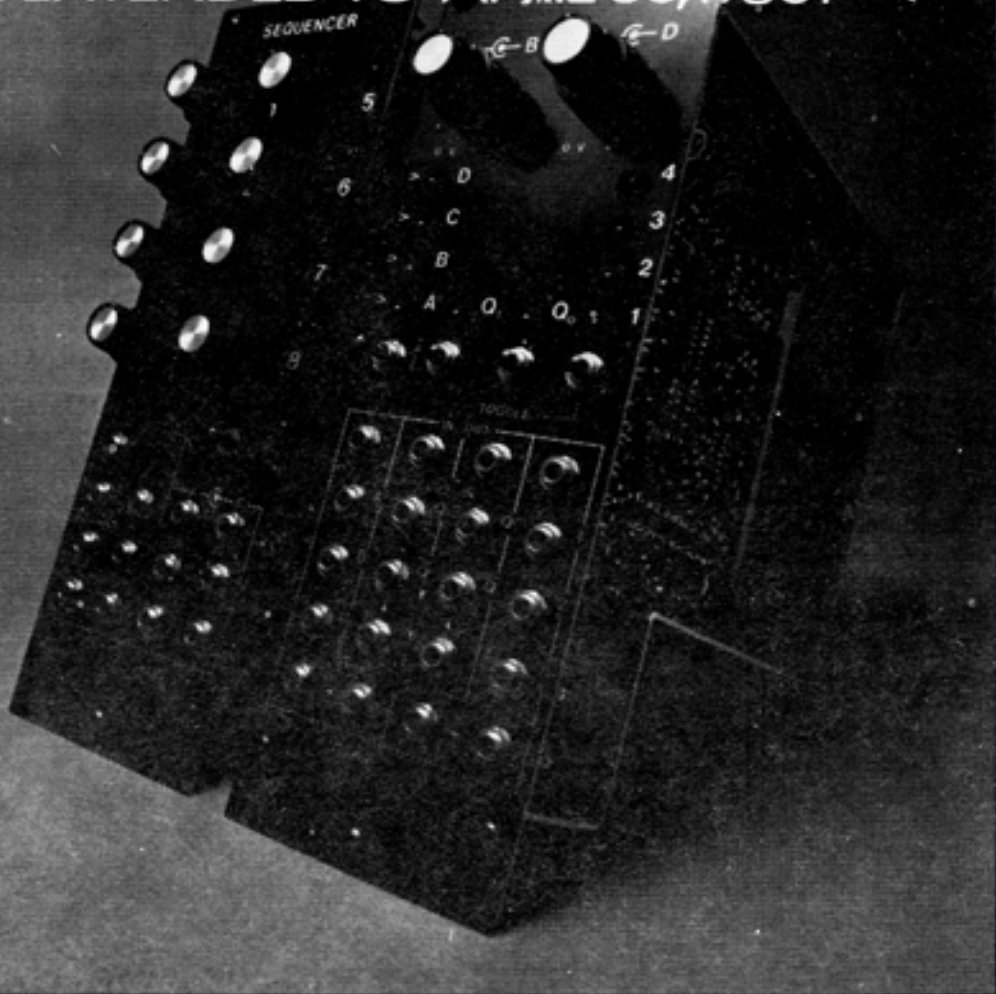
## INDUSTRY REPORT:

continued from page 7...

voice through a series of eleven voice character analysis filters. All of these filters are active and control an envelope follower which reacts according to the volume of that individual frequency. This information is then used to shape those frequencies of the carrier (musical) signal. The SVC-350 uses 10 filters for vowel sounds and there is also a filter that responds to the rapid transients of hard consonants, a feature not found even on higher priced units. The vocoder allows for both balanced and unbalanced program inputs and outputs, and contains a special guitar input that permits attenuation of the guitars harmonics. The SVC-350 Vocoder carries a list price of \$995. For more information, contact: RolandCorp US, 2401 Saybrook Ave., Los Angeles, CA 90040.7

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## Sequencer & Switches Contest

We at Aries Music are happy to announce our first contest, the subject being discovery of interesting uses for our new AR-334 Sequencer and AR-335 Switches modules. The AR-334 is a potentiometer-memory, 8-step by 2 row sequencer with position gate outputs along with reset and run, enable & step inputs.

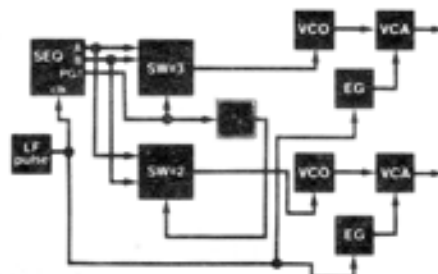
The AR-335 is a unique set of 4 bidirectional analog switches: 2 single pole, double throw (pulse controlled); 1 single pole, four throw (pulse controlled); and 1 single throw, four throw (voltage controlled).

Contestants will be asked to submit a block diagram for a patch which takes advantage of as many features of these modules as possible, while producing a musically interesting and useful result.

The twenty best patches and their descriptions will be published and sent to all of the entrants in the contest.

The five finalists will have their patches and descriptions published in *Polyphony*, whose readers will be invited to vote for the best patch. The winner will be able to select \$600 worth of Aries Music modules. (Which, coincidentally

enough, is the value of one each, Sequencer and Switches, assembled, or three modules in kit form.)



This patch produces a cyclical pattern of 32 notes.

The finalists will be selected by Bob Snowdale, president of Aries Music; Ron Rivera, designer of the modules; and Mark Styles and Ken Perrin, noted Boston area composers of electronic music.

So send today for the contest details, which will include the 47-page *Aries Music Owner's Manual Supplement* on the AR-334 and AR-335 modules. The contest entry deadline is January 31, 1980.



# ARIES MUSIC

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# HOME RECORDING

## RECORDING VOCALS

BY: CRAIG ANDERTON

For some reason, the idea of singing intimidates many people. This is unfortunate, because singing is a very natural act that requires no electricity, expensive equipment, or extensive training. While the results that occur when you first open your mouth to try singing may not be mind-boggling, with steady practice - and by paying attention to what you're doing - it is possible to develop a workable, if not excellent, vocal quality.

Recording vocals appears simple, but in reality getting a good vocal sound is quite difficult. In this column, we'll go over a bunch of tips that should help you get a good vocal sound on your tapes. However, before we get into that, we should really talk a little bit about voice generally, since unless you're happy with the way your voice sounds you probably won't have any great desire to record it.

### YES, ANYBODY CAN SING

I don't mean to imply that everyone can sound like Grammy awards material; but unless your vocal cords are physically damaged or you're tone deaf, you can sing. The trick is to find out the best context for your voice, and use your voice in that context as much as possible.

### STYLE COUNTS FOR MORE THAN TECHNIQUE

Consider these three singers: Bob Dylan, Mick Jagger, and Kenny Rodgers. None of these singers has a "textbook" voice; in fact, people have often compared Dylan's voice to the sound of a dog in heat stuck in a barbed wire fence. Mick Jagger has built a career upon one vocal style (versatility is certainly not his middle name). Kenny Rodgers has, at best, an average voice - and he'd probably be the first to admit it. But, he knows how to adapt that average voice to the material at hand, and how to throw in a few tricks that help give his voice a certain extra "something". Next time you think you can't sing, listen to these people and recognize that they are successful because they know how to use what they have, not because they have exceptional vocal qualities.

The point is to be yourself when you sing. Don't try to sound like some other singer or mimic another person's

style; people would almost always rather hear the original than a copy. If you have a good, strong voice that can put out all day and all night without ever getting sore, well that's just great. But Gerry Rafferty has had a number of rock hits based on a soft voice that is almost always doubled in order to make it appear stronger. So even if you don't sound like Robert Plant or something, don't get discouraged. After all, he can't sound like you but I don't think that bothers him in the least!

### BE RELAXED WHEN YOU SING

I was at a club the the other day where the band had two featured singers. One was a lead singer, while the other was primarily a guitar player who provided back-up vocals. It was interesting watching the differences between the two; the lead singer had excellent posture, and his singing - which was very forceful - appeared effortless. The guitarist, on the other hand, stuck his head out in order to reach the mike, and you could see that his neck muscles would tense every time he sang. The problem is it's not your neck muscles that produce sound; it's the motion of your diaphragm sending air through your vocal cords. The tenseness in the neck meant that energy which should have gone into singing was going into the wrong place.

I'm certainly no vocal coach, but I have found out a few things that really help when singing. Here they are:

1. When you're singing, lightly touch the sides of your neck with your hands from time to time. If there's tension, relax those muscles. You should note an immediate improvement in sound if you take the energy that went into your neck and transfer it to your lungs or solar plexus regions.

2. Visualize the process of air being collected in your body, propelled past your vocal cords, and being formed into words by your mouth. Think of this as a conductor of air, just like a wire is a conductor of electricity. Also recognize that one of your jobs is to eliminate any "resistors" in this conductor, so that the air flows as smoothly and efficiently as possible.

3. Pay attention to your posture. It's a cliché, but a straight spine and properly held shoulders allow your vocal system to work at peak efficiency.

4. Pay attention to your breathing. One of the best educations I ever got in breathing was when I saw the Who movie, "The Kids Are Alright". In it, much of the time Roger Daltry doesn't wear a shirt and you can see exactly when he inhales, and how much, in order to get a particular part of the song across. If your chest muscles aren't moving, then you're doing something wrong.

5. Don't blow your voice out. Like any mechanical device, your voice requires care. Don't strain it; don't sing louder than is comfortable (volume comes with practice, not by forcing); don't reach for pitches that strain your voice (again, practice extends your range better than anything else); and don't smoke or drink while singing ...in fact, you might as well do yourself a favor and don't smoke at all. Anything that dehydrates your body does nasty things to your vocal cords; whenever you sing, make sure there is a glass of water nearby to keep your vocal cords lubricated.

The above list is by no means complete, and it certainly doesn't substitute for professional coaching, but it should get you started in the right direction. By the way, should you elect to train with a vocal coach, be picky - make sure you train with a coach that feels comfortable with you. If you feel you're being forced to do things your voice doesn't want to do, or if your voice is sore after practicing, I'd advise looking for someone else.

### RECORDING YOUR VOICE

Now that we have some of those fundamentals out of the way, it's time to consider recording. Your first step is to warm up. Don't start blasting away immediately; work up to your level with some warm-up exercises, such as singing scales or something else that's relatively neutral. You are dealing with a physical/muscular process, and just as athletes warm up before a meet, you should warm up before you even think about plugging in your mic.

### WHICH TYPE OF MIC FOR YOU?

In most cases, condenser mics will give you a brighter sound, while dynamic mics will give a warmer, rounder sound. Since my voice tends to be a little lower in pitch than most, and since it isn't exceptionally strong, I favor a



# COMPOSER PROFILES



Joseph Byrd (b. 1937), composer-arranger-producer, is among the most talented and intelligent musicians on the scene today. His composition teachers comprise a formidable group including John Cage, Morton Feldman, Barney Childs, Richard Maxfield, and Carlos Chavez. In addition, Joseph also studied theory, musicology, folk and ethnic music, acoustics and perception psychology, audio engineering, and phonetics. Moreover, he received a Ford Foundation Fellowship in 1962 to study music and theater with Igor Stravinsky, Robert Craft, and John Crosby. Other grants include "The Social Roots of American Popular Music" (1976), and the production of "A Change of Tears: Social Reform and Sentimental Song in Jacksonian America" (1977). Joseph's formal education took place at the University of Arizona (Mus.B. 1959), Stanford University (M.A., 1960), and at UCLA, where he took doctoral studies from 1963 to 1966.

Aside from his 'scholarly' accomplishments, Joseph has performed with trumpeter 'Dizzy' Gillespie, singer Anita O'Day, done arranging for Don Ellis, Phil Ochs, Linda Ronstadt, and Ry Cooder. He organized the UCLA New Music Workshop (1964-66), has won many awards for innovative radio and television commercials, and has composed scores for experimental films. Furthermore, Joseph produced sound effects for "Close Encounters" and the "Star Trek" movie.



PHOTO: BARBARA SPARK

Joseph is probably known best for his albums. The first, The United States of America (1967), is contemporary with electronically innovative rock albums by the Beatles, Rolling Stones, Grateful Dead, and Frank Zappa's Mother's of Invention, and it pre-dates similar albums of the Velvet Underground and Pink Floyd by a few years. Joseph's group included the traditional rock instrumentation of voice, guitar, bass, and drums, plus electrified harpsichord and violin.

The USA album displays all of the trademarks of musical mastery due, at least in part, to Joseph's comprehensive formal training. It is an example of total-concept production

whereby individual tunes are not strung together, but rather related by musical motives, etc. The first and last songs, for instance, exhibit a philosophical attitude that pervades some of Joseph's later music: "The American Metaphysical Circus" (initial song) is ultimately followed by "The American Way of Life" (final song); this connection is enhanced by musical recurrences. In many respects "The American Metaphysical Circus" is a musical-philosophical exposition from which subsequent tunes proceed. Joseph establishes a vast timbral palate that includes piano, calliope, brass band, both natural and modulated voice, electronic and tape effects, in addition to standard rock sonorities. Compositional

techniques that are used in this album encompass several styles from the simple accompanied song to collage. Electronic effects frequently appear as recurring motives, both in the foreground and as accompaniment.

Joseph incorporates a variety of vocal effects that augment the affectiveness of the songs. Among the most striking are the gradual inclusion and elimination of ring modulation to the voice in "The American Metaphysical Circus", subtle synthesizer doubling of the voice in the "Cloud Song", use of electronic effects as a vocal accompaniment in "Garden of Earthly Delights", excessively filtered voice in "I Won't Leave My Wooden

Wife For You, Sugar" to give the effect of a distant voice—a technique also employed by Stockhausen in "Hymnen," a choral arrangement of the "Agnus Dei" followed by a strict two-part canon in "Where Is Yesterday," and distinct stereo separation of voices at the conclusion of "The American Way Of Life."

The compositional mastery of diverse musical styles progressively becomes more important in Joseph's later work, but it already emerges here in the aforementioned "Agnus Dei" segment, the collage portions of the initial and final songs, a Beatle-like use of strings in "Stranded In Time," and a lush string orchestra reminiscent of Hollywood films from the 1940's in "The American Way Of Life." The most salient



feature of Joseph's stylistic borrowings is that they intensify the overall musical effect, i.e. they are functional.

In his next album, The American Metaphysical Circus (1968), Joseph expands his use of diverse musical styles to embody vocal canons and drones in "Sub-Sylvian Litanies", elaborate choral-orchestral segments, rock, and Dixieland in "American Bed Music," gospel music and brass band in "Gospel Music For Abraham Ruddell Byrd III," culminating with choral, light-jazz, big band, rock, and collage in "Southwestern Geriatrics Arts & Crafts Festival." With the exception of "Gospel Music" all of these pieces are multi-sectional, thereby considerably longer than the songs on the first album.

The sociological and cultural commentary on the American life-style present in the USA album reappears in "Southwestern Geriatrics" as a distressing reflection on the reality of old age in contemporary society -- ranging from the much avoided thought of retirement to the pseudo-contentment of life at "leisure world". The conclusion of the piece, the groans of a man in pain, sums up the entire content of the song within a few seconds. Joseph's keen sense of timing in situations such as this is one of the prime reasons for the success of his music.

The next electronic albums recorded by Joseph were A Christmas Yet To Come (1975) and Yankee Transcendoodle (1976). Equipment used on both albums was an ARP 2600 synthesizer with an Oberheim Expander Module; the latter album also includes an Oberheim 4-voice polyphonic synthesizer. Both albums display tremendous technical knowledge interwoven with an acute understanding of all musical styles. A Christmas Yet To Come embraces a wide variety of seasonal songs--a fourteenth century German folk carol, a Spanish villancico, an organ prelude by Handel, a nineteenth century Ukrainian carol etc., as well as the popular "Silent Night," "Jingle Bells," etc. Joseph not only did much research to uncover such a wealth of music, but he also assimilated the stylistic traits of each historical period so that his arrangements are accurate realizations of the music; his Medieval and Baroque arrangements are especially convincing.

This is why the composer-arranger-synthesist must choose discriminately the timbres to be used, for each musical ear is characterized in part by specific instruments. Since Joseph is familiar with all types of music he is able to re-create the timbre of diverse, often obscure, musical instruments. In order to produce such realistic instrumental timbres Joseph applies his knowledge of acoustics and audio engineering--which far surpasses the information contained in typical patch charts. We will discuss briefly some of the main considerations that cultivate realistic instrument synthesis.

Appropriate waveforms and envelopes are obvious, but if you listen closely to the attack of acoustic instruments you will notice that it varies for individual instruments as the register is changed. This means that a single individual envelope generator will probably not be adequate if the pitch range of the instrument to be synthesized exceeds more than an octave or so. There are a few solutions to this problem. The first is simply to restrict the pitch range, although the limitations are evident. This solution may not be objectionable, however, if a multi-track recorder is used. A far better solution is to assign individual envelope generators to each register, and this is possible by employing the "SPLITZ" program by Bob Yannes (see POLYPHONY, Vol. IV, No. 2, Nov/Dec 1978: 13-17).

Filtering must also be taken into account and, like the envelope, overtone structures vary among different octaves and during individual envelopes--especially during attack and decay segments. Again, the "SHAZAM" program is useful; but it is also feasible to route the keyboard control voltage into a multiple so that each key activates both a VCO and a VCF. This way each pitch receives proportionately discrete filtering. Additional subtleties as voltage inversion, glide etc. help to enhance timbral authenticity in specific situations. It should also be mentioned that reverberation and equalization are valuable for this type of synthesis, especially the latter.

Yankee Transcendoodle, subtitled "Electronic Fantasies for Patriotic Synthesizer", contains numerous marches, hymns etc. by Sousa, George M. Cohan, William Billings, and Samuel Ward, among others. Perhaps the best description of this album is that which appears on its cover: "The sounds depict brass bands, calliopes, fifes and drums, Regina music boxes and Wurlitzer automatic organs, music hall orchestras and whorehouse pianos, a chorus of boy whistlers, jazz bands hot

and sweet, a Kentucky parlor on a warm afternoon in 1902, the bombardment of Fort McHenry in 1814, the Conquest of the American Wilderness, and a 15-year old girl cornetist in church on the Fourth of July." Joseph's extraordinary instrumental synthesis stems from his concern for minute detail, such as discrete use of vibrato, careful envelope assignment, subtle addition of brass pitch bends and trombone slides, along with coordinated shifts of register and timbre. He does not clutter his stylistically correct arrangements with unnecessary electronic effects, thereby heightening their impact when they do occur, as the bombing of Fort McHenry in "The Star Spangled Banner."

So far our discussion has centered around Joseph's commercially available albums, but he is also among the most creative composers for radio and television commercials and motion picture scores. Although some of the following examples are not electronic, their musical content, organization, and adaptability to specific situations merit their inclusion here. The "Cantata: To Radio" (1970) was written for the fiftieth anniversary of the National



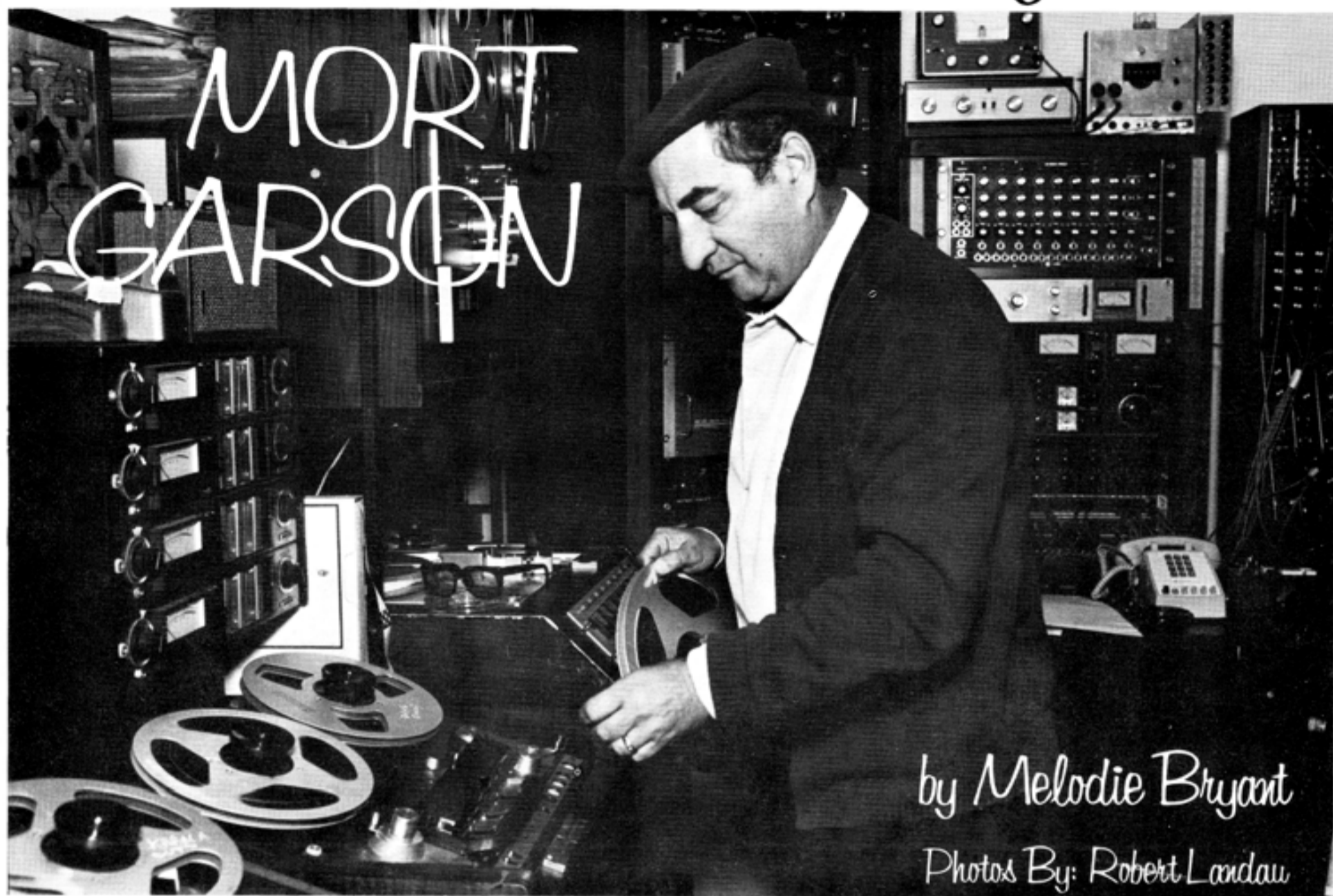
PHOTO: BARBARA SPARK

Association of Broadcasters, and it is a Baroque cantata complete with soloists, chorus, orchestra, and continuo. Another non-electronic work, "The Star Spangled Banner", was arranged for the approximate instrumentation of Handel's "Water Music", giving a refreshingly Baroque quality in contrast to the more common brass band versions. Joseph also incorporated the Baroque idiom for a CBS Executive Placement ad, broadcast in 1970 over WQXR-FM in New York city.

"The Death of the Dominant Seventh Chord" (1976) is a concert piece for slide trombone ensemble. It not only reflects Joseph's thorough comprehension of acoustics, but also his ability to derive worthwhile music from purely technical principles. His following description of this piece reveals the formative process through which it evolved. "The Death of the Dominant Seventh Chord refers to the most characteristic sequence of tonal harmony, namely V7 to I. By substituting the trombone's natural intonation for the piano's equal-tempered system, the character of the V7 chord, which is present throughout the piece, is qualitatively changed. It no longer appears dissonant, and requires neither resolution nor motion. The piece also may be interpreted as a political allegory."



# Pioneering Commercial Synthesis



by Melodie Bryant

Photos By: Robert Landau

Synthesist Mort Garson sits deep in concentration in front of his Moog, patching in sounds with an experienced hand. His movements are deft, a study in functional economy as is the room that surrounds him. A combination office/studio partitioned with baffles, it is here that he spends up to 16 hours a day composing, orchestrating and recording synthesized sound tracks for film and television. As he reaches for a knob with his right hand, his left hand gently depresses a key on the lower manual. Suddenly the little studio scintillates with the familiar sound of carbonated air bubbles rising to the surface. Garson leans back and smiles. It's business as usual at Patchcord Productions.

While the name Mort Garson is hardly a household word even among synthesizer players, if you ever saw Kentucky Fried Movie or a Safeway commercial; if you ever watched Untamed World - or any television at all for that matter - you have heard many of the sounds and music created by this synthesist. But Garson is not only one of the most hard working synthesists today; he also has the distinction of being one of the first. For it was with the 1967 release of his album "Zodiac" that the public was first introduced to the phenomenon of synthesized sound.

A classically trained musician, Garson had already had some success as a composer and producer in New York in the early '60s, where with his partner Bob Higgins, he co-wrote and co-produced hits for Ruby and the Romantics, the biggest one being "Our Day Will Come". But in spite of his success, he began to feel restless. "I remember at that time," says Garson whose speech still retains the traces of his New York days, "Everybody became a songwriter or singer. I had an office right in the heart of the city in one of the music buildings, and the kids used to come from school and start at the top floor and go to every office with songs. They wrote the lyrics right on their sleeves - here, Mr. Garson, here's my new song. Give me five bucks - and the things were making it," he says

with disgust. "I kept asking myself, is this what I went to Julliard for? I couldn't find a niche for myself." But in 1967, an event occurred which changed Garson's career forever. You might almost say that his niche found him.

"I came out to the west coast to do a movie and some albums for Doris Day around 1965. A couple of years after that, Jack Holtzman of Elektra Records approached me to do an album on the twelve signs of the zodiac. In those days, they were using twelve cuts to an album. It was a strictly dry cut thing: six sides, six sides. And the zodiac was ideal because it has twelve signs. He came over very excited about the idea. In fact, they were so excited about it that they did the album cover before I even did the music. And they put up a billboard on Sunset Strip - the first album billboard ever.

At that time I wasn't familiar with astrology, but I got into it, and I said hey, this would be a great idea for electronic music! I didn't know what I was talking about when I said that," says Garson with a smile. "In fact, the next day when I woke up, I was quite disturbed that I had opened my big mouth. I called up Jack right away and said, listen. And he said, I know what you're going to say. You're going to say, what about electronic music - he was a very astute guy. So he said, go to Mills College and see a guy there by the name of Buchla. He has a machine there. Get the machine and see what you can do. So I went to Mills, but this guy wouldn't let anybody use his equipment for commercial purposes. Since then, he's sold out to CBS for thousands of dollars - I was quite astonished. I guess everybody's got their price. But I wasn't allowed to fool around on the instrument or even listen to it back then. I just saw it. And when I came back, I started to conceive this idea which was quasi-electronic.

Well, Paul Beaver was very electronically oriented and he had a lot of instruments at his house. I used them all. That was the time when the big thing was the electronic harpsichord, and the Echoplex was just coming out. So I used a

flute player through the Echoplex - you wouldn't dare use it today although I still hear it occasionally. And I used Emil Richards who had all the exotic percussion instruments. Three percussionists, three keyboard players, guitar and drums. We had a narrator, so it was music with monologue. We did the album in three days and damn, it sounded pretty electronic!

And then - ta da! - they had the AES convention at the Roosevelt Hotel and somebody said, Hey Mort, you gotta go up there and look at this electronic synthesizer. Now the album was already done. All there was electronically on it was a sawtooth wave that Paul had put together, a couple of oscillators - very crude. But I utilized everything and got into it and saw how it worked. So I saw this instrument and met Moog for the first time and immediately said that's it!" says Garson snapping his fingers. "I said, you gotta come down to the studio and bring the prototype; so he did. Now, there were no holes on the album, but we put some whoops and whops on. And then I ordered one immediately. And then things started to happen."

"Zodiac", the first commercial LP to incorporate synthesized sounds, was followed a year later by another narrative album for A&M entitled "The Wizard Of Oz". Produced by Bernie Krause, whom Garson had met doing "Zodiac", "The Wizard" had a totally electronic soundtrack. "That was a real avant garde album," says Garson looking back. "It was so far ahead of its time. In fact, I was very surprised that A&M went for the idea because there was a lot of social commentary on it - never follow the yellow brick road - it'll lead you nowhere, you know? It was also the hardest album I ever did," he adds "Because I was just getting into it. I was really still learning. And I didn't have the equipment I have now; I didn't have a sequencer."

As time went on however, Garson's grasp on the instrument and its uses rapidly improved. His next electronic LP entitled "Black Mass" was an all instrumental synthesizer album based on occult themes. "I think electronic music matches the mystery of the occult," says Garson. "And I wanted to do an occult album because it was very big right then. But it's hard to do a strictly abstract electronic album; so I was looking for someone to do the liner notes. A witch came by, and some other people from the occult, and finally I found a professor at UCLA who had been cured by a healer. I had him write the liner notes for the subjects I wanted, and I wrote the music from the liner notes. It was an unusual way to go about it." The method worked however and "Black Mass", because of its haunting nature, has continued to be one of Garson's best sellers. That album was followed shortly after by two more electronic projects. "The Unexplained" was another occult album for RCA, and "Signs Of The Zodiac" was a twelve album package for A&M - the largest album project of its kind. In 1974, Garson's hard work was finally rewarded. The eerie synthesizer music he composed for "The Little Prince" won him a Grammy.

But long before "The Little Prince" had crowned his efforts with public recognition, Garson had already found his calling. "Things started to happen right after the "Zodiac" album," he says, "I don't know why. In fact, I got so busy with electronic music that I got out of conventional music altogether, even though I'd been in conventional music all my life. I got an NBC series - Untamed World - which I did the electronic scoring for. And some very enterprising agency people wanted commercials, so I got very busy at that."

Mort Garson, his head cocked intently to one side, stands in front of his two track tape machine listening. As the take up reel begins to turn, the thickly carpeted office is filled with a succession of familiar synthesized sound tracks. With each new track, Garson calls out the name of one sponsor after another: "AVCO ! Pacific Finance ! Yamaha !" To those not used to hearing commercial sound tracks without their accompanying TV visuals, listening to much of the music of Garson creates an uneasy feeling of *deja vu*, not unlike running into your dentist at a party without his white coat on. But to Garson, who has spent years mastering the microcosm of the 30 second spot, each track is unmistakable.

"Here's the Datsun Dali commercial," he announces over the distant sound of an approaching automobile. "You know that picture of Dali's in the desert with the clock? They got a car coming from the distance. I did the car sounds. We'd go out in the field and they'd record the car shifting, and all that was synthesized - because did you ever hear an outdoor field recording of a car? It's messy and dirty. So I did it all electronically, besides doing all the music. And here's one!" he exclaims to the faint drone of a motorcycle. "A guy from a big agency called up and said, I want you to do Flight Of The

Bumblebee sounding like a two-stroke motorcycle. Can you do it? I says, yeah! So here's how it came out." The theme is clearly recognizable, although without the visual image, it more resembles a bumblebee with indigestion. "And here's the title I did for the Cher show when she had all her laser sounds. There is no actual laser sound of course, but it sounded good. And as soon as I did it, everybody said, I want that sound! That one spot got me more commercials. I flew pizzas up in space - every product you can think of."

To avant garde synthesists, for whom the synthesizer was an exclusive tool just ten years ago, such an attitude may sound about as harmonious with the instruments uses as fingernails on a blackboard. Counters Garson, "I feel that anyone who really believes in avant garde music, more power to 'em. But I think when you write for pleasure and there are no limits on you, you're not really focusing on what is acceptable to reaching the audience: you're the only audience, and I think that is somewhat self-indulgent. I've always been commercially oriented," he adds, "I don't believe in making a point just for yourself or your friends - it's too restricted a communication. And communication runs parallel with commercialism. It's very easy to sit down and whip up a lot of very exotic sounds and bring your friends over and play it; but that isn't the reality we live with. The reality we live with is to present something and have it heard by the mass." Besides, he says, "There's a lot of creativity in my assignments. Because of the short structure - 3 seconds or a minute - that alone may be better than a large project. Believe it or not, the shorter the commercial, the longer it takes because you've really got to have impact: there's no time to waste."



And judging by his output, Garson doesn't waste any time. "It usually takes me between three to five days to do a commercial," he says. "First I lay it out on a Moviola and see where I want to fill it in, since I'm working with only 8 tracks. I put a 60 second sync pulse on track one, and a click track on number eight. That gives me six tracks to work with. Then I find out where I want the most tracks and work from that spot for eight measures or 15 feet or whatever. If I do a thing where it's conventional and electronic instruments, I'll do the electronics here and everything will be done to a click track and read off frame by frame. When I'm done with the eight track, I'll put it on a 24 track and put the orchestra on top of that."

As the tracks roll on, it is astounding the wealth of sounds created by one man. More astounding still however is the amount of equipment he uses for it: eight track, two track, and mono tape machines, a mixer, a Moog dual sequencer, a metronome click (for working with film), and one of the first production model Moogs to come off the assembly line - a machine whose perennial threat of pitch drift has caused Garson to refrain from switching it off for the entire 10 year span he has owned it. As he talks about his synthesizer, his affectionate attitude towards it, formed through so many years of shared musical experiences, is a bit reminiscent of how some people regard a spouse or a long time friend. There is a sort of (one assumes mutual) acceptance of each others quirks and idiosyncracies. Admits Garson, "This is a pretty old baby. If it has a model number, I don't know where it is."

There is some additional studio gear, also vintage. "This is the original Dolby," says Garson pointing to a black box. "I was the first guy to have Dolby in this town. I had to send

to London to Ray Dolby for it. Down there," he says motioning to the floor, "is a phaser and an old Fairchild unit. And that thing blinking up there," he says gesturing towards a plain metal box with one LED, "is a digital metronome. Its a prototype, but its really fantastic - better than the other ones. I've had it for quite a while. The guys never finished it. It was custom built for me by two math professors from UCLA and an engineer. I paid about \$3000 for it. It's put together with spit, but it works.



While Garson's equipment is far from primitive, his total inventory hardly compares to that of many synthesists these days, some of whom have been known to attend NAMM conventions in the same spirit that the rest of us go to after Christmas sales. But to Garson, his small studio is more than adequate. "I was asked to test the Yamaha synthesizer when it first came out, and it was a strange instrument for me. I knew right away that it wasn't getting the sounds I was getting. The word organ is anathema to a synthesist, but that's what it sounded like to me. I see something new sometimes, and I send away for a demo tape - there's so much flanging and digital delay and all that. But they're effects that don't become part of the music. I think probably the sound effects you can create without all that are better from a musical standpoint. And in all the things I hear, there's nothing that I'm not doing, so why should I spend \$25,000 on equipment?" Besides he adds, "If you're driving an old Mustang and it takes you where you want to go, you're not really interested in getting new cars."

Predictably, Garson has a dim view of many devices which are usually regarded by synthesists as handy technological tools - sequencers for instance. "It's so easy. A guy says, I want to do an album today, turns the sequencer on, goes out and after a couple of beers he comes back and the album's done. I wouldn't call that electronic music."



Nor does he have much use for polyphonics. "I don't think polyphonically electronically," says Garson, "I think monophonically. Sitting down at the organ and playing a chord just isn't the way to go for me. Once in a while, I make a couple of oscillators parallel. I do have an organ, but believe it or not, it's for avant garde arranging."

As someone who has been involved in the area of synthesis since its early beginnings, Garson has watched the growth of

electronic music and the number of its players explode within the past decade. What does he see as the biggest change?

"The overuse of it, actually. When I first got into it, when you said synthesizer, nobody really knew what you meant. Most people had a negative picture, unless they were very astute people. Then a couple of years later, there was a big surge of synthesizers. Everybody was doing it and doing it badly. I'd meet people who'd say, I'm in music. What do you play? I'm a synthesizer player. Didn't know anything about music - they started on the synthesizer. It was kind of weird, you know? Mostly it was people not involved in music - engineers or kids.

"I feel very strongly that it's a composer's medium. It's just an instrument, a tool for the composer. The composer has to control the tool. The problem is, if you're not a composer, the tool is controlling you. You're not creating the music, the machine is."

Garson is confident that synthesis has far from reached its sonic limitations. "I've done a lot of work. I've pumped out a lot of music - maybe more than anyone on the west coast. If I listen to my own music from the time I got into it to the present day, there are a lot of similarities. I feel like I still haven't explored the whole spectrum. Many times when I'm working on an assignment, I'll come up with something new, even though I know how to get in there and patch in and get a sound pretty fast. Because in conventional music, if you have two clarinets and a trumpet and you want to use that sound again, it's still going to be the same. But if I use a sawtooth and a square and a sine wave in some configuration and it sounds good and I want to come back to it, it will never be the same."\*

#### Selected Discography

|                              |                                      |
|------------------------------|--------------------------------------|
| Zodiac                       | (1967) Elektra EKL 4009              |
| Wozard of Iz                 | (1968) A&M SP4156                    |
| Black Mass                   | (1971) MCA-170 (formerly UNI #73111) |
| The Unexplained              | (1972) RCA APL-1217                  |
| Signs Of The Zodiac          | (1973) A&M SP4211, SP4222            |
| The Little Prince            | (1974) Pickwick PIP6813              |
| (Music from) Hair            | A&M SP4029                           |
| Plantasia (music for plants) | (1976) out of print                  |

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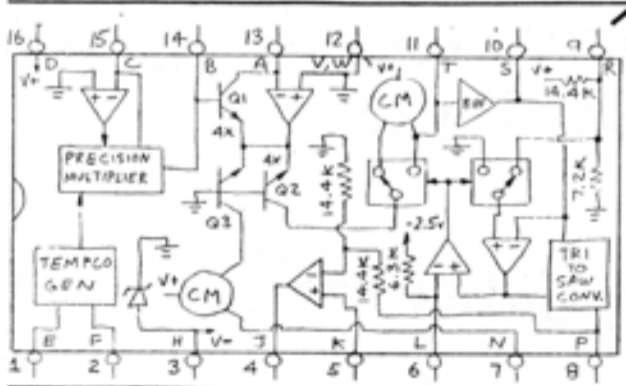
## EXPONENTIAL THE EASY WAY

BY: JOHN S. SIMONTON, JR.

I can't imagine anyone disagreeing with the statement that the pitch sources (VCOs) are the most critical part of any synthesizer. It's in pitch perception that human senses are most finely tuned.

For example, pitch changes are most usually expressed in "cents"; a cent being 1% of the interval between two adjacent semi-tones. At concert A, this calculates out to one cent being about .26 Hz. Most highly skilled musicians can recognize a 3 cent change in pitch or, at concert A, a little less than 1 cycle per second. Listen, this is the kind of accuracy that put men on the moon - and we're faced with the problem of reaching that resolution without going to NASA prices.

The easiest and most hassle free way that I've ever run into to do this is with a new chip produced by Curtis Electromusic Specialties, the CEM 3340 exponential VCO. In addition to being easy to use, it has all the bells and whistles that you would expect on a modern oscillator: exponential voltage control of frequency, triangle, ramp, and voltage controlled pulse output waveforms, linear FM control inputs, and hard and soft sync capabilities.



Inside the chip you find most of the things that you'd expect. The internal block diagram is shown in figure 1. One of the things that you wouldn't expect to find is internal temperature compensation. Every circuit designed to produce a linear to exponential conversion that I've ever seen was based on the non-linear voltage and current response of a forward biased diode junction. The only problem with this approach is that the response is extremely sensitive to temperature changes. Usually these changes are either eliminated by keeping the junction at an elevated controlled temperature or by cancelling the change

with a special resistor that displays a complementary temperature sensitivity, the infamous "Q81".

The Curtis chip uses neither of these approaches, yet internally compensates for these changes.

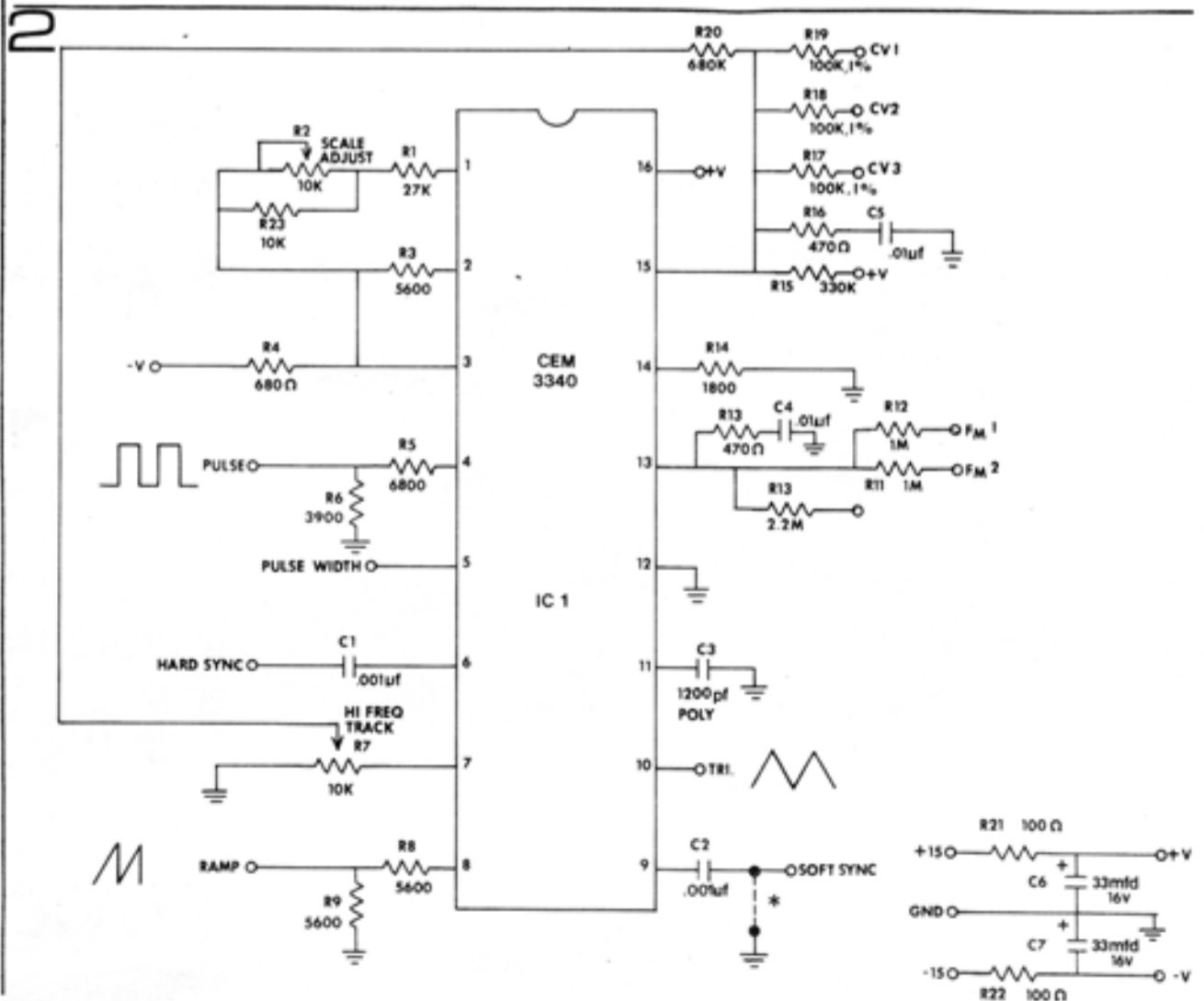
The ease with which the CEM 3340 can be applied is best illustrated by taking a look at the Paia EKx-40 experimenters kit, the schematic of which is depicted in figure 2. With the exception of the 3340 chip, the rest of the components are pretty garden variety stuff. There are three 1% resistors (R16, R17, and R18) so that individual trimming of the three exponential frequency control inputs isn't required, and a polystyrene capacitor as the timing capacitor (C3) because the extremely wide frequency response of the circuit requires absolute minimum leakage currents, but even those aren't what you would call really exotic parts.

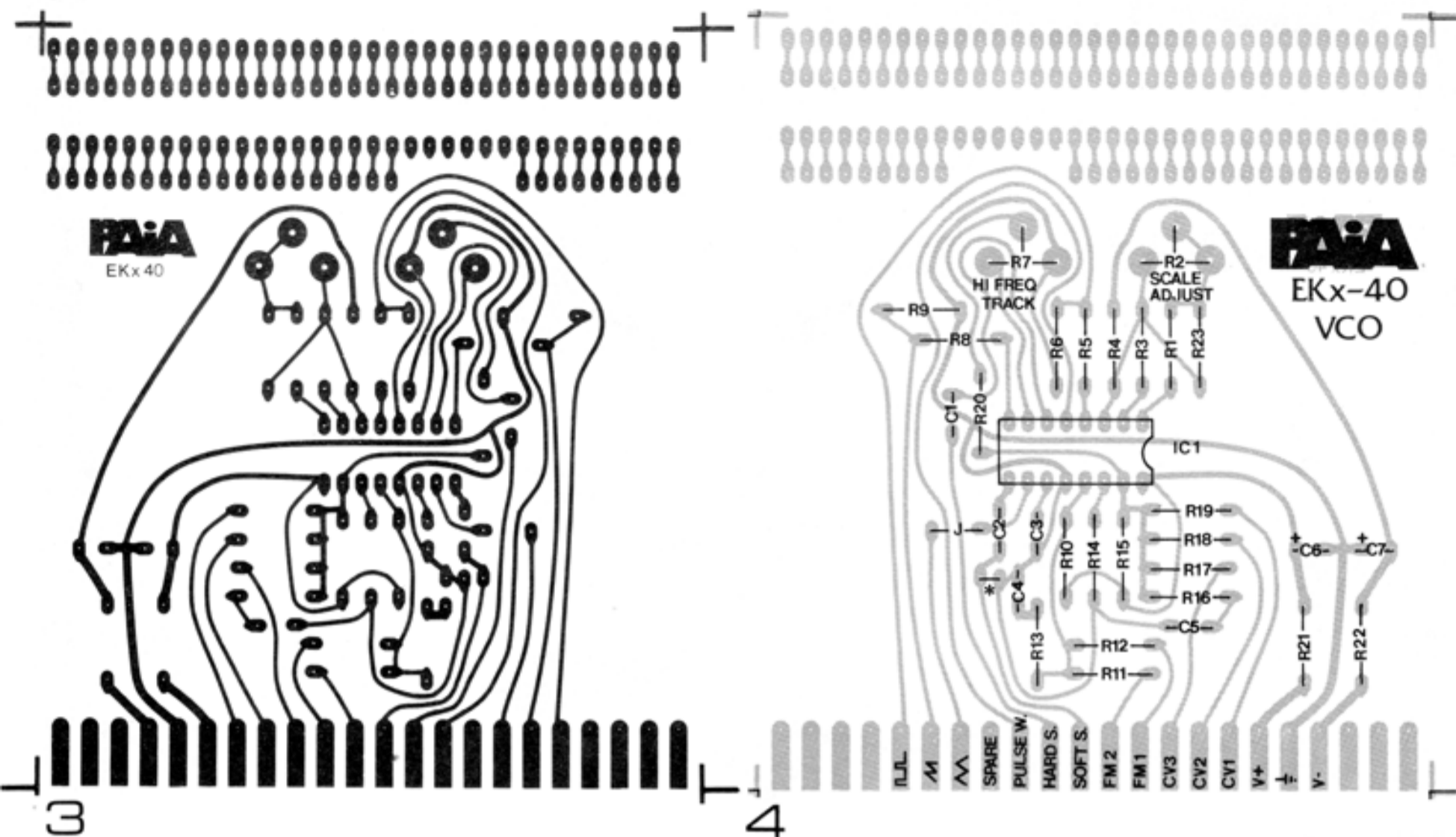
The circuit board layout for the EKx-40 and a parts placement diagram are

given in figures 3 and 4 respectively. Notice that all necessary inputs and outputs are routed to the edge connector pads. These connector fingers are on .156 inch spacing, so they are compatible either with standard 22 pin edge connectors (such as Radio Shack #276-1990, \$.69) or the more reliable (in my opinion, I know there are those who disagree) Molex connectors. Another couple of good points to mention are that only the middle 15 of the fingers are used so that seven are left over for customization; and, to allow for customizing, there is a good sized kluge area at the top of the board.

The EKx-40 has pretty impressive specs:

|                         |                                       |
|-------------------------|---------------------------------------|
| Power Requirement       | +15 volts @ 10 mA                     |
| Control Scale           | 1 volt/ octave                        |
| Chromatic Control Range | 0-10 v. @ worst case error of 5 cents |



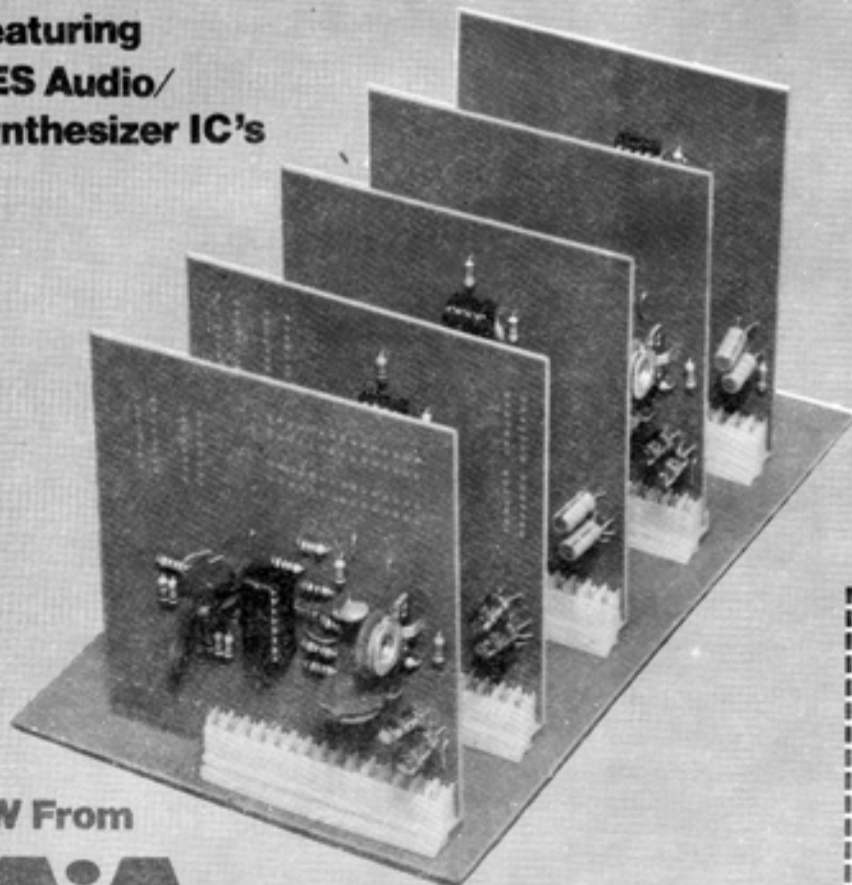


|                           |                  |                      |                       |                                   |                              |
|---------------------------|------------------|----------------------|-----------------------|-----------------------------------|------------------------------|
| Nominal 0 C.V. Frequency  | 10 Hz.           | Output Waveforms     | ramp, triangle, pulse | Minimum Driven Impedance          | 20K ohms (any output)        |
| Non-Chromatic Freq. Range | 0.2 Hz - 40 KHz. | Nominal Output Level | 5 v. peak to peak     | Nominal Pulse Width Control Range | 0-5v. for 0-100% duty factor |

continued on page 33...

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# EXPERIMENTER'S CIRCUITS

## ENVELOPE GENERATORS

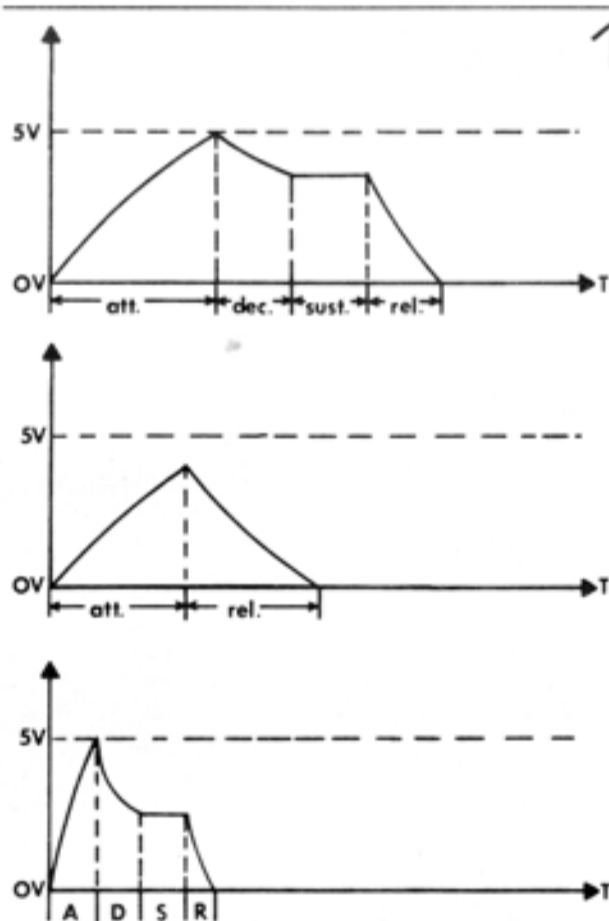
The circuits featured in this column were submitted by two of our readers. Neither was extensive enough to become a full feature article, but each has some unique features which we felt should be presented. So, since they both deal with envelope generators, we lumped them together for simultaneous publication in this column. We would like to do more of these "collection" type columns, so would be interested in getting all types of 'small' circuits from other readers. If you have a little circuit, accessory, or gadget you have designed or built, but feel is not 'earth-shattering' enough to write up into a full length feature for us, send it to us anyway. We can always find a way to fit it in somewhere. Chances are good that you will be helping someone find exactly the circuit they need for those odd-ball applications that always seem to avail themselves to synthesists.

Tim Lawrence, of Calgary, Alberta, sent us his design for a Logic Based ADSR. It was his interest to design a high quality, hassle free unit with a minimum parts count. By rethinking the basic operational modes of the device, he came to the conclusion that a solution lay somewhere in the realm of digital logic. The power for the circuit comes from a regulated +15 volt power supply, which is the main supply for his synthesizer. In short, the module works like this:

1. A step voltage from the keyboard is logic ANDed with the complementary output from an RS type Flip Flop. The flip flop is in the reset state, resulting in a high on pin 8 and a low on pin 11 (IC1). The ANDing of the trigger input and the flip flop causes pin 6 of IC1 to go to a high state, turning on a bilateral switch. The ON resistance of the switch is typically 80 ohms, thus a charge path for C1 is provided through R1. R1 controls the attack time, which technically is the time it takes for C1 to charge up to the trip voltage which will initiate the decay mode of the circuit.

2. When the voltage at pin 12 of IC3 reaches 7.5 volts, it is ANDed with the trigger voltage to set pin 11 of IC1 high and pin 8 of IC1 low. This enables the decay bilateral switch, while simultaneously disabling the attack bilateral switch. C1 will now discharge through R2 to a voltage level determined by R3.

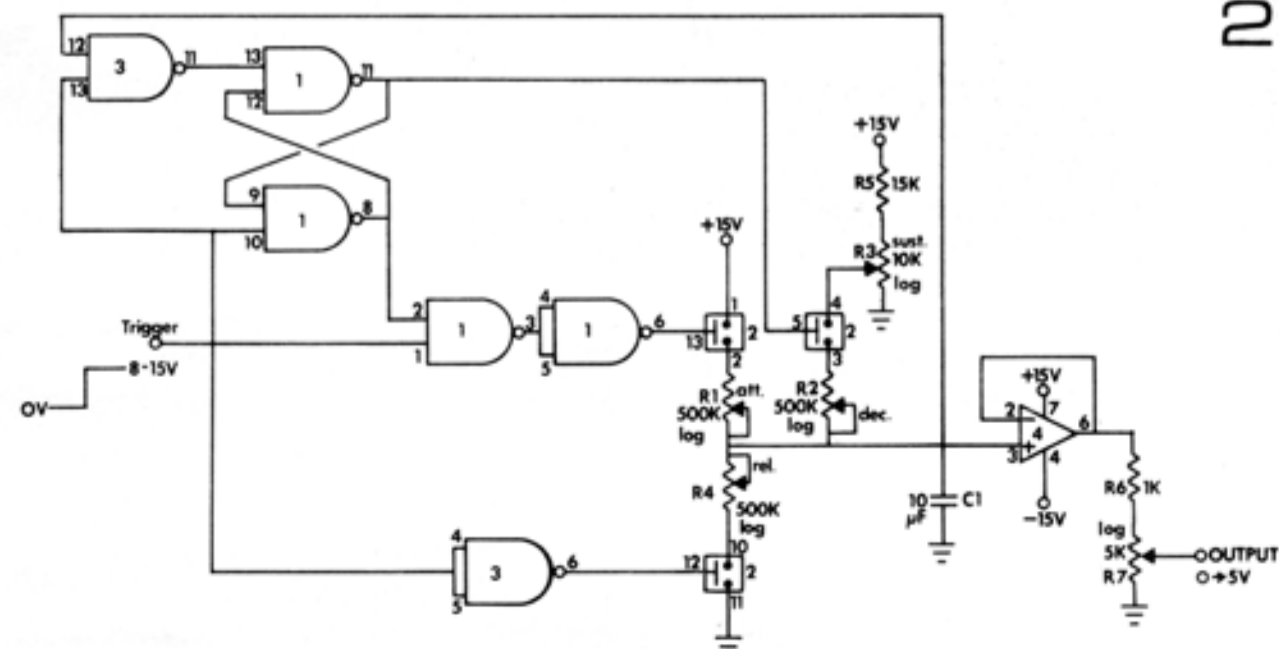
3. When the trigger voltage is removed, the RS flip flop is reset, disabling the decay bilateral switch. Now a high exists on pin 12 of IC2, enabling the release bilateral switch in order to provide a discharge path for C1 through R4. In this manner, the complete ADSR cycle is actualized.



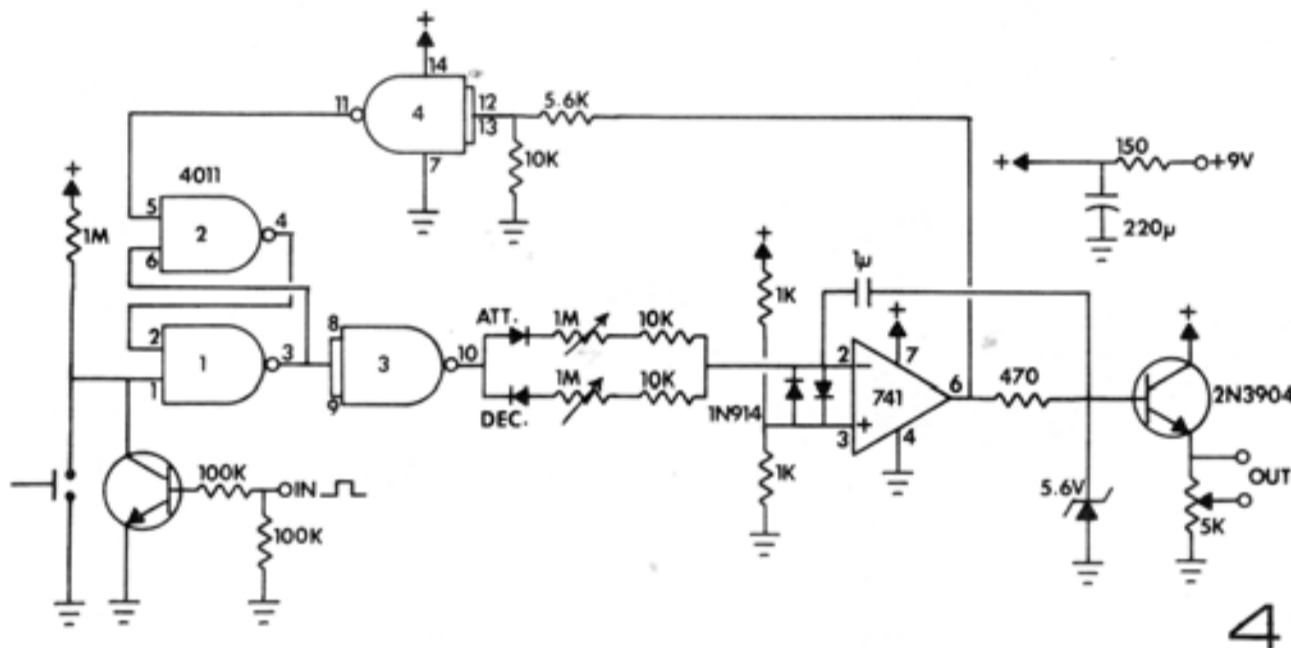
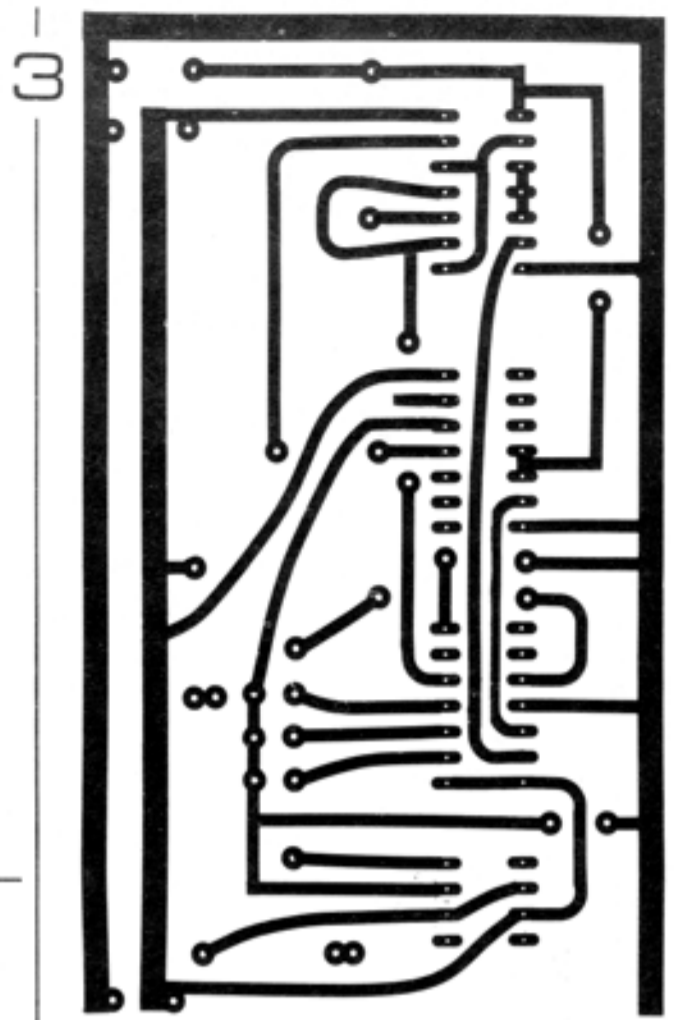
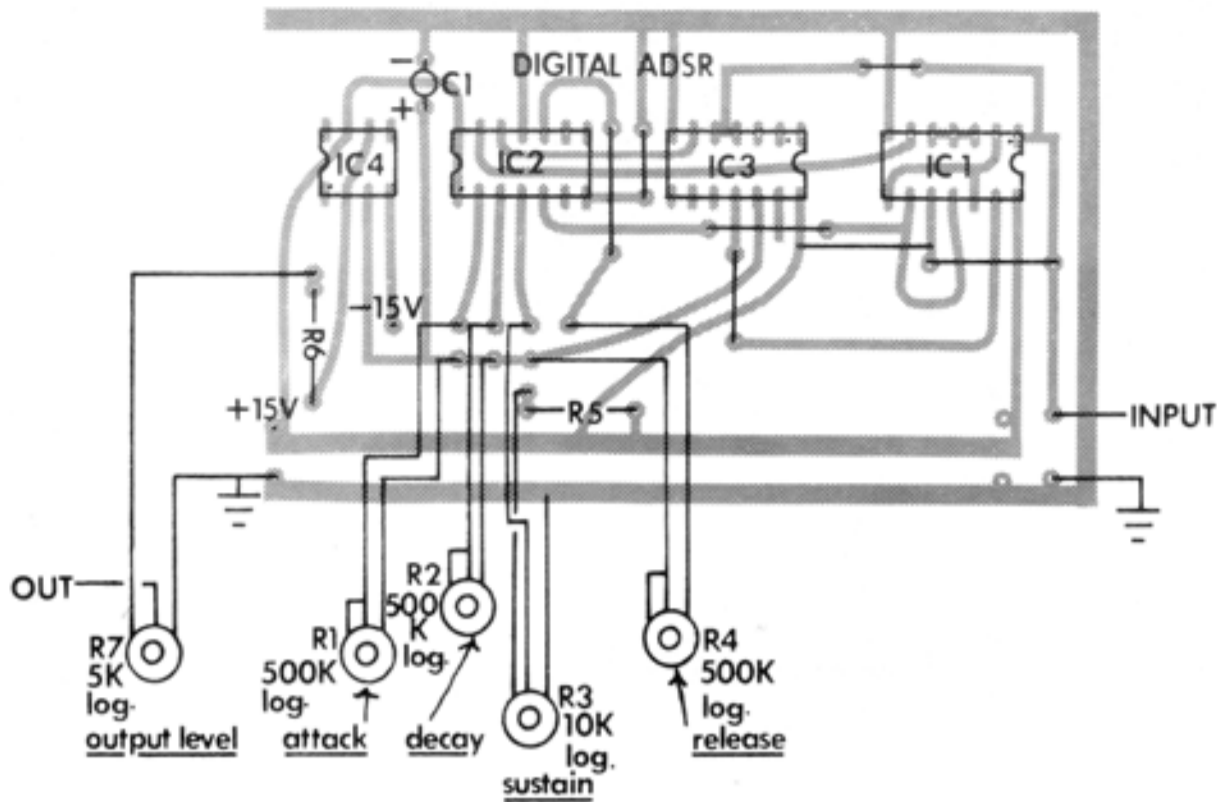
Now, if the trigger voltage is removed before the attack mode is complete, the logic throws the entire unit into the release mode, bypassing the decay and sustain sequences. See figure 1. IC4 serves as a high impedance buffer to the outside world, with R7 determining the level of the output voltage. NOTE: All potentiometers are logarithmic in order to facilitate good selectivity over the complete range of time constants available. The full schematic is shown in figure 2, with a circuit board layout and component placement depicted in figure 3.

The second envelope generator idea is from Bellotto Luciano of Chivasso, Italy. His idea is similar to our first in that logic circuits are used to save on components and size, but by designing around an active integrator circuit rather than the minimal RC design, linear ramping is generated during the timing sequences instead of the exponential ramping of the previous design. This type of circuit is less common in commercial equipment, but offers an entirely different type of sound - and can be used anywhere you use regular envelope generators.

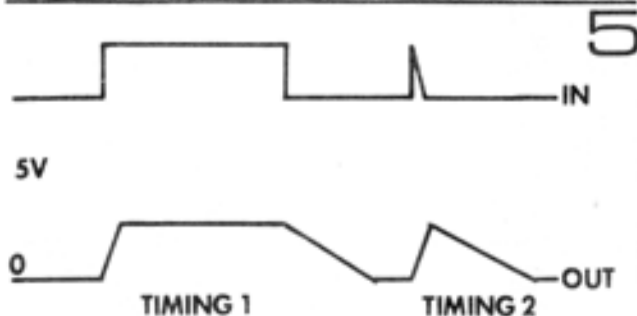
Gates 1 and 2 are cross coupled to operate as a set-reset flip flop as shown in the full schematic of figure 4. Gate 3 is configured as an inverter to drive the integrator through the front panel mounted timing pots. The output emitter follower, with its base to emitter drop, makes the output ramp







start from 0 volts. Gate 4 is easily triggered by the extra burst generated when the slope overcomes the zener voltage at the 741 output. The two diodes connected back to back at the integrator input eliminate any delay occurring from op-amp saturation conditions. The value of the 5.6K resistor driving the input of gate 4 can be varied to select for a full 5 volt output in "Timing 2" (see figure 5) mode of operation. The 100K pull-down resistor at the trigger input is required if capacitively coupled inputs are used (for pulse trigger derivation).



These circuits should provide easy projects for beginning music experi-

menters, as well as very functional modules for the active synthesist. Advanced experimenters should find it easy to meld the two designs to provide a full function ADSR with linear ramp outputs. Possibilities also exist for a switchable linear/ exponential ADSR. The low parts count for these projects and the minimal PC board real estate required should make these excellent candidates for quad or hex ADSR modules for use in polyphonic systems.

As always, Polyphony readers would be interested in hearing from other readers who expand on or modify these basic designs; also remember to send us other types of circuits you have developed - we'll use them in future Experimenters Circuits columns.7

## Send Us Your Ideas!

for projects, interviews, columns, reviews, or ...?... Polyphony can provide all the material you need; give us the raw ideas - we'll find people with info! Our increasing scope and space for coverage make Polyphony your #1 source of info on experimental music technique.

## EXPONENTIAL THE EASY WAY

continued from page 31...

There's nothing critical about building the EKx-40 with one exception - the board must be clean. After all, that .2 Hz - 40 KHz. range represents almost eighteen octaves and at the low end you are dealing with small charging currents (picoamps) into the timing capacitor. A board cleaned with a good quality resist removing solvent will assure that these small currents don't go anywhere but into the capacitor.

Calibration is covered in detail in the EKx-40 instructions. While the procedure must be done carefully for the same reasons that the board must be clean, it's not at all complicated. Essentially, the SCALE ADJUST trimmer is used to set the response of the oscillator for 1 volt/ octave at a relatively low frequency (2 KHz. and below) and the HI FREQ TRACK trimmer is then used to compensate for any sharpness or flatness of tuning at higher frequencies (10 KHz. to 15 KHz.).

If you're into exponential response equipment, or are thinking of heading that way, you'll have a hard time finding an easier or more economical way to start than the CEM 3340 or Paia's EKx-40.

The EKx-40 Exponential VCO experimenters kit is available from Paia Electronics, Inc., 1020 Wilshire Blvd., Oklahoma City, OK 73116 for \$29.95 + \$1.00 postage and handling. CEM 3340 VCO chips are also available separately; write for current pricing.7

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PAIA 4700 type system, includes (2)4720, 4730, (2)4710, 4740, 2720-4, 2720-1, 2720-5, 8780, 4771, (2)4770, 2720-11, (2)4761, and 8782. Also, Phlanger (no case). All exc. cond. and working. \$495 or offer. Bob Baker, 1661 Crest Rd., Cleveland Hts., OH 44121, 216-381-3326.

## DEVICE

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