POLYPHONY

JAN.-FEB.
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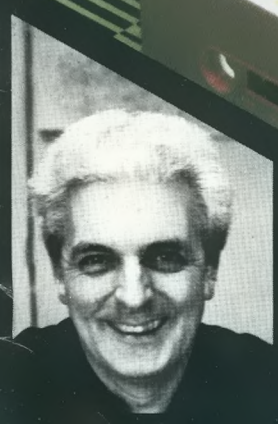
ELECTRONIC MUSIC & HOME RECORDING

ISSN: 0163-4534

handy Tape Timer included in this issue

CHIP POWER

SIMPLE VCA's



ROBERT MOOG INTERVIEW

THE ULTIMATE KEYBOARD

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

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

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

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

- **Simplicity; just play normally & record exactly what you play.**
- **2500 note capability, and 6 memory banks.**
- ***Built-in* micro-cassette deck for both sequence and program storage.**
- **Extensive editing & overdubbing facilities.**
- **Exact timing can be programmed, and an external clock can be used.**
- **Ability to change programs automatically in the sequence.**
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The Prophet-10 comes complete with a high quality flight case, two voltage pedals and two footswitches. It's now available; see your local dealer.

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EDITOR'S note

Recession? What recession?

If you just got laid off your job yesterday, then that might not seem funny at all. But hear me out - the subject of this month's "Editor's Note" is how you can make the most out of bad economic times, because there are always ways to turn obstacles into opportunities.

The conventional wisdom says that during times of economic hardship, the entertainment industry not only survives, but in some cases even prospers. The reasoning is that people need escape more than ever during hard times, and since they aren't going to be packing their bags for a European vacation, they'll end up going to the movies or buying a record instead. In fact, at a NAMM show two years I asked a number of companies if they feared the recession which, at least to me, seemed to be fast approaching (and which since then has come upon us in full force); the answer was almost universally "no", whereupon the company representative would say something about entertainment prospering during recessionary times.

But, conventional wisdom doesn't seem to be quite as accurate as it once was, and considering how many music companies have hit the skids recently, I don't think that we can take anything for granted any more. If we are to maintain our musical standard of living, we can't just assume that because entertainment did all right in the past, then it will do all right in the future: we're going to have to make a concentrated effort to keep financially afloat. Here are some ideas on how to cope with a recession and still maintain your musical jollies.

- **Do-It-Yourself.** Anything you can do yourself is going to save you money and increase your knowledge. Can't afford a spiffy new echo unit? Don't worry about it. Pick up a used tape recorder at a garage sale, spend a couple of bucks on some new heads, and you'll have a fine echo unit for a fraction of the cost of commercial equivalents. But you say you don't know how to add heads? Then get a Poly Paks assortment of 5 heads for $1 and experiment! Remember, you're dealing with a clunker tape recorder and it's doubtful that you'll make things worse. In fact, you might learn a whole lot in the process.

- **Make your subscription to Polyphony work for you.** Every issue has at least one modification or construction article...why not re-wire a friend's guitar, for example, and make a few bucks off of that endeavor? When times are bad musicians may not have the bucks to buy a new guitar, so they'd rather do what they can to improve the one they've got. You can be a part of those plans, and reap the rewards. You only have to do one or two modifications to make your subscription to Polyphony pay for itself. The only complication concerns taxes, since you are legally (and I feel morally) obligated to declare your income as well as collect sales taxes for the state. However, there are a number of books out on how to run a small business that should be of great help. Who knows? Your casual sideline could eventually turn into a steady job.

- **When you have money, put it back into the hands of other musicians.** I recently needed to have some work done on my car. Two mechanics were recommended to me, with equal skills and equipment. However, one managed a band and the other one did not...guess who got my business! And while you're at it, guess which one had a mixer that needing fixing and was willing to pay me to look at it?

- **Support musical events and endeavors run by musicians.** If at all possible, why not make a promise to yourself to buy at least one independently marketed record a month? The "Big 3" record companies may be crying the blues, but feisty little musician supported labels are doing better than ever...do what you can to help them along. You'll improve the lot of your fellow musicians and get turned on to some great new sounds in the process.

If there's a club in your area that is switching over to a policy of presenting live music, patronize the place; the next act they hire might be your band.

The important point about all this is that musicians live in a bit of a closed environment. For example, the guy who tests effects for the XYZ Effects Company takes his paycheck and buys a record...the artist who made the record takes the royalties and spends them on an XYZ Flanger. An astute Polyphony reader who's a friend of the musician offers to add the "XYZ Flanger Echo Mod" in an issue of Polyphony for a nominal fee; the reader takes the money and goes to a local club to catch the band; the band members get paid, and one of them, after hearing about a guy who modifies XYZ Flangers, gives our astute Polyphony reader another modification job; the reader then adds some more mods, writes it up for Polyphony, takes the money we pay him and buys some more records and parts, and so on...you get the idea.

I guess it comes down to the old saying that we had better hang together, or surely we'll all hang individually. There are ways to beat the "system" - all we have to do is stick together and support each other. Hopefully the world won't fall apart around us; but if it does, at least we'll go out playing our axes and humming a tune.

Craig

Craig Anderton

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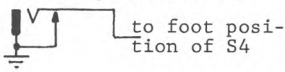
Letters

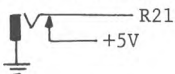
CORRECTIONS AND ADDITIONS

I noted some errors and would like to make some additional comments about the SuperController article, so here goes:

- S2 should not have a position going to ground; remove the line to ground right above C5.
- There is no C4, so if you've been looking for it, stop!
- By wiring the footswitch jack as shown below, you can eliminate the "on" position of S4.



- The gate jack should be wired as shown below:



- The resistor off of pins 5 and 6 of the 4001 should be R22, 100k.
- The 4001 should be labelled "each gate = 1/4 4001".
- C12 should be .01 uF, not
- Figure 3 should have the mode switch in the DELAY position.

Sorry for all these errors, I had so many revised schematics around that I didn't know if I was coming or going.

Also, here's a tip for the AMS-100 fans out there. When I first tried out the VCA/VCD module (DEVICE 1:8:79), there was an annoying buzz at all volume levels; it seemed to be due to leakage from the overdrive stage (IC2). So, I hooked up a DPDT switch with one pole wired as specified in the article. I then broke the connection between pin 6 of IC1 and C2, and installed the other half of the switch to these connections. Thus, in the VCA mode, IC2 and its associated circuitry is completely removed from the circuit. That simple change made my VCA/VCD work like a charm.

Thomas Henry
Iowa City, IA

MORE CHANGES

There are a couple of errors in my article, "Psycho-Acoustic Experiments", which should be mentioned.

Fig. 2a should show a connection between the 4730-2 output to VCA-2 input. Also, the empty box between the VCAs and the -3L should be labelled "REVERB".

Fig. 2b: The 4730 output going to the carrier input of the modulator should be labelled as LP (although BP also gives some nice effects).

Fig. 3 should show a 5V bias voltage into the CV input of the 4730.

Fig. 4: The last line of the isntructions should say: "Choose slowest rate of Sweep, minimum resonance/feedback and widest possible sweep".

Fig. 6: The inverter is controlled by the VARIABLE output of the ADSR-1. This was not labelled.

That's it for now.

Charles Lauria
Towaco, NJ 07082

MORE COMPUTERS!

Re Polyphony: I would like to suggest that you try to broaden its base, away from (without neglecting) the experimenter, to other aspects. My own interest in the electronics is strictly pragmatic: I'd rather make music than fiddle with a breadboard.

Incidentally, I'd like to see some stuff on music applications for computers, if you can round something up. Also, something on a double keyboard polyphonic synthesizer, with individually tunable keys (commercial gear with those capabilities cost many kilobucks).

Rev. Jones
Groton, CT

HELP!

I have an encoded PAIA keyboard (with D/A and Quash), and a TRS-80 I'd like to interface with my synthesizer. However, I lack enough knowledge to devise my own machine language program to interface the two. Can any reader help me in obtaining an interfacing schematic and an interrupt routine to refresh the Quash for a TRS-80 Level II microcomputer?

Michael D. Buck
4159 Commonwealth
Toledo, OH 43612
(419) 478-4088

POT VALUES

In the July/August issue, there's the schematic for an Analog Programmer. My question is, what size pots does one use? I'm new to all this and found no reference to their values; can you help me out?

Joel Graham

Joel - Sure. You can use anything from 50k to 500k linear taper pots, with 100k linear being the preferred value.

DATA BOOKS NOT EXTINCT

I'm writing in regards to Marc Briand's letter (July/August issue), where he asked about obtaining data books. In my most recent issue of Electronic Design, National advertises the Linear Data Book as being available for $9.00 from National Semiconductor, PO Box 70818, Sunnyvale, CA 94086. Delivery takes 4-6 weeks, and Californians need to include appropriate sales taxes. Write them for information on what other books are available.

Greg Vizzi
Belle Vernon, PA 15012

IS NEW ALWAYS BETTER?

I'd like to mention a few things I've often considered when reading your magazine, and which might interest your readers. One thing that is plain for all to see about electronic music is that it is tremendously expanding. This is brought about by its intimate relationship with technology. In fact, for people like myself electronic music is attractive for both its musical and scientific aspects. But one thing that is disturbing is the intoxicating novelty of the new instruments which are constantly making their predecessors "obsolete". The natural tendency for all of us is to forget that synthesizers, like most other instruments, have a potential that is primarily limited by the performer's creativity. Often I have been dissatisfied with my own creative abilities, but blamed it on the limitations of my electronic equipment. It takes listening to the music of a real master to make me realize where the fault lies. Now of course this is a difficult idea to reckon with; what are all the factors involved? It is certainly not true that all those who use a great deal of technical resources are using them to compensate for their own inadequacies; but it is true that in many cases these resources are grossly underused. The tremendous capability of electronic instruments for musical subtlety is too often abandoned in favor of the more dramatic novelty of "the sound that no one has heard before". This is of course more evident in popular music, but I think we've all fallen into the trap at one time or another. We should always think twice, if not thrice, when we find ourselves thinking "if only I had that piece of equipment". One must always decide whether the cycle isn't simply going to go on indefinitely.

This cycle is not only a bad excuse for one's limitations, but an instrument that is constantly changing (even if it is expanding) can be a serious detriment to the expression of one's creativity. In short, I think we could all benefit from firm restraint and self-evaluation when dealing with any form of self-expression, and especially from an awareness of our own limitations. This is something that everyone must consider carefully on an individual basis.

I think that about takes care of that, except that I have also enclosed money for the renewal of my subscription to Polyphony, and that I am grateful for its existence.

David Dana
Horseheads, NY

PA INFORMATION

Jim Falwero's letter in the Sept/Oct issue expressed his grief on his P.A. problems. I wish to recommend The P.A. Bible from Electro-Voice, and a series of supplements to the main pamphlet. This covers everything he needs to know to have a basic working knowledge of P.A. use. Write Electro-Voice for more info at 660 Cecil Street, Buchanan, MI 49107. Also, Recording Engineer/Producer has regular articles on concert sound reinforcement.

Rich Moroni
Chicago, IL

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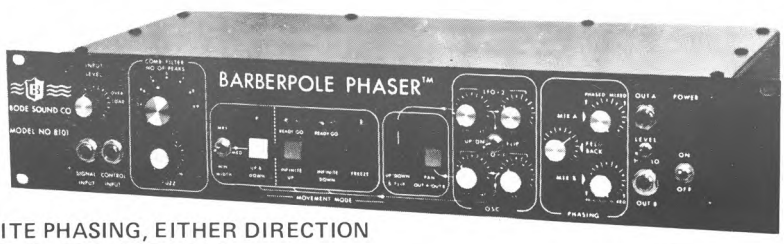

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CHIP POWER

by Jack Orman

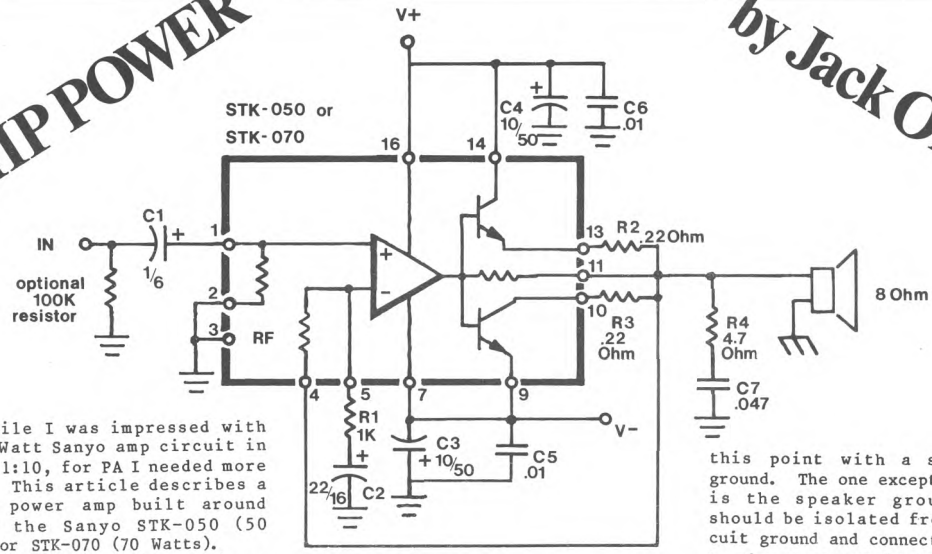


Fig.1

While I was impressed with the 25 Watt Sanyo amp circuit in DEVICE 1:10, for PA I needed more power. This article describes a higher power amp built around either the Sanyo STK-050 (50 Watts) or STK-070 (70 Watts).

How it works. Figure 1 is an amp circuit that can use either the STK-050 or -070 (the only difference is supply voltage). The signal AC couples through C1 to pin 1, the non-inverting input. An internal resistor from this pin to ground sets the input impedance at about 30k Ohms. Pin 5 is the inverting input; R1 and C1 connect from this pin to ground to form part of a feedback loop which sets the amount of gain. An internal 29k resistor (Rf) is available at pin 4 to complete the loop, or it can be left unconnected and an external resistor used in conjunction with pin 5. Using the formula for the gain of a non-inverting amp, Av = 1 + (Rf/R1), for R1 = 1k and the internal resistor = 29k the gain is 30 (this allows a signal of about 1V rms to drive the amp to full power). Pins 10 and 13 are connected to the chip's power transistors and should be tied to the output through 0.22 Ohm, 2 Watt resistors.

Power supplies. Pin numbers for both chips are the same and only the power supply voltage differs. The STK-050 needs ±35V and the STK-070, ±42V. Figures 2 and 3 show power supply designs for the chips. For the ±35V supply, make up a 50V center-tapped transformer from two commonly available 25V models (Radio Shack #273-1512 or equivalent). The secondaries must be properly phased to generate the correct output voltage; if the output voltage of the supply is much lower than expected, reverse the connections of one of the transformer's secondary wiring. Either of the power supplies should be fused with a 3.5A, fast-blo fuse.

Grounding. Pin 3 is the circuit ground, and all of the grounded components should tie to this point with a single-wire ground. The one exception to this is the speaker ground, which should be isolated from the circuit ground and connected directly to the power supply ground. When I first built this circuit, I had the speaker ground tied to the circuit ground. The resulting high frequency oscillation caused the chip to overheat, and while the internal protection circuitry prevented any damage, the clipping distortion was severe. Once the speaker ground was returned directly to the power supply, the oscillations ceased, the chip cooled down, and the distortion stopped.

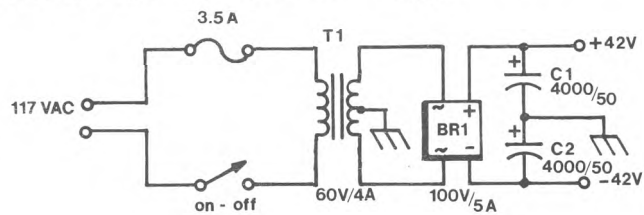


Fig.3

Heat sinking. Make sure that you coat the metal back of the power amp chip with heat sink grease and mount it in firm contact with the metal chassis or other appropriate heat sink. These chips, because of the extra power generated, run slightly hotter than the STK-054 or -56 but nevertheless you should be able to hold your hand on the case while the amp is in operation without discomfort.

I found these amps to be clean sounding and every bit as powerful as rated. At present I am using the 70 Watt chip to drive part of my PA system, with excellent results. ♯

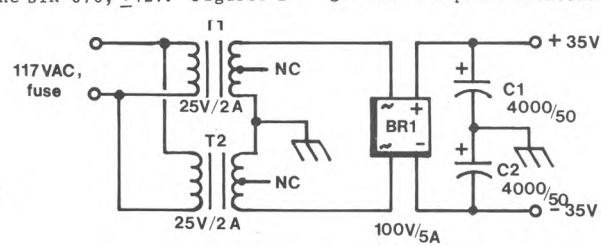


Fig.2

CHIP POWER

PARTS LIST

Power Amp (Fig. 1)

R1	1k, 1/2 W, 10%
R2, R3	0.22 Ohm, 2W
R4	4.7 Ohm, 1/4W
C1	1 uF, 6V min
C2	22 uF, 16V min
C3, C4	10 uF, 50V min
C5, C6	0.01 ceramic disc
C7	0.047 ceramic disc

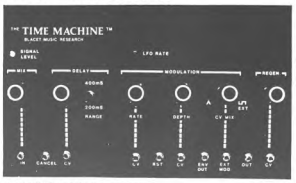
±35V Power Supply (Fig. 2)

T1, T2	25V, 2A (Radio Shack 273-1512)
BR1	Bridge rectifier, 100V, 5A min
C1, C2	4000 uF, 50V min

±42V Power Supply (Fig. 3)

T1	60V, 4A center tapped (Triad F-281U)
BR1	100V, 5A min
C1, C2	4000 uF, 50V min

SOUND DELIGHTS



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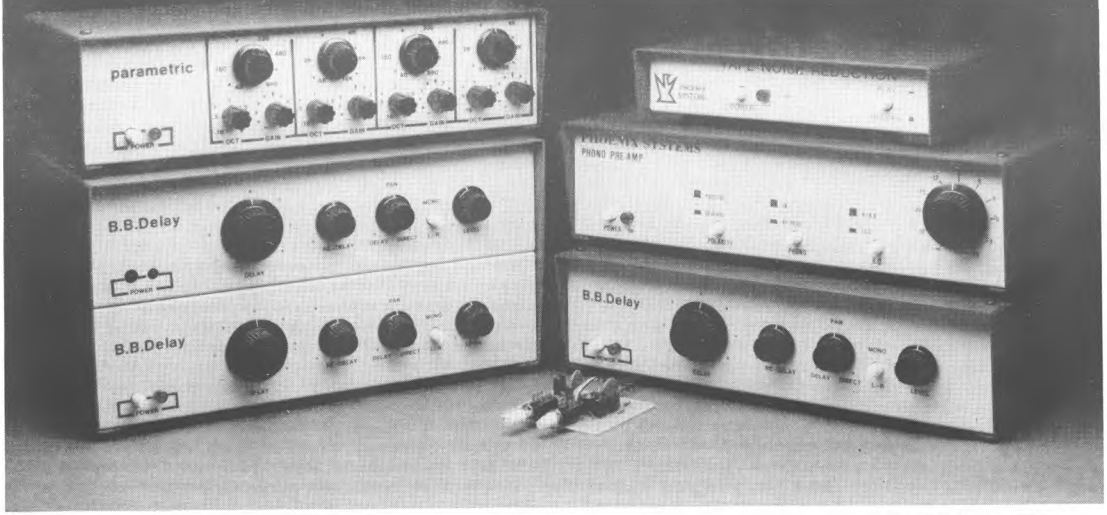

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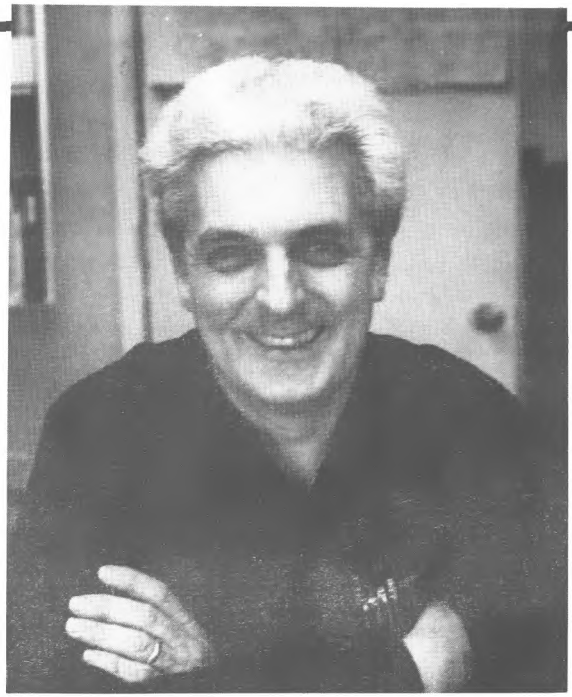
What more can be said about Bob Moog that hasn't been said already? The inventor of it all, the man who started the revolution, etc. But what can be said for the man is his incredible humility, and his almost puzzling lack of understanding of what he has contributed to the electronic musical scene. I've known Bob for eight years now, and without question he is the most mystical man I've ever come across - and yet at the same time, the most straightforward. The first time I met him he walked into my apartment with his wife Shirley, sat down and listened to some music, ate some quiche, listened to some tapes and said "Gee, that sounds like good s--t". Then he looked over my E-mu system and said "My God, all those attenuators. My, how times have changed". That was about it.

Bob is truly a remarkable human being, as well as a remarkable engineer. Whether or not he was the first to come up with the synthesizer concept or not is totally irrelevant - Bob Moog stands alone. He is a man to be admired, and I hope this interview portrays that.



By: JAY LEE

INTERVIEW: ROBERT MOOG

Jay Lee: What was your first electronic music project, and did it work?

Robert Moog: Well, I haven't thought about that one for a long time...I really can't remember what the first project was, I was just too young. My father, in his early days, was one of the first radio amateurs. Even when I was a kid, he was experimenting with very simple electronics. He used to like to fix radios and build this and build that. I can remember building a one tube, battery-operated radio - just a detector and amp circuit - and building a two tube radio that actually developed enough volume to drive a loudspeaker. I guess I was about eight or nine years old at the time when I did those projects with my father.

By the time I was a teenager, I had eased into working by myself and could open up Radio News or Popular Electronics to build something out of there for myself. Just about everything I built worked sooner or later, but I can't remember anything I ever built that worked right off.

JL: When you first were getting started, you designed and marketed everything from tape recorders to oscillators. What was your philosophy behind this?

RM: Our philosophy was that we saw ourselves as suppliers to electronic music studios. For the same reasons that the Columbia-Princeton electronic music center resorted to making their own consoles, microphone preamplifiers, frequency shifters, ring modulators, and so on in the 50s, I went to work making tape recorders as well as oscillators in the late 60s. Up until about 1968, our clients were the electronic music studios and universities. Most of them couldn't afford to buy an Ampex 8 track recorder, and there was no such thing as a 4 track recorder on quarter-inch tape that you could just buy at your local hi-fi store. At that time, a four channel tape recorder head was something very special; you had to special order it, and a reasonably priced deck with solenoid controls was also something special. Putting that kind of capability along with sel-sync was unique at that time. In the late 60s, someone who wanted to set up a small studio with a 4 channel tape recorder could not do it at the price we were charging - around $1500 - with anybody's equipment but ours. That's why we designed a multi-track tape recorder. Nobody else was building an affordable tape recorder that was suitable for multi-track tape work. It's hard to imagine all that now considering that Teac's been selling 4 tracks for 10 years. Now you can get 8 tracks on quarter inch and Portastudios with 4 tracks on a cassette, and everybody around the world is into putting together music on tape. This was not the case from 1965 to 1970.

JL: What about mixing consoles?

RM: When it came to mixers, you couldn't get a simple mixing console, suitable for electronic music composition, where you could mix down into four output channels and continuously control the amount of a given input in any of the four channels. Columbia-Princeton had mixers like this, but they made them themselves. The mixers we made had a matrix of attenuators, where the inputs were columns of the matrix and the outputs were the rows, and you could mix any amount of input into any of the four outputs.

So that's why we made tape recorders, mixers, and things like power oscillators to change tape speed. You couldn't buy anything like that for less than twice or three times what we were charging. As a result, we designed and installed a great many packages - what are today called "turnkey" systems. The first one was delivered to the University of Buffalo. For $25,000 we equipped the whole studio, starting with the bare room. We eventually acquired a Scully dealership and then equipped a dozen, maybe two dozen, university studios from the ground up. About the only thing we didn't supply was the furniture.

JL: What do you consider to be your most important breakthrough in synthesizer design?

RM: (Long pause) You know, there was no "breakthrough". I guess technically the most notable thing I did was the voltage controlled filter. But I think that the most important thing I did in the late 60s was put all the elements of a system together. The ideas of control voltage, of an exponential relationship between the control voltage and frequency, of keyboard control, of a ribbon controller, of modular organization with compatible signal levels, the idea of putting it all in a box with a handle so that you could carry it around, were all new. I spent endless months and years talking to musicians, giving little lectures, showing musicians how to use this stuff, removing all the obstacles that musicians had to applying electronics to composition. Sometimes a person's contribution is not a single, striking invention, sometimes it's just putting it all neatly in a box. I think that was my contribution at the time.

JL: Who purchased the first Moog, and what's the story behind it?

RM: The person who purchased the first Moog is different form the person who has the first Moog. The first Moog synthesizer was all the prototypes that I built before we offered the equipment commercially, and that prototype system is owned by Herb Deutsch, who is now the marketing and sales manager of Moog Music. The first paying customer was Alwin Nikolais, who is a choreographer in New York City. His dance troupe is well known. In addition to choreography, he has always designed his own lighting, produced his own music, and designed his own costumes. He does the whole schtick. Before he met me he was making music with tape recorders and microphones and not much else. It was very good music, very suitable for dance. He's just one of these guys with incredible talent and taste.

Anyway, I was exhibiting at the October 1964 AES show in New York City. I had four hand-made modules in a hand-made wooden case on a card table with a tablecloth, and was surrounded by all these big tape recorder and mixing console manufacturers. I felt just like a eunuch in a harem. But then Jimmy Seawright, who was a technician with the Columbia-Princeton electronic music center, saw what I had and said he knew of someone who would be interested. He disappeared, and three hours later showed up with Alwin Nikolais. He saw what it was, lit up, placed an order, and a couple of months later we delivered our first synthesizer system for money.

JL: Who were some of the people who played a role in helping you develop the modular Moog? What were their contributions or input?

RM: (With emphasis) Every customer we had in the first 2 or 3 years contributed something. It's hard to think of anyone who didn't have some idea. With Herb Deutsch, in early 1964, we evolved the concept of the VCA and VCO. We also came up with a keyboard with very simple envelope generators, but there was no sample and hold (no memory in the keyboard) so the envelope generators didn't have any release

"Sometimes a person's contribution is not a single striking invention, sometimes it's just putting it all neatly in a box."

JL: How did the modular concept evolve?

RM: It always seemed natural to me. I began in 1964 with this modular business, but years before that, in 1961, Harald Bode published an article in Electronics magazine on a modular system he had designed. It was not a complete modular system, but he had the forerunner of a voltage controlled amplifier, reverb unit...well, I don't know what all else, but it was definitely a modular system that sat in a rack and was patched together with phone plug patch cords, the same way as our stuff.

So, the very first thing I built was a breadboard with a voltage controlled oscillator, another breadboard with another VCO, and a third breadboard with a VCA. All the inputs and outputs used jacks, and that's how the modular synthesizer evolved.

time. When you let go of the key, the note stopped. Anyhow, by the time Herb and I finished our work at the end of the summer of 1964, we had the basic idea of a modular system, the basic idea of voltage control, the basic idea of a keyboard that produced control voltages, and simple envelopes. From Nikolais...let me think...we might have gotten the idea of a ribbon controller. From Eric Siday we got the idea of a bank of oscillators controlled by a single control voltage. His first system had something like six or eight oscillators controlled by a single controller. From Vladimir Ussachevsky we got the idea of four part envelope generators. What everybody calls "ADSR" today, like it was engraved in stone, came right out of Ussachevsky's requirements and specifications. Also the envelope follower, and the idea that a VCA should be either

exponential or linear with well-defined control characteristics came from Ussachevsky. Gustav Ciamaga of the University of Toronto electronic music studio specified the first VCF. I designed it, but he specified how it should work. Carlos had quite a bit to do with the filters, and also improving the keyboard. That was at the beginning. A great deal of what we did together became standard. Keyboard with memory was one thing we worked on together, certainly the fixed filter bank was another. I guess by the time 1967 ended, we more or less had all of the basic ideas in place, and then we began cranking the stuff out because the demand began to accelerate.

JL: There has long been the question of who was first, you or Don Buchla, in the design of the modular voltage controlled synthesizer. Could you shed some light on this?

RM: I don't know who was first. I do know when we started working on modular synthesizers. I can tell you that we knew nothing of Buchla, and I have to think that he knew nothing, or very little, about us. I began working myself in the spring of 1964, and had actually shown stuff in public during October of 1964 after showing it at the University of Toronto in the summer of 1964. My understanding was that Buchla was working at the same time. I would say that we took parallel paths, because the technology and requirements of the musical world were such that the modular approach just made sense at that time.

JL: What do you think of the modular approach now?

RM: It has to be the most versatile way of getting fairly rapid access to shaping sound. I still think it's musically useful. On and off, there have been competitors - particularly in the late 60s - who took pot shots at patch cords. Primary among them was ARP, who made a lot of noise about how much better matrix switches were. EMS in London made noises about how pin matrixes were better, but the fact is that nearly all successful modular synthesizers have used patch cords. Serge is modular, Roland has a modular system, PAIA has a modular system, E-mu, Polyfusion, and Synton - they're all modular. It just makes sense, because it's so damn basic and there's no limitation on the quality. And you don't spend a huge amount of money on something that 50-cent patch cords can do perfectly well.

JL: Was there ever a time in your career when you wanted to pack it all in and do something else?

RM: Oh, there have been many times like that! My gosh...around the spring of 1967 we were having a hard time making ends meet. There weren't that many customers, and we weren't making any money. Then this guy on the West Coast named Paul Beaver - who we didn't know from a hole in the ground - asked why didn't we come out to the AES show in Los Angeles to show our stuff, and maybe he could be our representative. That was the beginning of an incredibly successful collaboration. Paul was our West coast rep and did very well. He sold hundreds of thousands of dollars worth of modular systems to West coast musicians from 1967 to 1971 or so. At the end of 1970, there was a recession, the market was temporarily saturated with modular system, and we were stuck with an inventory that was much bigger than our ability to pay for it. We had no customers to sustain cash flow so we had to sell out. It was very tempting then to pack it all up, in fact not only pack it all up but throw it in the garbage and declare bankruptcy - but we didn't. Then from 1971 to 1977 I was working for somebody else, which was by and large a difficult, gripey experience for me because there was a lot of politics and there was a corporation at the top that didn't understand the market, my capabilities, or the customers.

These were the main frustrations that occurred during the last 14 years or so. There haven't been any frustrations like that recently, because I am my own boss again and I haven't gotten into something deeper than I can control.

JL: What are you working on these days? Any new projects?

RM: I'm just finishing building a house that I've been working on for three years. It's in the woods. It's a fairly big house...I've done all the electrical work, plumbing, and heating. My wife and I put down all the floors, and now we're just about done. I'm setting up a shop to build custom and limited production of electronic music instruments that stress well-designed, smooth-acting, easily controllable control devices - control surfaces. I'm building a performance synthesizer right now that's polyphonic, microtonal, computer controlled, and touch sensitive in several ways. There are three keyboards. Each key on each keyboard is touch sensitive in four different ways: back and forth on the key, side to side on the key, up and down, and the fourth way is that once the key is down, pressing harder gives a higher output. All of this is controlled by computer. The capabilities are, at this point, limited by people's ability to play it. It's also limited by the fact that we haven't developed that much software for it. That's what we're working on now. It should be done shortly, I hope by the time this interview appears. After that, I don't know - perhaps other people will want similar instruments.

JL: How does the business of electronic music influence you now, and how has it influenced you in the past?

RM: (Pause) I don't really know how to answer that question. How about if I said that you learn very fast from your customers. I began in this business as an engineer with no business sense and only the

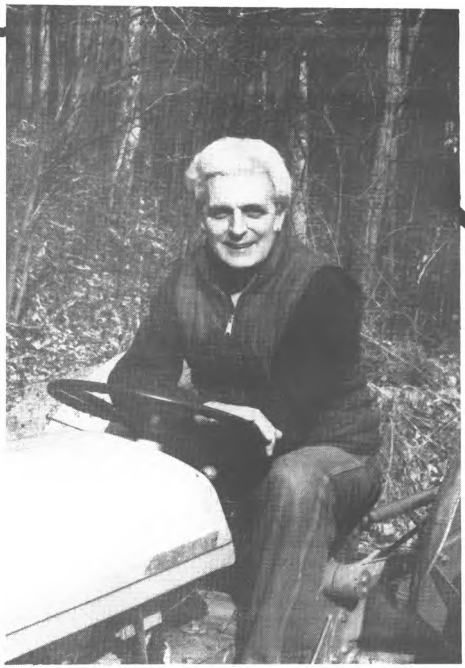
vaguest feeling for what it's like to be a professional performer, a creative person. Sure, I had piano lessons and I could read music, but that didn't mean that I experienced things the way a professional musician does. You very quickly learn that sound quality is extremely important, that the feel of an instrument is extremely important, that just because something is technically elegant and pleases you as a technician doesn't mean that musicians will get anything out of it.

I guess last, but certainly not least, you begin to realize how important it is to make something that WORKS. When you plug an instrument in tomorrow, it has to work the same way as when you plug it in today, because what you make is something that becomes part of a musician as much as his fingers and his feet. The instrument just becomes an extension of himself, and it rips a musician up to have something that he relies on so much for his creative work crapping out on him. So you learn that these simple things - good feel, good sound, reliability, and to a lesser extent, lots of functions and versatility - these are more important than you would guess just sitting at a desk pushing a pencil or looking at a meter.

JL: What do you think the future holds for electronic music in general?

RM: I think the electronic music medium has the potential for being more fun to a wider variety of people than any other technical/musical medium. A lot of people have learned piano, but it takes a lot of work to learn piano. Same thing with violin, drums, guitar - you have to practice them, and then you do what you can do on them. Not everybody can play a guitar, or piano, or sing for that matter. When you look at something like Casio's VL-1, or all these new keyboard instruments that range from the size of a phone book to a full grown combo organ, they're just a lot of fun. It's not the sort of fun an electronic organ of the 60s and 70s was, with all those automatic gadgets - you know, you push one key and it plays all the rhythm, and bass line, and arpeggios, and with the other finger you play a melody. To me, that doesn't have the potential for being fun. It's a very quick dead end, because the instrument is really nothing more than a recorder of some very simple stuff, and all you do is turn the recorder on and off. With electronic music, it's open-ended. You can explore as much as you want or as little as you want. You can make Polish polkas or something far out, or anywhere in between. I think that as time goes on, electronic instruments are going to become more suited for use as musical tools, cheaper, and more reliable. Look how fast it's going. Ten years ago a digital sequencer was something that cost $1000. Today you can go out and buy a digital sequencer with ADSR capabilities, and a whole bunch of other things, at K-Mart. That's just 10 years. Who knows what the next ten years are going to bring? Nobody ten years ago would have said that you could buy a digital sequencer at K-Mart, made by a Japanese company that's turning out a half-million of them.

T MOOG



JL: What's it like being a household word?

RM: Well...it's sometimes convenient. You come back from a trip abroad with a suitcase full of this and that, and the customs official looks at your card and says, "Moog...oh yeah, you have anything to do with synthesizers?" And I say, yes, that's me. Next he says "No kidding, I play such and such in a rock group" and then he gets to talking to me about his rock group, and how he likes Moog synthesizers, and he forgets to look in the suitcase...that sort of thing goes on all the time, although not all the times you'd want it to go on! (Laughs) So it's convenient in that respect. Another thing is you get a lot of - "respect" is not the word - you know, people are sort of dazzled by actually coming into contact with someone who is famous with a capital "F". All that means is that the media did a job on us in the late 60s. But generally, if a person recognized the name at all, he or she doesn't know exactly what it is I did or didn't do, exactly why it is I'm famous. Most people think I have THE patent for THE synthesizer, and they don't see my part in the industry anywhere near like I do. I try to discount that, because it's a pain in the ass. If you start explaining it, nobody wants to know. All they want to do is the celebrity trip, with the autographs and all that. Aside from those things, I don't think it affects my daily life at all.

JL: Well, what you've done has certainly affected the daily lives of Polyphony readers. Thank you for the interview.

P.S. to Polyphony readers: This is my third interview now, and I'd like to know who you would like to see profiled. After all, this is your magazine and I want to satisfy your needs. My mailing address is 8 Tyler St., Norwell, MA 02061.♯

ON LOCATION: DENTON, TEXAS
The 1981 International Computer Music Conference

by Don Wilson

The 1981 International Computer Music Conference was held in Denton, Texas, November 5-8. The conference, hosted by the North Texas State University School of Music, was attended by approximately 300 composers, theorists, engineers, programmers, and others from all over the U.S. as well as several foreign countries.

There were over 50 papers presented and six concerts, including special performance of HPSCHD by John Cage and Lejaren Hiller. Cage also gave a lecture with slides, "Composition in Retrospect", as a part of another concert.

The general topics of the papers were Compositional Approaches, Compositional Philosophy, Studio Reports, Computer-Assisted Composition, Musical Data Structures, Computer-Assisted Instruction, Synthesis Hardware and Signal Processing, Real-Time Synthesis, Psychoacoustics and Sound Analysis, Computer-Assisted Analysis, and Music Notation and Printing. Tutorials were also given at the beginning of the conference for those with little or no experience in computer music.

When Computer Music Conferences began in the mid-seventies, the most innovative work seemed to be emanating from universities; however, some of the most interesting work presented at the 1981 conference came from commercial groups. Of particular interest was the Lucasfilm Ltd. (maker of "Star Wars") Audio Signal Processing Station presented by Andy Moorer, John Snell, and Curtis Abbot - three of the better minds in computer music.

The Lucasfilm digital audio signal processor-synthesizer, now being built, is intended for use in film sound and music processing. The processor sub-units consist of a controlling computer with a high-resolution graphics terminal, a real-time digital console that is software reconfigurable, disk storage with around 300 Megabytes capacity, and a high-speed audio signal processor. This audio system appears to be quite powerful, fast, and flexible with capabilities of recording, generation, modification, and analysis of sound.

The conference concerts encompassed quite a variety of compositions and performances. There were pieces for tape, live instruments, tape and live instruments, tape and dancers, tape and slides, as well as one for live digital synthesizer (performed by Jon Appleton). The dancers from NTSU were exceptional. Compositions ranged from rather perceptually complex to minimalistic. A large number of pieces employed computer-assisted compositional processes.

One different and entertaining composition, Any Resemblance is Purely Coincidental for piano and tape by Charles Dodge, had a computer-synthesized operatic voice based on an old acoustic recording of "Vesti la Giubba" from Leoncavallo's I Pagliacci. The essential ingredient of the piece, the interaction between the live performer and the tape, was quite obvious and at times humorous. "...a computer-synthesized voice searches for an accompaniment: with the original orchestration, with the (live) piano, with copies of itself and with other computer sounds."

There was a noticeable lack of compositions realized by hybrid systems (computer controlled analog modules). The outstanding exception was Colors by Wayne Slawson. Colors is a set of variations based on a structure of sound colors with many of the "colors" being speech-like. It seems natural that a composer using a hybrid system would concentrate on an analog module that is rather different from its digital correspondent - the filter.

Since the composer has performance responsibilities for a tape realization, the performance and the computer generated timbres are of as much interest to some as are the compositions. While computer generated sound is still in its infancy, some of the tape (or tape plus live) pieces played at the conference concerts displayed excellent technique. It appears that even though Stanford University and IRCAM are still the leaders in computer generated sound research and technique, other computer music centers or studios are making a significant contribution through new compositions.

Concurrent with the conference papers were a concert gallery and exhibits. At the gallery, a number of compositions were played with the order programmed randomly. Some pieces had program notes displayed on CRTs and another was played through multiple speakers suspended from the ceiling. The exhibitors included Alpha Centauri, Casheab, Digital Keyboards, Fairlight, and New England Digital. These companies represent the major commercial digital synthesizers currently available.

This conference did not seem to have the excitement of so much being new, or the camaraderie of a small exclusive group of the earlier conferences; however, it was well worth attending. The papers and pieces were generally better and more accessible than in the past. The conference was well organized and the NTSU facilities were outstanding. As a bonus, without computer assistance, the renowned NTSU One O'Clock Jazz Lab Band presented a special, hour long concert for the ICMC conferees.

The 1982 International Computer Music Conference will be held, for the first time in Europe, in Venice, Italy. Tentative plans are to charter a plane from the US to Italy. If you wish to attend, watch for announcements in Polyphony, the "Computer Music Association Newsletter" (PO Box 1634, San Francisco, CA 94101), and/or the Computer Music Journal (MIT Press, 28 Carleton Street, Cambridge, MA 02142). ♯

CABLE TEST FIXTURE by David Fuglewicz

Here's a simple test fixture to check for continuity and short circuits in cables. The circuit is a basic continuity tester made up of battery B1, LED D1, and current limiting resistor R1.

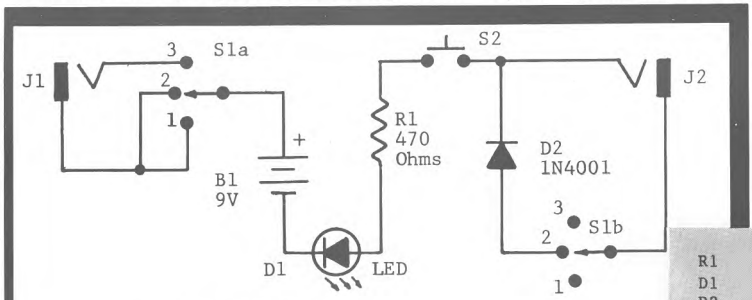
Construction. The circuit is non-critical and very easy to build. Make sure you hook up the connections to S1 correctly, that D1 is oriented properly, and that the jacks are mounted on an insulated surface (plastic, bakelite, etc.). If you have more than one type of male connector on your cables, you can hook up multiple female connectors in parallel (both signal and ground connections) for J1 and J2.

Using the tester. Position 1 of S1 checks for short circuits; the ground at J1 connects to the signal line of J2, while D2 blocks voltage to J2's ground in this position. If the LED lights when you press S2, the cable has a short.

Position 2 checks for continuity of the ground path. If the LED lights when you press S2, the ground is okay.

Position 3 checks for continuity of the signal path. If the LED lights when you press S2, the signal line is okay.

That's it for the simple cable tester, I hope you find it useful.



Cable Test Fixture

Parts list

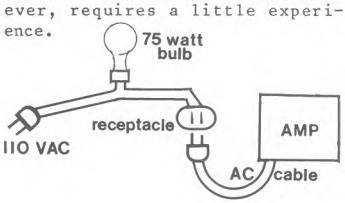
R1	470 Ohm resistor
D1	Red LED
D2	1N4001 or equivalent diode
J1, J2	1/4" phone jack - see text
S1	2 pole, 3 position rotary switch
S2	SPST pushbutton switch

Repair Tip

by Richard Sloan

Here's a circuit I use to help repair amps and power supplies. Figure 1 shows the basic circuit; it consists of hooking a regular light bulb in series with one side of the power cable. If the unit under test is shorted (in the power section), it will turn on the light rather than blowing a fuse. One can also work on the equipment while power is on to help locate the shorts, as well as test repaired equipment using this trick.

Generally, for medium size power amps a 75 Watt light bulb works well. For larger amps, the bulb wattage should be increased. This setup can also indicate the relative amount of current demand by the unit under test; interpreting this reading correctly, however, requires a little experience.



It's not just a guitar tuner!

It's not just a guitar tuner even though it works just great with any type of guitar. The fact is, that you can use Instratune 1000 with any type of musical instrument or electronic sound generator. HMR's new Instratune 1000 is so versatile that it is considered by many to be a piece of precision test equipment rather than an ordinary tuner.

With quartz crystal accuracy, Instratune 1000 generates 96 notes in eight octaves. The large 20 LED, 3 color dot graph tuning display is so easy to read, you can even tune up from across a room. Instratune 1000 also lets you hear every note on a built in speaker. Pickup is made by the internal microphone or a rear panel jack. A unique feature allows band members to tune up to a keyboard or an organ.

Drop us a note and we will be glad to send you all the details. HMR, CP Division, P.O. Box 204, West Newton, PA 15089.

PRACTICAL CIRCUITRY

We're starting to accumulate a pretty good collection of synthesizer circuits here in "Practical Circuitry". In fact, I hope to present enough plans over the next year to allow you to build a complete synthesizer. So far, we've covered the noise source, LFO, and sample-and-hold (all part of the SuperController module), and a fairly elaborate dual VCO module. Now it's time to start thinking about amplitude modulation, hence this month's dual VCA (and a companion dual ADSR, which we'll cover next month). The dual VCA and dual ADSR fit conveniently behind a 19" by 3.5" rack panel; if you wish to use the same construction technique, you may want to wait until next issue before you start building. I think you'll find that a dual VCA/dual ADSR module makes for a pretty sharp combination.

Now, about that title. The name of the game is "think simple", since VCAs can get pretty wild in a hurry. For example, the VCAs used in a dbx unit, or for automated mixdown, can get very complicated. This is because such applications demand very wide range, low noise, and accurate tracking. However, for electronic music it isn't necessary to go that far. You know the old saw about the human ear being relatively insensitive to amplitude variations as opposed to frequency changes? Well, it's true. So we can cast out accurate tracking as being of rather minor importance to us. However, we would like a fairly wide dynamic range, and this also implies that we would like low noise as well. Finally, we want something that won't cost us an arm and a leg (remember, we're going to build dual units).

I think there's a good solution to the above requirements: the CEM-3330. If you're not familiar with this chip, let me tell you about it. The CEM-3330 is a dual VCA designed specifically for electronic music. It has "standard" input and output structures, is easy to apply, offers linear or exponential response and a choice of class A, B, or AB operation, and best of all, it's relatively inexpensive - about $8. If all this sounds good to you, be sure to check out the spec sheet to get a real idea of the power of this chip.

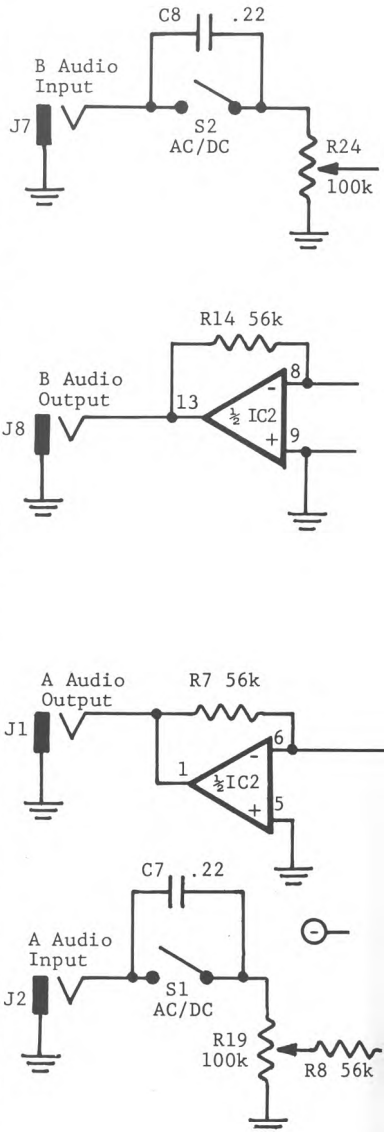
"All right, I'm sold", you say - "Let's get cooking!". I'm with you - but wait a second while I justify still further the title of this article. As I said, this chip has a lot of features; but that doesn't mean we have to use them all. So in this design, I'm going to strip down, streamline, and sometimes ignore various features of the CEM-3330. What's left is a terrific, low noise, and simple to build VCA.

The audio signal path. Figure 1 shows the schematic. Since this is a dual unit, I'll only describe one half (the other half is identical, except that the power supply connections are shared by both halves). The audio input enters through J2; S1 chooses either AC coupling (for audio processing) or DC coupling (for processing control voltages). If the audio signal were not centered about ground (i.e. if it had a DC offset), you would hear a terrific "thump" every time you opened the VCA quickly. We can certainly do without that, and that's the purpose of putting C7 into the circuit. To further reduce thumping, trimpot R17 allows you to trim out any residual offset in the chip itself. To set this trimmer, repeatedly hit some fast envelopes and adjust R17 for minimum thumping in the audio output.

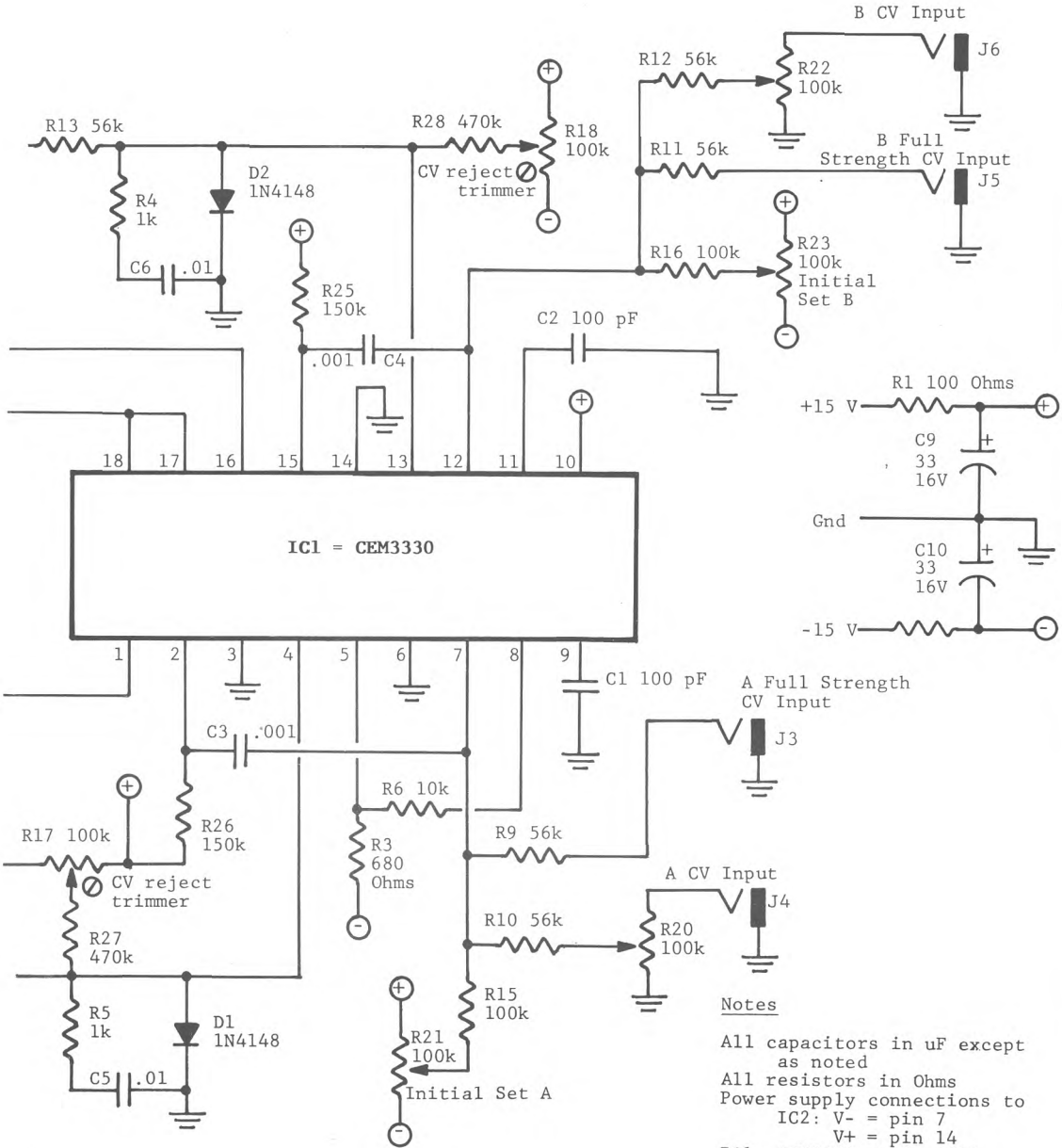
R19 is an attenuator that pares the signal down to size as needed. This design follows a standard that I have been using for some time now, namely ±5V audio signal levels and 0V to +5V control signals. With R19 wide open, the VCA accepts ±5V audio signals.

Now for a few words about D1, R5, and C5. Ordinarily pin 4 should remain at a voltage somewhat below 0.7V. If that voltage were to rise above this level, latch-up and possible damage to the chip would ensue. D1 makes sure this never happens by clamping pin 4 to a maximum of 0.7V (a diode drop). R5 and C5 form a compensation network. Their job is to help C1 (the actual compensation capacitor) keep the amplifier from breaking into supersonic oscillation.

For you "theory" buffs, this VCA is a current in, current out, current controlled amplifier. R8



VCAs: THINK SIMPLE



Notes

All capacitors in uF except as noted
All resistors in Ohms
Power supply connections to
IC2: V- = pin 7
V+ = pin 14
IC1: CEM3330 IC2: 4739

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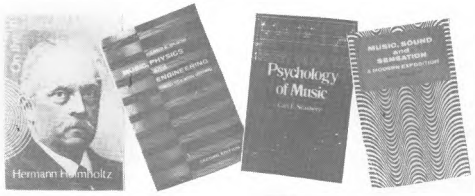
POLYMART

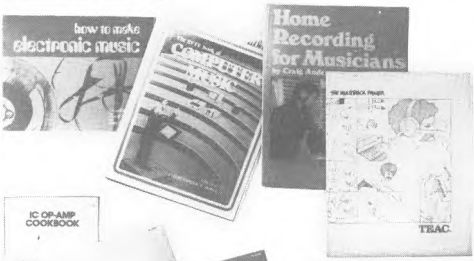
SCIENCE



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

#SENS On The Sensation Of Tone	**$7.50**	**#PSYCH** Psychology of Music	**$5.00**
#MPE Music, Physics & Engineering	**$6.00**	**#MSS** Music, Sound and Sensation	**$3.50**

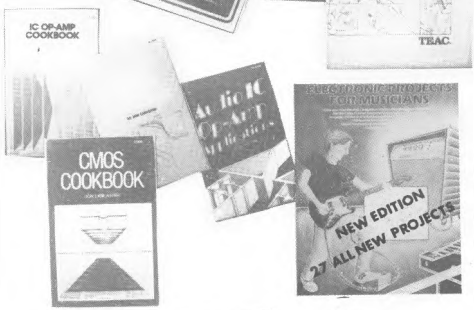
TECHNIQUE



Synthesists must be well versed in a number of techniques and principles. "How to" and project oriented books are a great way to pick up these skills easily. **How to Make Electronic Music** by Drake, Herder and Modugno is a standard introductory text for music systhesis classes, with chapters on equipment, tape technique, composition projects, and more. **Multitrack Primer** by Teac is a step-by-step guide to building, outfitting, and operating your home studio. The Byte book of **Computer Music** describes computer control of electro-mechanical instruments, Fourier analysis, circuits and loads of software. **Home Recording For Musicians** is the original guide to outfitting and operating a budget studio for maximum results, including mixer and audio processing circuits and a demo recording.

#HMEM How to Make Electronic Music	**$3.95**	**#TEAC** Multi-Track Primer	**$4.95**
#BYTE Byte Book of Computer Music	**$10.00**	**#HRFM** Home Recording	**$9.95**

ELECTRONICS



Electronic cookbooks are a great way to stock your library with materials that are not only heavy on theory, definitions, and educational material, but chock full of practical applications as well! These books can easily replace stacks of manufacturers data sheets and applications notes all in an easy to use reference. Walt Jung's **Op-Amp** and Don Lancaster's **Active Filter** books are self-explanatory -- required reading for synthesists! **Audio Op-Amp** is an edited version of OACB, containing only audio applications. Lancaster's **CMOS** book is much more than a digital reference -- phase lock loops, top octave generators, touch switches, and other things you need! **Electronic Projects** discusses electronic construction technique for the novice and provides **27** projects with PC patterns and a demo recording of the effects.

#OACB Op-Amp Cookbook	**$ 15.95**	**#CMCB** CMOS Cookbook	**$ 12.95**
#AFCB Active Filter Cookbook	**$14.95**	**#EPFM** Electronic Projects **2nd edition**	**$14.95**
#AUOA Audio Op-Amp Applications	**$8.95**		

REFERENCE

Often used reference materials to answer the many questions encountered in everyday synthesis(?)... **The Source** is over 125 pages of patches in universal flow chart notation; the largest publication of its type. **Audio Cyclopedia** has 1760 pages with 3650 entries and hundreds of drawings and schematics to answer any questions about audio. **Polyphony Binders** hold up to 12 issues of any 8½" x 11" publication without punching holes; keeps issues like new for unending service. **Electronic Music Synthesizers** devotes the first half of features and functions of commercial equipment (Moog, Arp, Paia, Oberheim, EML, and RMI); the second section provides schematics and projects for the experimenter.

#SOURCE	The Source	**$4.00**
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#EMS	Music Synthesizers	**$6.95**
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BACK ISSUES

The wide variety of practical applications and construction projects in past issues makes 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 $2.50 each postpaid. Check the issues you wish to order on this coupon and add the total to your POLYMART order.(other side), or order by volume and issue number (0304,0402, etc.) on the POLYMART order form.

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

☐ #0301: 7/77: 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: 11/77: The Sensuous Envelope Follower, digital gates, LED wall art, build a bionic sax, data to music peripheral project, Apple II as a music controller, using the NE566 as a VCO, patches.

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

☐ #0304: April/May 78: Minimoog 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, Volume 3 index.

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

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

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

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

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

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

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

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

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

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

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

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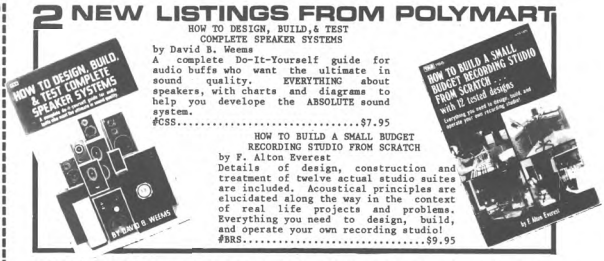

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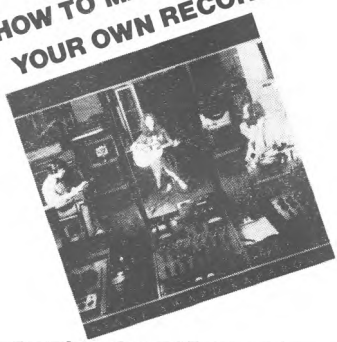

By: Diane Sward Rapaport

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CURRENT EVENTS

'Tell Them You Saw It In Polyphony'

Fast CMOS. CMOS logic has long been popular due to its low current consumption and non-critical design qualities; however, it will not operate as fast as TTL or LSTTL logic. Now Motorola (3501 Ed Bluestein Blvd., Austin, TX 78521) has introduced the MC54/74HCXX series, which are claimed to accept 25 MHz clock speeds. Initial offerings include popular counters and gates, with additional logic devices scheduled for introduction this year.

Microphone news. For a copy of Audio-Technica's new 24 page catalog, listing electret and dynamic types, accessories, and more, write to Audio-Technica U.S., Inc., 1221 Commerce Drive, Stow, OH 44224.

TASCAM from TEAC (7733 Telegraph Road, Montebello, CA 90640) has announced the PE-250, a moving coil cardioid microphone that has the ability to handle high transient spikes without overloading or distortion. Equipped with XLR connectors, the PE-250 lists for $250.00.

CMOS active filter. National Semiconductor has announced the MF10, a low cost, monolithic, CMOS active filter that can perform a wide variety of functions and requires no external capacitors for operation. Center frequencies are directly proportional to an external clock frequency within an accuracy of 0.6%. External resistors determine gain and Q. Available responses include allpass, lowpass, highpass, bandpass, and notch up to 20 kHz with a Q as high as 500. Price is $3.70 in quantities of 100 up.

Con Brio announces Scorewriter System Option for the ADS 200. The Scorewriter system prints keyboard performances, derived using the Con Brio's music programming capabilities, on paper in conventional music notation. Con Brio, 975 San Pasqual St., Suite 313, Pasadena, CA 91106.

New Serge. Serge Modular Music Systems, 572 Haight St., San Francisco, CA 94117 has introduced a "Divide-by-N Comparator" module. In addition to normal comparator functions, there is a voltage-controllable divide by 2 to 32 function suitable for processing audio or control signals. Kit price, $140; $170 assembled.

Shhhhh. Micmix (2995 Ladybird Lane, Dallas, TX 75220) has introduced the Dynafex single-ended noise reduction system. Controls include a threshold control that determines at what level maximum noise reduction occurs, and a hard-wired bypass switch. #

re-view

by Robert Carlberg

Anderson/Giorno/Burroughs **You're the Guy I Want to Share My Money With** (Giorno Poetry Systems 020/021). One-third of this 2-record set is some of the previous work leading up to Laurie Anderson's single, "Walk the Dog", reviewed July/August 81. Although not as tight as the single, it's still interesting for that reason. Another third is John Giorno's poetry, shouted like a radio evangelist and over-dubbed from three separate performances. The last third is sleepy storytelling from William S. Burroughs, which relies equally on humorous inflection and the shock value of swear words. How do you divide four sides three ways? The fourth side has three sets of grooves which run concurrently - it's mere chance which one you'll get each time.

Cluster **Curiosum** (Sky 063). The direct opposite of their last, **Curiosum** returns to simple musical patterns and complex patches. For my money it's good to have the boys home.

Laurie Spiegel **The Expanding Universe** (Philo 9003). Computerized drone music, warmer and more human than usual.

The Scientific Americans **Taking Time/Call Home/Service with a Smile** (Techno Tunes LES 30). A 9-inch, 3-tune, 1-sided flexidisc, featuring electronic percussion, with guitar, bass, drums, and vocals. Eno and Talking Heads influenced rock that is progressive in the best sense - I give it an 85.

Collier & Dean **Whistling Midgets** (Inner City 1126). Tom Collier plays vibes and marimba, and Dan Dean plays bass guitar, and this is a jazz album. Dan also runs his bass through a 360 Systems/-Oberheim interface, and Norman Durkee plays some very tasteful keyboard synthesizer, but the electronics definitely serve the music rather than vice versa.

Conrad Schnitzler **Con 3** (Sky 061) and **Control** (DYS 04). After a decade of near-total silence, the founder of both Tangerine Dream and Cluster seems to be making up for lost time. Unfortunately, not everything that he touches turns to gold. **Con 3** contains marginal vocals backed by electronic patterns and surprisingly normal drums. The electronic patterns on **Consequenz** (reviewed May/June 81) were better. **Control** consists of random voltage generators into a variety of patches. Not much beyond the noises to hold your attention.

Roedelius **Wenn der Sudwind Weht** (Sky 064). Roedelius, who like Liberace has lost his first name, returns to his Farfisa for another album of spacey carnival music.

Wrinklemuzik **A Move to the Right/Bangkok/Rein** (Exit 1201). A 33-rpm 7" single by Kenn Lowy, using E-Bow guitar, rhythm box and the Public Access Synthesizer Studio in NYC. Side 1 contains two pleasant rock tunes, side 2 an introspective mood piece for Frippish guitar. A good effort.

Harold Budd **The Serpent (In Quicksilver)** (Cantil 181, E.P.). Harold Budd plays dream soundtracks on undamped electric and acoustic pianos. They're not so much tunes as resonance studies.

Gavin Bryars **Hommages** (Crepuscule 027). Somewhere between the dreamola piano of Harold Budd and the engineered tedium of Phil Glass lies Gavin Bryars. Piano, vibraphone, marimba, and orchestral percussion play four tune/non-tune homages to, in order, Bill Evans, Gustav Holst, Ferruccio Busoni, and Percy Grainger.

Eugene Bowen **Bourgeois Magnetic** (Cantil 281, E.P.). Side 1 takes the drifting piano of Harold Budd and overdubs some synthesizer and African percussion - an intriguing concept.

Magic Dragon **Emotional Landscape** (Panik PFRQQII) Magic Dragon is a German band now living in Canada, and four of the five tracks are in a popular German rock style: guitar, bass, string machine, and early Pink Floyd vocals. The last track collages preachers over a ponderous synthesizer phrase - very dark and scary.

Basement 5 **In Dub** (Island 2038). Dub is one of the most interesting developments to come out of reggae, where the multi-track backing tracks of a song are echoed, reverbed, and mixed in and out for an outlandish new composition. Basement 5 apply the same technique to their wall-of-sound English protest music, which owes more to the Sex Pistols than King Tubby.

Tom Tom Club **Tom Tom Club** (Sire 3628). After publicly lambasting leader David Byrne for acting "like a 14-year old", Talking Heads members Tina Weymouth and husband Chris Frantz have used the same studio, the same engineers, and the same back-up musicians for their solo debut. It sounds a lot like "Remain in Light" without Byrne's paranoid lyrics and voice - replaced rather insipidly by Tina and two sisters. Only the

.....continued on page 32

DETAILS:

The Story of Gozinda

This month's column will revisit the "Gozinda-Gozouta" balanced/unbalanced, input/output structures (first mentioned in the July/August 1981 issue of Polyphony) by presenting a complete, do-it-yourself Gozinda/Gozouta board that you can add to your own projects. But first...

The title of this column is "Details" because it is the fundamental details that make or break quality design work. I am a detail fanatic, and it has paid off over and over again during my many years of design work. Inattention to details is responsible for almost all good circuits that have found themselves needlessly floating in the toilet.

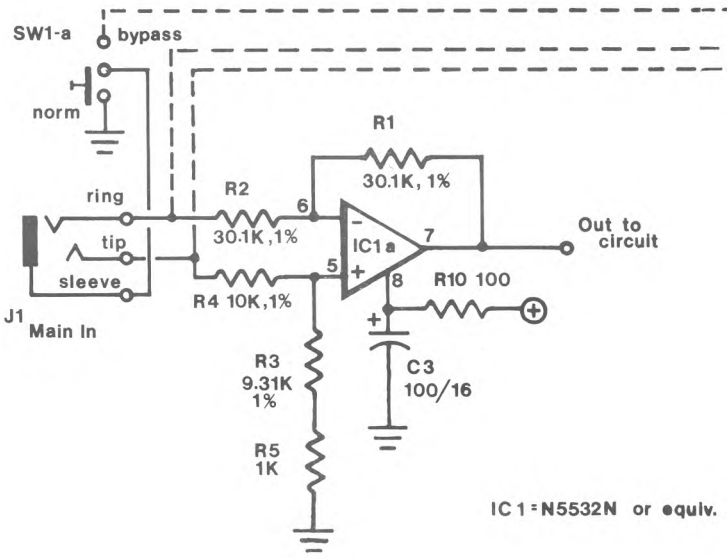
Confession time.

I have fallen victim to the exact problem that I preach against - namely, inattention to detail. In the Gozinda/Gozouta column, I stated that the input impedance seen by Vin (-) was R2 (see figure 1). Not so. It is 2/3 R2. This makes a big difference when it comes to keeping balanced lines balanced! The correct value for resistors R1 and R2 is 30k Ohms (30.1k Ohms being the closest 1% value), not 20k Ohms as shown in the Jul/Aug issue.

The trap I fell into is a mis-application of something called the "rule of superposition" used extensively in circuit analysis. Superposition allows you to look at one piece of circuit at a time and then combine the results in the end for the final answer. But it must be used correctly, or you wind up lying to yourself.

Like I did.

I treated the negative input impedance by looking at that port only, out-of-context to what the positive input was doing at the same moment. That means I treated this part of the circuit as an inverting amplifier whose input impedance would indeed have been equal to R2. However, looked at correctly, it is seen that the voltage at the intersection of resistors R1 and R2 is the same as the voltage induced by the positive driving line (tip) at the intersection of resistors R4 and R3a. That is, the voltage at the plus input equals the voltage at the minus input. It has to; that is what an op amp is all about - the output will do whatever is necessary in order to make the two input voltages equal. It is called a servo loop.



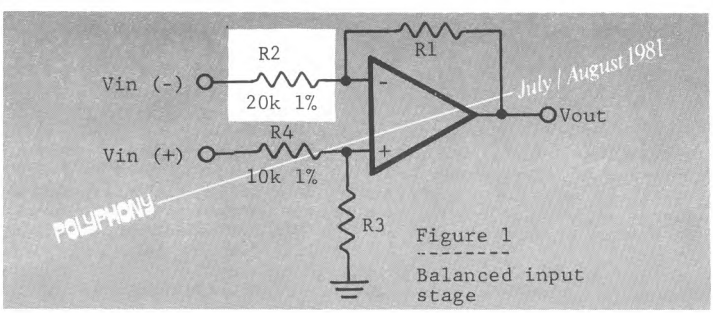


Figure 1

Balanced input stage

I think an example is the best way to understand why the impedance is 2/3 R2. Assume there is +1V at the tip and -1V at the ring of the input jack. That is, therefore, +1/2V at the plus input port of the op amp. And the minus port. The ring input current will be equal to the voltage across resistor R2, divided by R2. This voltage equals +1/2V - (-1V), or 3/2 Volts. The current is then 3 divided by 2 R2. The ring input impedance is, by definition, the input voltage (-1V) divided by the input current (-3 divided by 2 R2, with the minus sign indicating current flowing out of the circuit), giving an answer of 2/3 R2.

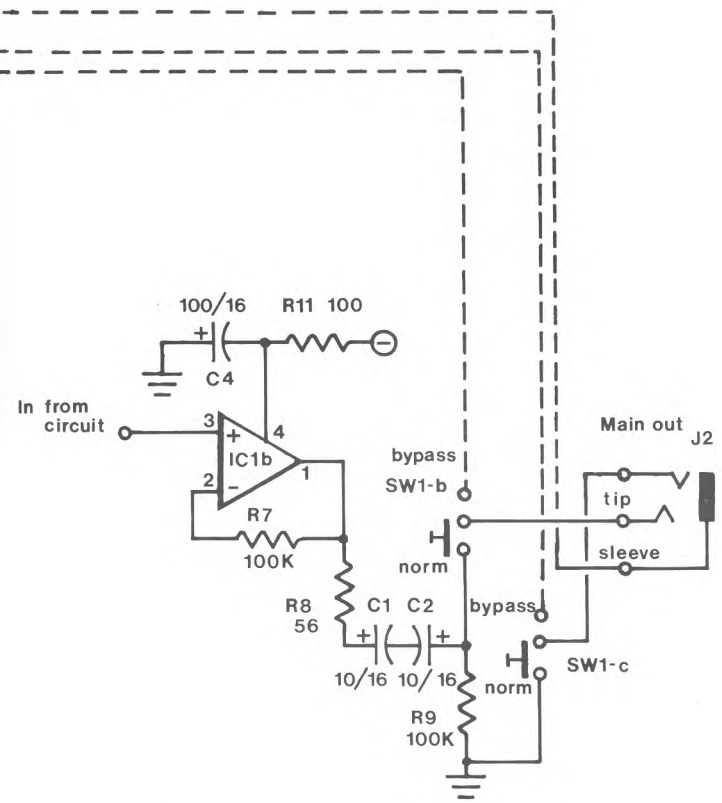
Simple...if you pay attention to details.

The new rules are that R1 = R2, R3 = R4, and R2 = 3 R4 for perfectly balanced line input impedances. Each leg will "see" an impedance equal to R3 + R4.

There, I've confessed. Now let's move along to the G/G-1, a complete Gozinda/Gozouta submodule with all the required embellishments for any of your D. I. Y. projects. With the G/G-1, you don't have to worry about signal conditioning of the inputs or outputs; you can jump right into

& Gozouta Revisited

by Dennis Bohn



whatever goodies you want to build. Easy and inexpensive to build, you will find this a useful circuit to have around.

Construction. The printed circuit board isn't required, but it sure makes things easy by allowing PC mounted phone jacks to be used. Mounting the jacks on their 1" centers through a pair of 3/8" holes also supports the PC board and all circuitry, making things easier yet.

Using the NE5532 dual low-noise IC provides superior noise and slew performance. In addition, it can drive 600 Ohms and long lines without getting upset, thus eliminating the need for any additional line drivers.

Switch SW-1 is an optional bypass switch which can be added when required. Holes are provided on the PC board for the switch, or for jumpers if it is not used. Note that three poles are required since the ground must also be disconnected and bypassed; therefore, the bypass mode gives a true three wire bypass.

Calibrating the G/G-1. Apply a 1 Volt, 1 KHz signal (or whatever kind of steady tone you have handy) to the ring and tip of the input jack. An easy way to do this is to use an unwired male stereo input jack with the shell removed, then jumper the ring and tip together and apply signal to this point. Next, adjust the trimpot for minimum signal at the output.

Applying the G/G-1: New Projects. I tried drawing some diagrams, but they got pretty messy pretty fast. Hopefully the following words will do the job.

- Run a twisted pair of wires from the G/G-1 PC board points marked "OUT" and "GND" to the input and ground point of your project's main circuit board. The G/G-1 now provides the input for the device.
- Run another twisted pair of wires from the G/G-1 PC board points marked "IN" and "GND" to the output of your new circuit and its ground point. The G/G-1 now provides the output for the device.
- Run a twisted triple group of wires from the G/G-1 PC board points marked "V+", "V-", and "GND" to your power supply positive, negative, and ground points respectively.
- **Important:** Be sure the G/G-1 input and output jacks are isolated from the chassis (if you buy the G/G-1 kit this is guaranteed by the Switchcraft insulated jacks provided with the kit).
- Run a parallel 10 Ohm resistor and 0.01 uF capacitor from your power supply ground point to chassis ground.

Applying the G/G-1: Modifying existing equipment. This is a little more cbmplex, but it still isn't too hard to retrofit existing equipment with a Gozinda/Gozouta board.

- Remove the input jack and cut the hot wire; reconnect this hot wire to the G/G-1 terminal marked "OUT". Cut the ground wire from this jack and reconnect it to the "GND" terminal on the G/G-1.
- Remove the output jack and cut the hot wire; reconnect it to the G/G-1 terminal marked "IN". Cut the ground wire from the old jack and reconnect it to another "GND" terminal on the G/G-1.
- Run a twisted triple group of wires from the G/G-1 PC board points marked "V+", "V-", and "GND" to the power supply positive, negative, and ground points of the existing circuitry.
- Install the G/G-1 along with its input and output jacks. **Important:** When mounting the G/G-1, be sure to isolate the jacks from the chassis.
- Run a parallel 10 Ohm resistor and 0.01 uF capacitor from the existing power supply ground point to the chassis.

That should do it. For studio equipment, rack mount gadgets, or whatever, the G/G-1 board lets you have consistent, standardized input/output structures that work well with each other - as well as with other pieces of equipment.

.....continued on page 34

SIMPLE SQUARE WAVE SHAPER

by BOBBY BEAUSOLEIL

With everything going digital these days, we're seeing a lot of square wave audio signals, especially in toys and mini-synthesizers; after all, in the language of digital technology a square wave is a series of 1s and 0s of equal duration and is very easy to generate. Of course, digital techniques can also produce more complex sounds. In a sophisticated digital tone generator, the action still begins with a square wave - running at a very high frequency - which clocks out a complex waveform previously stored in memory. A D/A converter then converts this data into an analog waveform, with one complete cycle through memory resulting in one cycle of the final waveform. With microprocessor control the synthesist can program literally any conceivable waveform into memory, clock out the waveform at the desired frequency with a VCO, and even use various techniques to modify the waveform in real time. For those of you interested in learning more about the techniques of digital tone generation, Tony Lewis' Digital VCO construction article in the Jul/Aug 1980 issue of Polyphony is highly recommended.

An analog waveshaper. While the wave shaper presented here is not as elegant as the ones mentioned above, it will nevertheless produce quite a broad palette of sonic variations from simple square wave and pulse signals. Anyone who has been annoyed by the voicing limitations of instruments using a top octave generator as a tone source may see these devices in a different light when processed with this circuit. The Bionic Sax and Bionic Trumpet (Nov '77 and Feb '78 issues of Polyphony, respectively) are particularly suitable as inputs to this device, because they are only designed to output one note at a time - you'll even be able to get some pretty decent approximations of sax and trumpet voicings for the first time with these instruments, along with many other voicings. Playing more than one note at a time produces iffy results, but can work in some specialized cases. This circuit will also do wonders for any PWM output of a standard VCO. Perhaps the ideal input for this device, however, is Craig Anderton's outstanding "Pulse Width Multiplier" circuit, which appeared in the Jan/Feb '81 issue of Polyphony. Not only will you be able to produce complex modulated pulse waveforms from a standard VCO, but you will be able to shape the pulses into variations of sawtooth waveforms, and these new variations will still be subject to the modulation!

How it works. The circuit is simple to put together; just observe the usual care in handling the CMOS IC and observe good wiring practice.

The Simple Square Wave Shaper (see figure 1), or SSWS for short, is designed to accept an input square wave that swings from ground to more than about +8V. This means that you can drive it directly from binary dividers, CMOS logic outputs, and the like. For processing lower level signals or signals that are symmetrical about ground, add the comparator input stage shown in figure 2. In fact, for the most universal box possible, it might be a good idea to include this input conditioning stage whether you anticipate needing it or not.

The portion of the circuitry in the box is optional; it is necessary only if you plan to process the outputs of tone generators which have 50% duty cycle square wave outputs. If you plan to use this module only for processing a modulated pulse waveform, this portion of the circuit can be eliminated. The purpose of IC2a and IC2b is simply to assure that the amplitude of the signal is equal for both settings of S1, while preserving phase integrity. The circuit built around IC2c and IC2d extracts a narrow pulse from a straight square wave signal.

The next portion of the circuit will look familiar to anyone who has built simple transient

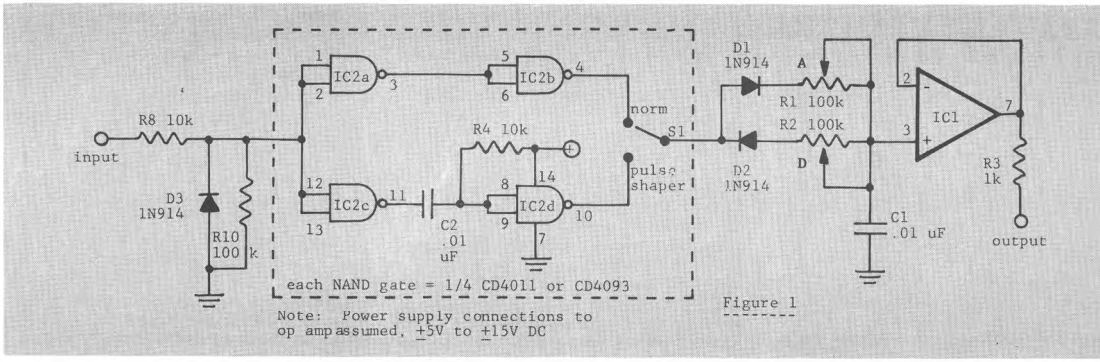


Figure 1

generators. It is exactly the same kind of lag-processing type of circuit used in transient generators, except that the values of R1, R2, and C1 are selected for the audio range (note that this same circuit can process square wave modulation signals by changing C1 to 1 uF and changing R1 and R2 to a value of 500k or 1 Meg). The wave shaper works by selectively filtering the ascending (A) excursion of the waveform and/or the descending (D) excursion of the waveform present at its input; that's really all there is to it.

How to use it. The effect of this module on various signals is quite different from that of a conventional filter, so it's best to think of it strictly as a wave shaper. With S1 in the "normal" position the waveform at the output will depend on the duty cycle and frequency of the incoming signal, and on the position of the A and D controls. With the controls set at minimum resistance, the signal will pass virtually unaffected (this, combined with the unit's low noise, makes a bypass switch unnecessary). If the input is a 50% duty cycle square wave, advancing the "A" control will delay the rise time of the ascending excursion of the waveform, thereby affecting the harmonic content of the signal. Conversely, advancing the "D" control will cause the descending excursion of the waveform to ramp, while leaving the ascending portion intact. Advancing both controls will produce variations between square, triangle, and skew (trapezoidal) type waveforms. With a narrow pulse input only a small part of the rotation of the "A" control is useful, but rotating the "D" control will produce variations between a pulse and a sawtooth. Of course, if the input is a modulated pulse the results can become impossible to describe in the standard terminology of VCO oscillations.

Despite this module's usefulness, there are some limitations since the device is frequency dependent (in other words, it will not produce consistent results over a very wide range, but should be restricted to a few octaves for a given setting of the "A" and "D" controls). Ideally R1 and R2 should be voltage controlled resistors so that at higher frequencies their resistances become smaller; I've been too busy to pursue this right now. Any readers with some ideas and the necessary ambition to turn this simple wave shaper into a voltage-controlled version are invited to dig in - just remember to share your results with Polyphony!

Conclusion. Until reasonably priced programmable tone generators with musician-oriented controls reach the market (hopefully in kit form), we're just going to have to use our imaginations and ingenuity to provide some readily accessible means of producing the complex timbral structures that creative synthesis demands. Besides, even sophisticated digital tone generators may benefit from established analog filtering techniques and outboard wave-shapers along the lines of the one presented here. It's too early to tell for sure just yet, but I prefer to think of analog and digital as having a both/and relationship with music synthesis in the future, rather than it being a choice between one or the other. In any case, I do know that it is the will of the creative musician, more than any other single element, that is most responsible for designing the future tools of the craft. Who knows what new marvels will emerge from the embryo of our dreams?

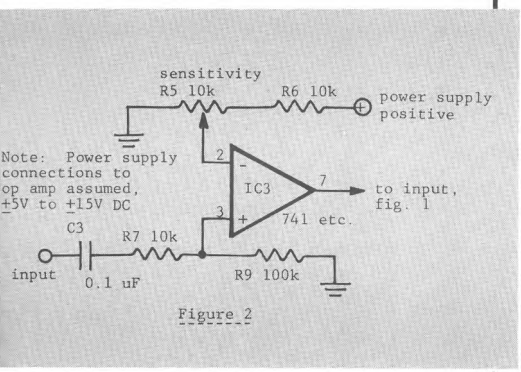


Figure 2

Don't miss the notes on this project in POLYTEST....page 27

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.....continued from page 17

converts the input signal to a current, while the output current is converted to a voltage via R7 and A1. The output is then presented to J1. Once again, this circuit is set up to give a ±5V output signal under normal conditions.

The control signal structure. The exponential control, at pin 6, is not used in this circuit so we simply ground it. My reason for going with a linear mode VCA is simple. Almost all ADSRs (including the one I'll be presenting next issue) already put out an exponential control voltage. This being the case, it makes sense to follow the ADSR with a linear VCA since the end result will be an exponential envelope anyway. This is perhaps the most "natural" envelope. However, suppose that we were to follow the exponential ADSR with an exponential responding VCA. The result would be "exponentiating the exponential", an unusual envelope. So let's play it simple and ground pin 6.

Pin 7 is the linear control input, which, unlike pin 6, is at virtual ground (which in plain language means that we can sum as many inputs into this node as we want). The full strength CV input feeds J3 and then R9. The value of this resistor is such that a 0V to 5V input yields full off to unity gain. This is the input that you would normally use with an ADSR. J4 is another control voltage input with an associated attenuator. You would use this input most commonly for tremolo or amplitude modulation applications. R21 (linear tape) is an initial set pot, with wiper centered giving full off. This pot can be used to manually open up the VCA, or to offset any possible bias present in a control signal applied to J4.

C3 is a rather new development. If you have the spec sheet for the CEM-3330, you won't find C3 mentioned anywhere. But if you are a subscriber to Synthesource (Curtis Electromusic, 110 Highland Avenue, Los Gatos, CA 95030), you may remember a little note that was presented in the Winter 1981 issue, page 11, on how to stabilize the linear control input. This capacitor helps prevent spurious oscillations at low control currents.

Well, that's it: VCAs the simple way! I have four of these VCAs in my system and love them. I confess that VCAs are not exactly the most exciting modules in a synthesizer, but if you have suffered through differential pairs, FETs, and CA3080s like I have in the past you will really appreciate the simplicity and reliable operation of this chip.

Looking ahead. For a dual VCA/dual ADSR circuit, a good printed circuit board layout is important, since stray capacitance can be troublesome. If you want to see how I implemented this dual module, stop back next issue when I present the ADSR and say a few things about construction. #

Specifications

Audio Input:	AC/DC selectable ±5 signal level 50k input impedance, with attenuator
Control voltage:	Full strength input, (0 to 5V), 50k impedance Initial set, from 0 to greater than unity gain

PARTS LIST

All resistors in Ohms; 1/4W; 5% preferred.

R1, R2	100	R15, R16	100k
R3	680	R17, R18	100k trimmer
R4, R5	1k	R19 - R24	100k pot
R6	10k	R25, R26	150k
R7 - R14	56k	R27, R28	470k

All capacitors rated 15 VDC or higher.

C1, C2	100 pF
C3, C4	.001 uF
C5, C6	.01 uF
C7, C8	.22 uF
C9, C10	33 uF, electrolytic

Semiconductors

D1, D2	1N4148 or equivalent
IC1	CEM-3330
IC2	4739 dual op amp

Mechanical parts

J1 - J8	Open circuit 1/4" phone jack
S1, S2	SPST slide switch
Misc.	Knobs, wire, solder, hardware, etc. #

Thank You!

Thanks to your exceptional response, we're almost completely sold out of the parts listed in our Sept/Oct 1981 ad. So, please - no more orders! However, we are currently scouring our warehouse for other bargains that might appeal to the **Polyphony** readership. We didn't have time to get an ad together for this issue, but next issue we'll have some more goodies for you...including rare high-voltage capacitors suitable for all you tube amp fans.

Incidentally, these closeout ads are only appearing in **Polyphony**. It's our way of saying thanks for your support during our years in the parts business, and frankly, we get a better response out of you folks than we do from ads in the other magazines. So, happy experimenting, and thanks again.

Bill Godbout
Godbout Electronics

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POLYTEST

Simple Square Wave Shaper.... page 24

This is the kind of project that almost appears to be too good to be true - it's so simple there might be a tendency to dismiss it. That would be a mistake.

We tested the simple square wave shaper with a variety of sound sources, and it worked well in its intended application of modifying the square and pulse waves emanating from synthesizer VCOs and other square wave generators. The only inconvenience was having to re-adjust the A and D controls for different frequency ranges; however, the range of the SSWS was greater than you would expect. Having a D time greater than the period of the waveform reduced the overall level, but caused no other problems. The A control was, as stated in the text, of limited usefulness with pulse waves but was extremely effective when used with square wave inputs. While Bobby says that the circuitry inside the dotted line is optional, we recommend including it (as well as the input conditioning stage shown in fig. 2) as part of the module for maximum applicability to a variety of sound sources.

There were two major surprises we encountered while testing the SSWS. First, the fact that the device is frequency dependent may actually be an advantage, not a disadvantage. Most acoustic instruments do not have a timbre that is consistent over a given frequency range; take the guitar as an example. An open string has more harmonics, and is louder, than the same string fretted higher up on the fingerboard. Interestingly, the SSWS mimics this type of effect exactly. You can set the A and D controls for a fairly mellow high register sound, while the lower regions sound much brassier. This is tremendously useful for bass synthesizer patches; you want the lower notes to be a little brighter so that they cut, but you also want the upper notes to be a little more muted so that when you play in these upper registers, you don't interfere with other instruments. Aside from a device like the SSWS, there is no simple way to duplicate this effect with conventional synthesis equipment - setting a filter for weighted keyboard tracking, for example, does not even come close to imitating the timbres produced by the SSWS.

Our second surprise occurred when we tried the SSWS with two guitar effects, the Mutron Octave Divider and the Ultra-Fuzz (project #6 from the book "Electronic Projects for Musicians"). By processing the octave lower output of the Mutron with the SSWS, we could achieve rich, bassy sawtooth waves that sounded just great. The only problem was that C1 was a little small for these low frequency waves; we had better results with a 0.02 uF mylar capacitor. Since this value also seems to work well with high frequency signals, you might wish to just use a 0.02 uF capacitor for C1 in the first place.

The Ultra-Fuzz is basically a comparator circuit that produces a square wave output from guitar, voice, and the like. It only accepts one note at a time. If you like square waves, then it's fine as is - but this little circuit really dresses up the basic output. With a little twiddling, you can get everything from spikey, biting pulse sounds to mellower triangle wave effects.

Considering the low cost and wide applicability of the SSWS, it's worth building one. Despite its simplicity, the SSWS is a useful signal processing device that produces its own family of unique sounds.

Editor

Ad Index

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CASIOTONE MODEL TWO-O-TWO

BY MARK STYLES

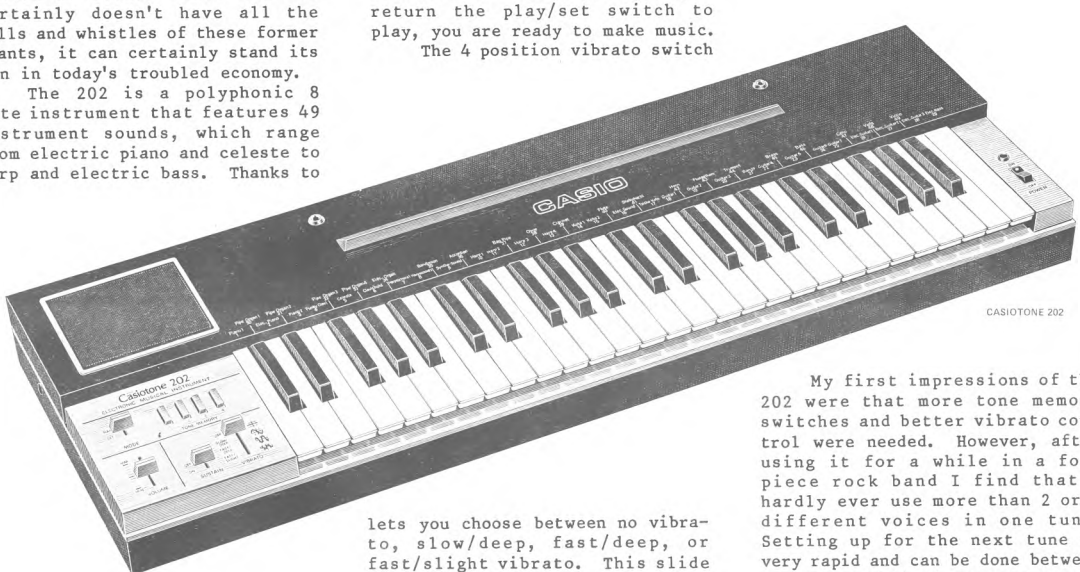
The next generation of digital synthesizers (Synclavier, Fairlight) has been on the market for a while now. Casio's contribution is the Model 202, a cousin to the big boys at Bell Labs and New England Digital that costs about 1/64th as much. While the 202 certainly doesn't have all the bells and whistles of these former giants, it can certainly stand its own in today's troubled economy.

The 202 is a polyphonic 8 note instrument that features 49 instrument sounds, which range from electric piano and celeste to harp and electric bass. Thanks to the two LSI chips and 14 bit DACs, the 202 delivers some amazingly realistic sounds. Some of its features are a presettable tone memory circuit (which allows instant access to any four preset sounds), three different vibratos, pitch tuning, volume control, a built-in speaker, and sustain switch.

To keep both packaging and price economical, Casio designed the presettable memory system. This allows you to set up and instantly recall 4 of the 49 available instrument sounds. You preset an instrument sound by switching the play/set switch to set, depressing one of the 4 "tone memory" switches, and playing a note on the keyboard (in the set mode, each key represents a different instrument sound). When play/set is switched to set, all keyboard notes play middle A, making it easier to discern differences in tonality. Once you return the play/set switch to play, you are ready to make music.

The 4 position vibrato switch lets you choose between no vibrato, slow/deep, fast/deep, or fast/slight vibrato. This slide switch has detents for each stop, and the transition is made smoothly with no glitches in the sound. A sustain switch lengthens the decay of all notes even if you play in a staccato manner. The tuning control varies the pitch approximately plus or minus 1/4 tone. Another useful feature of the 202 is its built-in speaker, which makes it a snap to set up and practice anywhere.

The Model 202 is lightweight (15 lbs) and stylish in design. The specification sheet mentions that it is available in velvet black and walnut grain although I have only seen the all-black units. The preset instrument names are screened in above the keyboard, but the printing is small and from more than a few feet away looks more like a design. Normal stage lighting is usually not adequate to read such small print, but after a few days of use you'll probably end up memorizing the presets anyway.



CASIOTONE 202

My first impressions of the 202 were that more tone memory switches and better vibrato control were needed. However, after using it for a while in a four piece rock band I find that I hardly ever use more than 2 or 3 different voices in one tune. Setting up for the next tune is very rapid and can be done between numbers. While independent control of the vibrato speed and depth would certainly add more versatility to the instrument, for ensemble playing the 4 position vibrato switch is adequate.

The operation manual for the 202 is printed in 4 languages, and is well diagrammed and to the point. All features and procedures are explained in detail, along with examples. One section of the manual lists all the voices along with their note range, which is a useful guide for orchestration. While each voice is playable over a 4 octave range, some voices are placed one or two octaves below middle C. This results in the instrument being able to cover a total of six octaves. For example, the Piano 2 preset begins an octave higher and has a

slightly different tonality from Piano 1.

Standard accessories that come with the 202 are a music rack, plastic dust cover, AC cord, and polishing cloth. Optional accessories include a volume pedal, sustain pedal, hardcover case, and stand. The volume pedal is a standard attenuator which makes use of a stereo plug; if you are running through an amp, it's cheaper to patch a standard DeArmond pedal between the instrument output and amp. The sustain pedal will hold the sound (up to 8 notes) depending on the instrument voices you are playing (organ, string sounds). A plucked instrument sound will still fade away, although with sustain its decay is greatly lengthened. Mechanically speaking, the sustain pedal is very ingenious. It is a simple arrangement of two metal pieces holding a small switch. This is completely enclosed in a thick, 1/4" piece of flexible rubber-like material. The result is a simple, lightweight, dust-free footswitch.

Instrument voices. The instrument sounds are high quality, distortionless, and on the whole, very interesting. A little practice with the sustain and vibrato can yield some remarkable sounds. Some of the preset sounds are:

3 various piano sounds
4 clavichord/harpsichord sounds
3 koto sounds
7 guitar sounds
3 electric guitar sounds
7 assorted organ sounds - pipe, electric, accordian, and bandonian
4 various woodwind instruments
3 strings - cello, viola, and strings
4 brass
2 bass - standard and electric synth type bass
Synthe-Sound - a humorous distorted clavinet type sound
Elect. Sound - a synthetic phased flute type sound

The pipe organ sounds are particularly rich and realistic. The bandonian approximates a tinny, high pitched Vox or Farfisa organ sound. The harpsichord sounds are also very realistic.

The Casiotone sometimes makes dramatic use of sweeping filters, which is very apparent on the Shakuhachi (Japanese bamboo recorder) voice. The Shakuhachi has a very noticeable "wah" effect which is just shy of being too cute.

The insides. As you would expect from a Casio product, the instrument is well constructed and neatly laid out. The power supply is very solid looking, with 6 fast blow fuses. A 4", 10 Watt speaker is completely sealed in a wooden housing and packed with sound absorbent material to give a loud, pleasing sound. The main circuit board utilizes two 64 pin LSI chips which work in tandem to produce the various sounds. The rest of the circuitry comprises two 14 bit DACs, various filters, and gain controls. All connections to the main board are Molex type. Components are well labelled, with some Japanese symbols interspersed. Several test points are located about the board as well.

The keyboard is a separate module (about 1.5" thick) that connects to the circuit board via a 16 pin Molex connector. It is well built, with a light, quick action; all white keys have rounded edges, making the keyboard great for slides. Only the first 8 notes depressed will sound. If a voice with a natural decay is chosen (piano, harp, etc.) and more than 8 notes are depressed and left down, the additional notes will sound as soon as the decay cycle of the first eight notes are completed.

Still being curious about the 202's operation, I tracked down the American division of Casio (15 Gardner Road, Fairfield, NJ 07006), and for $3 I ordered the 26 page service manual. (Incidentally, while the service manual is clear and to the point, it could be longer; and occasional translation discrepencies result in an awkward sentence or two.)

Technically speaking, eight key common signals are generated by one of the LSI chips and applied to the keyboard. Any depressed key short circuits the key common signal and a key input line, which in turn begins the sound generation process. The two LSI chips work together to generate digital waveforms. One controls the "consonants", and the second LSI chip controls the "vowel" sounds for an instrument voice. Each LSI chip has its own 14 bit DAC. After the DAC the consonant signal is fed to a filter block, which consists of one high pass filter and two low pass filters. After filtering, the consonant signal is fed to a volume control circuit that compensates for the various output level variations of different selected tones.

The vowel sound block utilizes three low pass filters. The filters are switched in and out of the circuit, depending on which instrument voice has been selected. If a new voice is selected while you are playing, a cut circuit switches in to prevent glitches or distortion.

Overall evaluation. The Model 202 is an update of the Model 201 which came out last summer. The 201 featured 29 voices (not so well chosen), no tuning facility, and lower fidelity. The 201 did have a few nice extras that were dropped, such as an auxiliary input and effects send/return connections. Casio learned quickly from their mistakes, and came out with the Model 202 this spring.

On first approaching the 202, the sheer number of different instrument sounds can be bewildering; but, they are logically laid out in families of instruments and much better labelled than the Model 201. Personally, I would have liked a few more electronic synth sounds and a few less guitar sounds. A number of the sounds such as celeste, pipe organ 4, harp 1, electric sound and electric bass are exceptionally fine-sounding.

The 202 is an excellent instrument for the price ($500-$650 depending on where you purchase it). The 202's features make it great for practicing, songwriting, or playing on stage. My only complaints involve the on/off switch and vibrato; the on/off switch is located next to high "C" (once while doing a frenzied solo I inadvertently shut off the instrument), while the vibrato lacks flexibility. If Casio added a variable speed/variable depth control for the vibrato, along with some kind of pitch bending option and a slight revoicing of some of the instrument sounds, they would have a truly outstanding live performance instrument.

For even twice its price, nothing can come close to the 202. It is clearly the result of many hours of research into technical, musical, and financial considerations. Judging from the progress Casio has made in the last year, they could conquer the music market within two years. This product shows creativity, efficiency, and craftsmanship - all at an affordable price.♯

PRODUCT REVIEW:

by Bill Rhodes

Another polyphonic (eight voice) mini synthi-orchestra hits the market! But what is refreshing about Korg's latest release is that up to three different voices per note can be played simultaneously. I'm not comparing this instrument to a Prophet 5, or OBX, Opus, Jupiter, Orchestrator, etc. - this baby is in a class by itself. There are many different functions available, and each one becomes more intriguing as you experiment with it.

The Trident, which lists for $4195, incorporates six major features in its 46 lb. frame. These are:

- A separate string ensemble with bass and treble EQ;
- A brass ensemble, with complete ADSR and extensive filtering capabilities;
- A programmable synth with 16 presets;
- Three useful presets for piano/clav;
- A damn good flanger that is relatively quiet and fattens up many of the voices; and
- A joystick that can pitch bend, vibrato/trill, or open the filter.

The five octave keyboard can be split, allowing any combination of up to three voices to be assigned to either end of the keyboard, or the entire keyboard. The graphics are well laid out, the controls for each functional section and intelligently laid out, and the switching is (mostly) color-coded to allow for easy differentiation between function, output, modulation, and triggering related switches.

String section. 16', 8', and 4' string voicings are present, with all voices being affected by the bass and treble EQ controls. A de-modulation control erases the chorusing mode, and a unique retriggering circuit (Korg calls it their "bowing effect") provides overlapping attack envelopes. This is particularly helpful in obtaining good string sounds, since "real" string players do not have identical attack characteristics due to such differences as phrasing, acoustics, and style. I like the string sound, principally because it has a rich chorus, does not sound too reedy, and is low-noise. It is reminiscent of the earlier Delta and Lambda synthesizers, but seems richer in sonority.

Brass section. 16' and 8' voices are available, with complete filter control and VCA ADSR. However, as in the case of many brass emulator keyboards, there is an infernal trigger glitch that occurs with certain filter settings. Also, the brass sound is too weak, not like the characteristic meatiness of the Oberheim or Prophet brass sounds...but I said I wasn't going to compare apples and bananas. Assigning the flanger to the brass section gives a fatter sound, but without it there is only one oscillator per note. Incidentally, the brass section also includes single and multiple triggering.

Programmable synth. The dual oscillators (which can be de-tuned for fullness) provide pulse, square, and sawtooth waveforms; the pulse can be pulse-width modulated with its own rate control (both oscillators produce the same waveform at the same time). There is a complete ADSR for the VCA, but not the VCF. Korg seems to want to use a rotary switch instead of separate attack, decay, sustain, and release controls for their filter, so you can't optimize for punchiness. The filter is a 24 dB/octave low pass type and can be coarsely adjusted with one rotary switch. The programmer has two banks of eight presets for a total of 16 total presets. You can lock the program by flipping a safety interlock on the rear panel of the instrument.

Overall, the synthesizer section gives you typical slow decaying filter sweeps, brass, B-3 (organ), flute, bass, polysynth percussive sounds, heavy modulation sounds, strings, and the like, which are all the more convenient because you can tuck them away safely in memory when you hit on the right sound. This section is slightly noisy, but with proper noise gating and EQ it is great for the studio as well as live.

Preset sounds. There are two piano modes and a clav setting, all of which can be damped by a footpedal for sustaining characteristics. The clav mode is especially nice when used with the flanger to make those funky clavinet sounds.

Modulation options. There's delayed vibrato, with adjustable rate and depth; the joystick, which has an adjustable pitch range, can bend pitch up or down, trill/vibrato, or open the filter.

Summary. Since the string, brass, and synth sections have separate outputs (which therefore can be individually processed), and since the overall sound quality is so good, the Trident is a great instrument in the studio or on stage. Once you get familiar with it, it's easy to use; but best of all there's the richness of sound, which would normally take three keyboards to produce. Play some string lines, add some brass, call up one of your favorite polysynth patches, punch in the flanger (which can be assigned to any or all sections); then realize that you are creating all these sounds on one keyboard! You can play most of the popular synthesizer sounds we know today while layering strings and brass on top in real time. It is amazing - which makes me wonder all the more why they had to name it after...chewing gum?

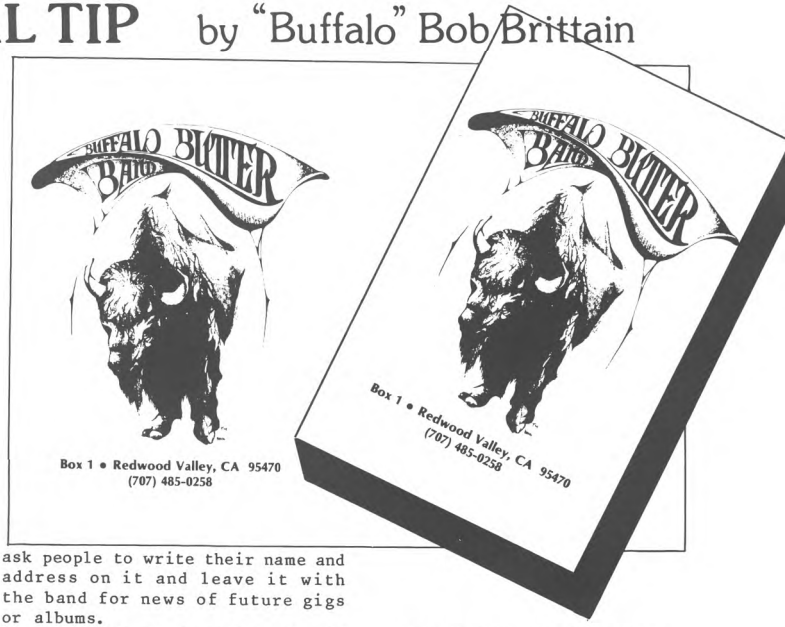
(Editor's note: If you want to hear what the Trident sounds like, it is used extensively in Bill's upcoming release on Jazzical Records, "Key Essentials".) ♯

PROMOTIONAL TIP by "Buffalo" Bob Brittain

Like many Polyphony readers, I promote my band through live performance and cassettes. To simplify promotion, I've come up with a "universal" promotion card that is inexpensive and useful.

I basically took a piece of post card sized stock (5.5" by 4"), and printed the band's logo, address, and phone number on the left hand side (see photo). By adhering to this size, the card provides the following functions:

- **Post card.** Good for sending to people on your mailing list when you want to promote a gig.
- **Cassette liner.** The card can be folded twice and tucked inside a cassette. Having your own cassette label looks better than using the ones provided by manufacturers.
- **Table setting card.** A lot of gigs occur in clubs or restaurants where people sit at tables. You can rubber stamp or overprint information on the right hand side of the card (such as "Album available from cashier for $7.95" or whatever), fold the card in half, and leave it standing up on the table. This is also a good way to promote your next gig, or to get names for your mailing list - just ask people to write their name and address on it and leave it with the band for news of future gigs or albums.



- **Bulletin board card.** If you have a nice looking logo, a card like this really shows up on bulletin boards.
- **Business card.** And this one's big enough that they're not going to lose it right away.

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re-view

hot back-up, Tina's tight basslines and the occasional dub technique lift this from mediocrity.

Jerry Harrison **The Red and the Black** (Sire 3631). Talking Heads' rhythm guitarist/keyboardist sounds even more like recent Talking Heads, backed by the personnel and facilities of "Remain in Light" and Byrne/Eno's "Bush of Ghosts" (reviewed May/June 81). Harrison's singing is similar to Byrne's, and his music indicates that he was important to the development of "Bush of Ghosts". A burnished and meaty production able to stand with the best of them.

David Byrne **Songs from the Broadway Production of "The Catherine Wheel"** (Sire 3645). Byrne hasn't been idle either, as this album indicates. An assortment of normal, abnormal, and treated instruments play out fast, Byrne-ish rock with his odd touches. As usual there are some fascinating electronic alterations, and about a third of the album features Byrne's affected lyrics (including a couple of "found vocals" as on "Bush of Ghosts"). I can't imagine it on Broadway.

Eurythmics **Never Gonna Cry Again-/Le Sinistre** (RCA 68, 12" single); **In the Garden** (RCA 5061). Ex-Tourists Dave Stewart and Ann Lennox make up Eurythmics, and the album bears much resemblance to Tourists material. The single, however, extracts the best tune from the LP and an unreleased flip side. "Never Gonna Cry Again" is a driving rocker with several nice touches (like the electronic noises and French horn), and "Le Sinistre" is a sinister tune based around footsteps and a grand piano bass line.

DEVO **New Traditionalists** (Warner Bros. 3595). DEVO has been doing what they do long enough that they can probably do it in their sleep. What they do, for the uninitiated, are quite traditional song structures bopped up by having all the instrumental parts (except drums and a little guitar) played on catchy synthesizers. The lyrics wouldn't bear quoting, but the toe taps anyway.

Supersister **A Present from Nancy** (Polydor 2441-016), **To the Highest Bidder** (Polydor 2310-146), **Pudding and Gisteren** (Polydor 2480-153), **Superstarshine Vol. 3** (Polydor 2419-030), **Iskander** (Polydor 2925-021), **Sweet Okay** (Polydor 2441-048). Supersister was a Dutch band from 1969 until 1975, who started as a very tight, conservatory-trained rock band and gradually evolved into a still-tight jazz parody of themselves. Full of quirky rhythms, fast changes, and hummable melodies, these are records to play for friends who believe that nothing good ever came out of rock and roll.

Tangerine Dream **Exit** (Elektra 5E-557). Take $100,000 worth of gear, a drumkit and two months in the studio and what do you get? Unfortunately, 40 edited minutes of $100,000 patches. It's not quite rock, and it's not quite avant-garde - it's just two months of twisting dials with a beat. Of course, the patches are VERY nice.

Everfriend **Tropicsphere** (Jazzical 009033), **Sphere of Influence** (Jazzical 105072). Playing classical piano and keyboard synthesizers, Bill Rhodes manages to outflash his acknowledged influences Chick Corea, Keith Emerson, and Rick Wakeman. The musicianship is flawless, although the synthesizers are used mostly for melodic fills and ornamentation.

Paul Winter **Common Ground** (A & M 4698), **Callings** (Living Music Records 1). Jazz saxophonist Paul Winter creates musique concrete when he plays to recordings of whales, dolphins, wolves, and eagles. Sometimes imitative, sometimes making a tune out of a call, sometimes just playing out of the spirit of the animal, Winter shows a real affinity and affection for his fellow creatures.

The B-52s **Party Mix** (Warner Bros. mini 3596, E.P.). "Tacky" describes the B-52's perfectly, with their beehive hairdos, lava lights, off-key vocals and cheesy melodies. **Party Mix** is supposed to be dub versions of some of their songs, but these seem pretty straightforward with only an occasional echo-out. Fun if you're in the mood.

Serge Blenner's La Vogue **Magazin Frivole** (Sky 059). Synthesizer and rhythm box, rhythm box and synthesizer - I think this stuff comes in tubes.

Crusaders **Standing Tall** (MCA 5254). Joe Cocker's earthy singing perfectly balances the slick uptown jazz of the Crusaders, with bittersweet lyrics about his recovery from alcoholism. The other 5 tunes are faultless uptempo instrumentals, including Sample's mastery of keyboard synthesizers.

Colin Newman **Provisionally Entitled The Singing Fish** (4AD cad 108). A variety of instrumental textures - from electronic daydreams to chomping rock - from multi-instrumentalist Newman. He's from the English band Wire, one of the more interesting descendants of new wave.

Deutsch Amerikanische Freundschaft **Die Kleinen und Die Bosen** (Mute Stumm 1). I think this is D.A.F.'s first record (March 1980) and they've released a couple since. I've heard that the newer one(s) aren't as experimental as "Kleinen & Bosen" and that would be a shame. It's full of wonderfully strange synthesizer lines, freaky lyrics sung crazily (in German, of course) and assorted rude interruptions by sax, guitar, synth, and voice. Definitely out of the ordinary.

Stuart Dempster **In The Great Abbey of Clement VI** (1750 Arch 1775). Remember "Inside", where Paul Horn played solo flute inside the Taj Mahal? Well, Stuart Dempster plays trombone (side 1) and plastic sewer pipe (side 2) inside this French cathedral, and at times it's hard to believe you're not hearing a synthesizer into a tape loop.

Jon Gibson **Two Solo Pieces** (Chatham Square 24). Jon Gibson works with patterns, both as a visual artist and on record. Side 1 is a rigidly structured pipe organ drone, the second side is random phrases on a flute drawn from a narrow range of choices. As you might suspect, Gibson is from the Riley/Reich/Glass school of microscopic composing.

The Tapes **Party** (Passport 9842). A lot of "new wave" relies heavily on effect, but some composers write material that would stand up under any production. The Tapes, from Holland, write strong, intelligent material which doesn't seem to have attracted the attention it deserves. Check it out.

Simple Minds **Sons and Fascination** (Virgin 2207). Synthesizer sample and hold keeps time, while voice and guitar weave simple tunes around it. Simple Minds have a good feel for not rushing things, or bogging them down with unnecessary frills. ♯

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NEW MINI-MOOG - still in factory carton - $1000 plus shipping. ARIES owners: Assembled Aries system 300 modules (never used). AR-318 S/H, noise, clock $75, AR-328 Reverb/output $130, AR-339 Multimode VCF $155. Assembled value:$815 ($545 unassembled) - will sell all 3 above modules for $300. Also, AR-310 module case (unassembled) $60, AR-320 Keyboard case (unassembled) $40, AR-326 power $20. Call Harry Poole (803) 667-4883 for details, or write 1300 Valparaiso N-10, Florence, SC 29501.

PAIA PROTEUS I Programmable Preset Lead synthesizer, Factory Assembled, Bought new in Sept. 81, used less than 5 hours (still in original carton), want to move up to a computer, $450.00. V. Walraven, 4812 Lionel Ave., Texarkana, TX 75503 (214) 838-5642

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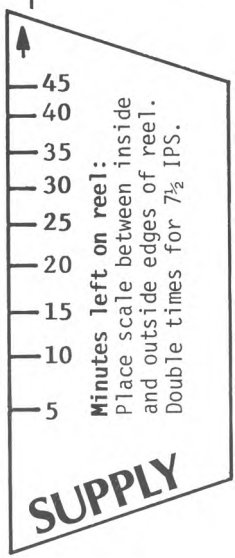
TAPE TIMER RULER CUT-OUTS



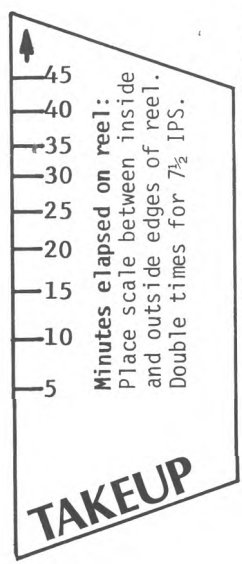
by Craig Anderton

Have you ever been recording and wondered how much time was left on the supply reel, or how much time had elapsed on the take-up reel? Well, it happened to me just one too many times, and what with necessity being the mother of invention...

Note that both rulers are designed for use with 3600 foot reels of tape (Maxell UD 35-180 et al); differently calibrated rulers would be required for shorter tape lengths or different reel sizes. For greatest longevity of the rulers, I'd suggest photocopying or cutting out this page, and pasting the timer rulers on to thick cardboard or posterboard.

Using either ruler is simple. Referring to figure 1, place the ruler against the surface of the appropriate reel so that the edge with the arrow points to the outside flange of the reel, and the inside edge (at the other end of the calibrated scale from the arrow) is pointing at the inside edge of the reel. Read the amount of time directly on the scale in minutes; double times for 7.5 IPS operation, or halve times for 30 IPS operation.

There it is, a tape timer that takes 5 minutes to build and doesn't even need to have its batteries changed! I hope that you find it useful; may you never again try to record a 6 minute piece with 5 minutes of tape remaining.



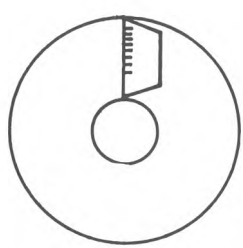


Figure 1

DETAILS:

.....continued from page 23

Specifications

Input resistance
Balanced: 20k Ohms each leg to ground
Unbalanced: 20k Ohms
"In from Circuit": 100k Ohms

Output resistance
Main out: 56 Ohms
"Out to Circuit": less than 1 Ohm

THD+N (+4 dBm, 1.23 Vrms, into 600 Ohms)
20 - 20 KHz: less than 0.009%

S/N ratio (A-weighted)
-98 dB re +4 dBm output level

Common mode rejection
200 Hz: 100 dB
2 kHz: 80 dB
20 KHz: 60 dB

Frequency response
10 Hz - 100 kHz, +0/-0.25 dB

Maximum output level
±15 Volt supplies: 9 Vrms into 10k Ohms, 7.75 Vrms into 600 Ohms (+20 dBm)
±9 Volt supplies: 5.4 Vrms into 10k Ohms, 4.65 Vrms into 600 Ohms (+15.6 dBm)

Slew rate
10 Volts per microsecond

Parts List

Resistors (all resistances in Ohms, 1/4 W rating)

R1,R2	30.1k, 1% metal film
R3	9.31k, 1% metal film
R4	10k, 1% metal film
R5	1k trimpot (CTS X201R102B or equivalent)
R6/7/9	100k, 5% carbon composition or film
R8	56 Ohm, 5% carbon composition or film
R10, R11	100 Ohm, 5% carbon composition or film

Capacitors (all rated at 16V DC or greater)

C1, C2	10 uF electrolytic
C3, C4	100 uF electrolytic

Semiconductors

IC1	NE5532N (optimum performance), or TL072 (satisfactory performance)

Other parts

SW1	Three pole, double-throw switch (optional)
Misc.	8 pin IC socket, hookup wire, suitable enclosure, power supply, circuit board, solder, etc.

Note: The following is available from TOLECO Systems, Box 401, Kingston, WA 98346: #GG-1 kit of parts - includes NE5532, PC mount jacks, and etched/drilled/plated glass-epoxy printed circuit board (but less "other parts"), for $14.00 plus $1.00 postage and handling in the U.S. and Canada. Circuit board only (order #GG-2), $5.00 postpaid in U.S. and Canada. Washington state residents add 5.3% sales tax. No COD orders.

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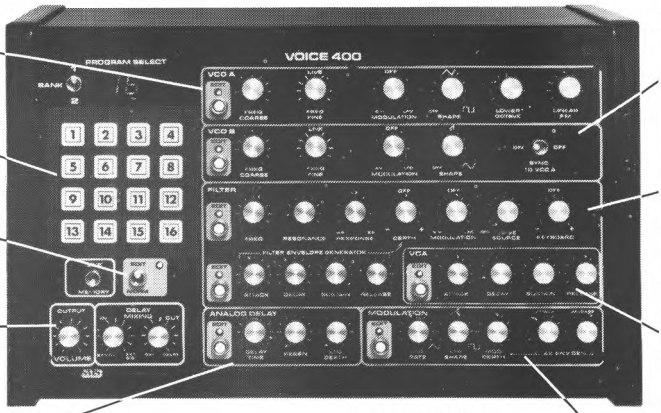

Oscillator B
continuous waveshaping from saw to sine, AR envelope generator or LFO modulation, hard sync to VCO A.

Filter
High pass, Low pass, Band pass all modes are 24db/oct. Controls include Resonance, Response (continuously variable) ± ADSR modulation, S/H or LFO mod, Noise source, Keyboard tracking.

Voltage Controlled Amplifier
has its own ADSR and features low noise and wide dynamic range.

Analog Delay
wide range low noise delay line operates from flanging to multiple repeats. Regeneration and LFO depth control will create a wide range of effects.

Modulation
wide range Low Frequency Oscillator with continuous waveshaping of three waveforms. LFO may be modulated by the Attack Release envelope generator.

The Voice 400 answers the need for a programmable synthesizer that's versatile enough to be all these things:

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The new Veloci-Touch controller from PAIA adds what may be the two most important parameters any electronic keyboard can have - Velocity and Pressure.

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Even that's not all. The Veloci-Touch controller also provides an output proportional to the pressure you apply to the key after it's down. Imagine - tremolo the natural way.

The best part of this minor miracle from PAIA is that it's non-denominational. You can retro-fit it to essentially any synthesizer from any manufacturer. At a price that's so low you won't believe it's possible.

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