POLYPHONY

Sept./Oct. 1981
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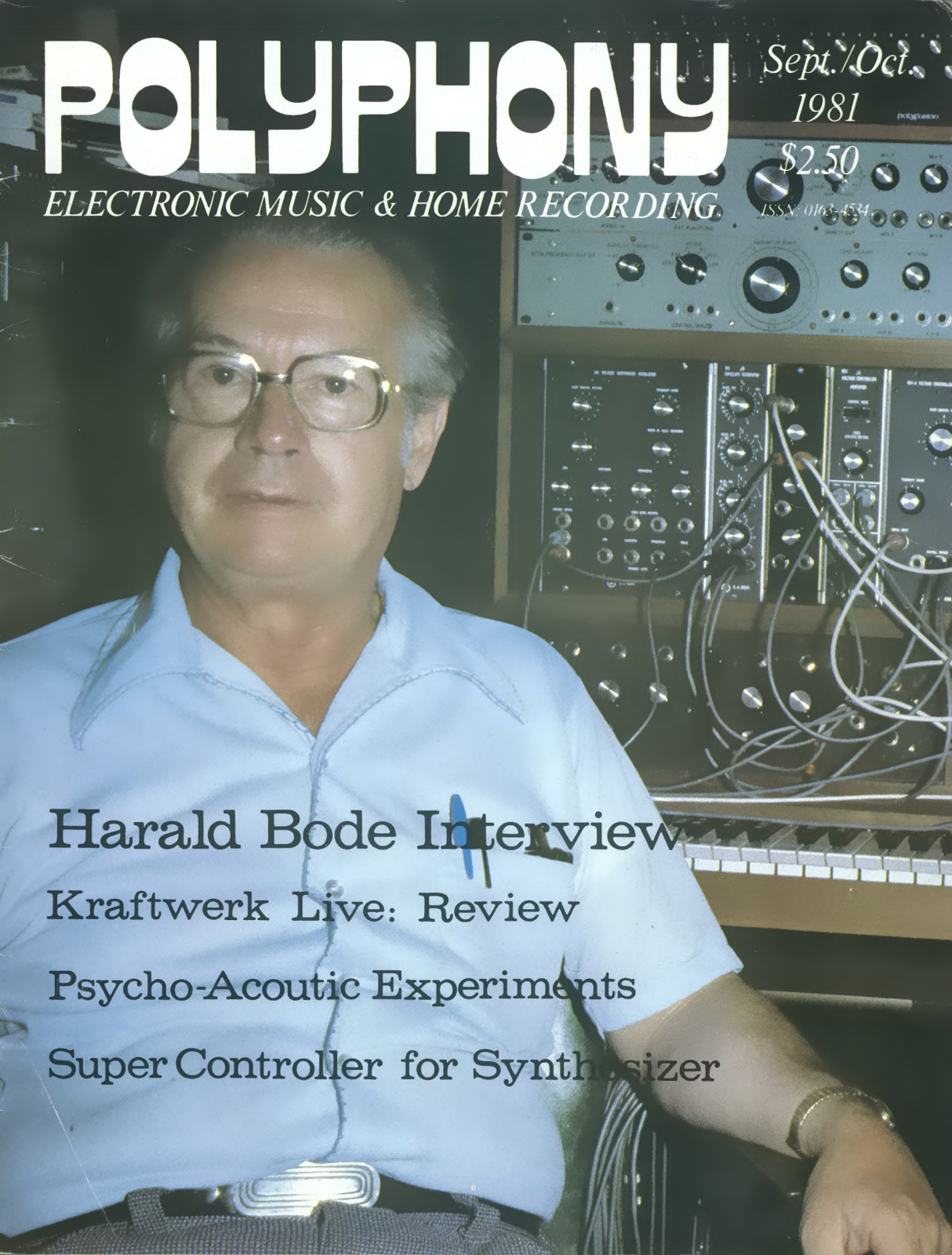
ELECTRONIC MUSIC & HOME RECORDING



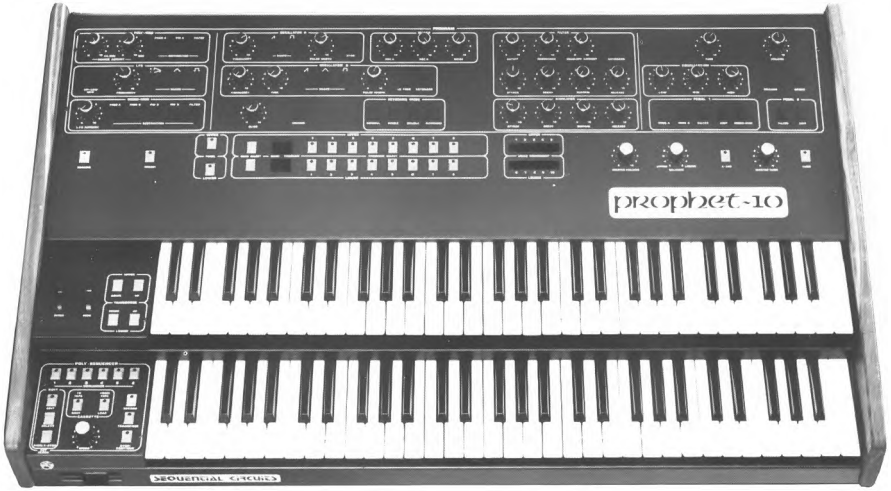
Harald Bode Interview

Kraftwerk Live: Review

Psycho-Acoutic Experiments

Super Controller for Synthesizer

THE ULTIMATE KEYBOARD



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

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

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

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

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

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

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

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

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LETTERS

MORE TUBE TIPS

Here's a tip on tubes that might be useful to Polyphony readers who work with tube guitar amps.

The most common problems I've found in older (as well as some newer) tube circuits are inadequate filtering of the power supply, coupling capacitors that are too small in value (thereby restricting bass response), or coupling capacitors that leak a little. The capacitor problems stem from the fact that with the old paper-type capacitors, if you had values that were big enough to efficiently pass low frequencies, you had to use a very low or minimal voltage rating in order to keep the physical size down - which makes the leakage problem worse. I assume that modern capacitors make it easier to find the right compromise. But recently I ran across some new coupling capacitors in a tube circuit that leaked just enough DC to affect the bias of the next tube. It is a good idea to mount these capacitors in such a way that you can replace them easily and can lift the output end to check for DC voltage leaks.

Another consideration is that a solder joint that might be all right in a low impedance circuit can cause all kinds of noise in a tube circuit, so you want a good physical joint.

By the way, although it's currently out of print Jack Darr's "Electric Guitar Amplifier Handbook" (Howard W. Sams #20848 is still very useful.

Carl Hartman
Newport Beach, CA

WHITHER SANKEN?

First, I want to let you know how much I enjoyed "DEVICE" during its brief life. But I enjoy Polyphony a lot more!

I'm writing in hopes that you can give me a little info.

In the Jan/Feb issue of Polyphony you ran an article on a 50 Watt/channel stereo amp, using Sanken hybrids. I'd love to build one, but I can't find anyone that carries the little guys. Could you please give me the name and address of someone who carries the modules? Thank you!

Steve Porter
Ventura, CA

Steve - Sanken modules are getting hard to find, but in the 9/81 issue of Radio-Electronics, Solid State Sales (PO Box 74P, Somerville, MA 02143; tel. 617-547-7053) is advertising Sanken 50 Watt modules for $27.50 each. Incidentally, Greg Schneck of PGS Electronics tried to purchase some Sanken modules for sale through his company, but had the same problems you encountered. While we couldn't get confirmation of this, it appears that Sanken is discontinuing these models and may be coming out with revised versions in the future. In the meantime, if you need some Sankens better move fast - there aren't many left. However, other hybrid amps (such as those made by Sanyo) sometimes show up surplus and are applied in much the same way as the Sankens. In fact, one of our regular authors is working on a power amp article using some of the new FET output hybrids that have just been introduced to the market.

THE ELUSIVE "GOOD SOUND"

I've been a musician most of my life. Recently I joined a group driving two Bose 802-Es with analog delay, four mikes, and two monitor systems. I would like to have a comprehensive understanding of how to best use a system like this; EQ etc. I don't know where to go to get info to read up on this. Can you suggest some books? I would like the band to sound good but I'm a little lost.

Jim Falwero
Cherry Valley, NY

Jim - Unfortunately, there are no hard and fast rules for getting a "good sound" with regards to EQ and such. All you really have to go by is your ears; if the drums sound too bright, then cut some treble...if they sound too dull, boost the treble somewhat. However, at some point feedback might intrude and make it impossible to get the exact EQ you want. All in all, PA requirements change from gig to gig, from musician to musician, and from one piece of equipment to the next.

One source that does offer insights on live sound is Modern Recording & Music magazine. They often have features on touring bands, and the type of equipment and techniques used to get a specific sound. Even among the pros, though, there is disagreement on how to achieve a "good sound".

Write for... POLYPHONY

.....Polyphony will pay $25 per printed page for articles on items such as equipment modification, circuit design and "build it" projects, software, equipment service and maintenance, interviews, theory tutorials, recording tips and techniques, and other topics of interest to our readers. $10 is paid for each patch chart published - we want patches for any model synthesizer. We also want photo or graphic submissions for use on our cover .....
.....If you have never written an article before, don't hesitate to give it a try. Material need not be polished -- that's our editor's job! Illustrations and schematics can be presented as rough pencil drawings. Photos should be black and white glossies. Text should preferably be typed double spaced .....
.....All material submitted must be original and never before published. Payment is made upon publication. Submissions are returned if you provide a SASE. All materials accepted and associated copyrights become the property of POLYPHONY (unless arranged otherwise) and may not be reproduced without written permission from the publisher. If you'd like to test your ideas first, send 'em in. Or, if you have any questions, let us know .....

If any readers know of good books on PA installation and applications, drop us a note so that we can check out the book for possible inclusion among Polymart's offerings.

DIGITAL VCO/CASIO CHIPS

In regard to my letter about the "Digital VCO" in the March/April issue, one really interesting option I didn't think to mention (and haven't tried yet) is to use Vic Huebner's "8 Bit Pseudo-Random Generator (Electronotes #67) with its 8 bit latched outputs to provide a random waveshape capability. It might be necessary to change the clock IC's timing capacitor, though.

One final thing in closing, the Casio VL-Tone review was very interesting. I would like to get one myself! (I will very soon.) What I'd like even more is for Casio to make their chips available to experimenters. One circuit that comes to mind is driving their mysterious "waveform computer chip" with a voltage controlled clock, tracking a keyboard or other controller. This would produce a voice with more complexity than standard VCO waveforms before filtering.

I guess by now you've figured out that I'm supportive of your efforts and am looking for good things from Polyphony in the future! Best wishes and good luck...

David Vosh
Gaithersburg, MD

TODAY'S TECHNOLOGY TODAY

16.777 SECOND ECHO WITHOUT TAPE

7 OCTAVE (82 NOTE) AUTOMATIC CHROMATIC TUNER FOR LESS THAN $200

4 OCTAVE (48 NOTE) AUTOMATIC CHROMATIC TUNER FOR LESS THAN $100

It's Already Happened At Imagineering Audio, - Not in the future, but **TODAY.**

The ECHO/DIGITAL RECORDER records up to 16.777 seconds without the use of tape! The EDR will also ECHO or REVERSE ECHO (in times from .0011-16.777 seconds),ECHO HOLD, ECHO REVERSE HOLD, PLAYBACK forward or reverse and LOOP forward or reverse. Produce studio effects like multi-track and sound on sound recording - live on stage - with one of the two available remote controls . . . . **TODAY.**

Imagineering Audio's ALPHATONE 3 was the only alphabetical readout digital tuner on the market 'til the ALPHATONE JR. came along. The ALPHATONE 3 can TRANSPOSE and it is the only direct in-line tuner that allows you to TUNE SILENTLY while performing. You'll like the ALPHATONE 3 for guitar tuning, and wait until you try it for tuning and monitoring your **synthesizer!!** Now the ALPHATONE JR. has arrived with 4 octave chromatic and automatic tuning for under $100 . . .**TODAY.**

These three Imagineering concepts designed, engineered, and made in Oregon, U.S.A. are here . . . **TODAY.** There are more to come so please STAY TUNED.

IMAGINEARING AUDIO

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re-view

by Robert Carlberg

Magnetic particle review. This month, I'm going to review some of the cassettes that have come in. Cassettes attract a slightly different crowd from the private LP biz; not only do cassettes require a much smaller investment, they also have smaller profit potential. I am limiting myself to nationally distributed cassettes so that, if someone wants one, it would be relatively easy to acquire.

If you have 46 or 60 or 90 minutes of music that you'd like to have distributed, contact one of the several distributors listed below. Then have them contact us, because we'd like to continue our coverage of independent cassette activity.

Don Slepian **Sea of Bliss;** Don Slepian **Open Spaces.**

Don Slepian, at 28, is something of a pioneer in the electronic music cassette business. His "Electronic Music from the Rainbow Isle" (1978, now out of print) has sold an impressive (for cassettes) 400+ copies (incidentally, the two best tracks from "Rainbow" were recycled onto his recent LP, "Computer Don't Breakdown"). Side two of that album, and these two cassettes, feature music Don calls "sonic perfume". What used to be known as "cosmic", "floating", or "meditation music" is now coming under the nomenclature of "healing", "ambient", or "New Age music", or in Don's case, "aural fragrances".

Don's version consists of very rich symphonic and vocal-like chords realized on digital synthesizer, gliding calmly back and forth, up and down in a percussionless, gentle tone poem. In the wrong hands this could have been quite somnolent, but Don manages to maintain interest with a variety of synthesizer voices (including some very convincing flute and koto), by varying the tempo, and most of all by avoiding formulas. Both tapes, as well as several other non-electronic "healing" cassettes, are available from Plumeria Productions, PO Box 54, Kailua, HI 96734; $8.95 each plus $1.00 shipping.

Emerald Web **Whispered Visions;** Emerald Web **Sound-Trek**

Flutists/synthesists Bob Stohl and Kat Epple also present "healing" music, but augmented by sequencer, tape echo, chord changes, shorter formats, and of course real flutes. Their synthesizers are less exotic and thus more recognizable than Slepian's, but the faster pace also makes them less of a focal point. The Web's material would be more likely classed as "songs", though "a beat" and strong melodies are again absent. Also, occasionally a track will be given over totally to tape alteration of bells or voice, leaving a more varied overall impression. Available directly from the artists at BobKat Productions, 58 Roble Road, Berkeley, CA 97405; $7.98 postpaid, or from Eurock Distribution, PO Box 4181, Torrance, CA 90510; $6.00 each plus $1 postage.

Bernard Xolotl **Return of the Golden Mean**

Guitarist Xolotl utilizes a near-feedback tape echo to elongate his fast guitar runs and Zeta Systems guitar synthesizer. Backing him are a violinist (3 tracks), a cellist (1 track), and Cyrille Verdeaux (ex-Clearlight Orchestra) on synthesizer (2 tracks). The energy of the playing makes this pretty dynamic for "meditation" music, and although Bernard points out "There are no sequences on this tape - all notes are played by hand", at times he sounds like an untended sequencer. To be fair, though, there are also some very dreamy minutes. This tape, along with one other by Xolotl, two by Verdeaux and a joint effort, are available from Fortuna Records, 11 Kavon Court, Novato, CA 94947; $8.98 each plus $1 postage.

Galen **Xom;** Galen **Limacon**

Whatever "meditation" music is, synthesist Galen Herod definitely isn't. Dark and foreboding self-triggered synthesizer is woven into slightly frightening soundtracks, causing the listener to immediately sit up and take notice. Galen evokes a very effective "nightmare at the machine shop" feel, while presenting it in a refined, always-evolving structure. He is one of the few artists in electronic music (Frank Garvey, next up, being another) who uses the synthesizer as a totally new instrument, not just another keyboard. Galen, however, is no stranger to the larger musical conventions as he presents themes, variations on these themes, contrasting themes, and returns to the opening themes. Galen seems to have invented a new post-Industrial Revolution music, which is graced by a wise beauty. Available from Eurock Distribution, PO Box 4181, Torrance, CA 90510; $6.00 each plus $1 postage.

Frank Garvey **Totem**

Frank Garvey is one of the only musicians to move FROM albums TO cassette releases. His modestly successful private LPs "Labyrinth" and "Omnicircus" were both elaborate concept albums, somewhat difficult to listen to but rewarding of the effort.

continued on page.....11

FINALLY THERE'S A COMPACT YOU CAN DRIVE AT 15 ips.

Introducing the Tascam 22-4.

After setting the standard for ¼" 4-track recording, it's only logical that Tascam would be the one to introduce the compact generation. After all, we developed the format.

Which means we knew what we were doing when we designed this high-speed transport drive for 7" reels.

The 22-4 4-track multi-channel recorder with sync was built to use 1800 feet of one mil tape. At 15 ips that gives you 22½ minutes of recording time.

And we didn't sacrifice an inch of quality to get you up to speed. Have a look.

Specifications (15 ips)

Wow and Flutter (Teac Test Tape YTT-2004): 0.07% peak (IEC/ANSI weighted), 0.10% peak (IEC/ANSI unweighted), 0.04% RMS (NAB weighted), 0.07% RMS (NAB unweighted).

Frequency Response* Record/Reproduce 0 dB referenced to 1 kHz: 40Hz-22kHz ± 3dB at OVU, 35Hz-25kHz at −10 VU.

Signal to Noise Ratio* at a reference of 1 kHz, at 10 dB above OVU, 585 nWb/m: 61dB A weighted (NAB), 56dB unweighted.

The 22-4 is a hard-working, no-frills machine. Which makes it perfect for the System 20, Tascam's hard-working, no-frills manual mixer.

See them both at your Tascam dealer. For the one nearest you, plus more information, just write to us at the address below.

Then you can test drive our new compact 22-4. It's the only way to see how well it performs at high speed.

TASCAM CREATIVE SERIES
TEAC Production Products

EDITOR'S note

This month, we have a favor to ask of you. It won't take much of your time and effort, but it will help us immensely.

What we need is for as many of you as possible to fill out the reader survey included in this issue.

The reader survey performs two very important functions. First of all, it lets us know more about you - who you are, what you're doing, and what you want. With this information, we can then determine what direction Polyphony should take in the months and years ahead to best serve our readership. Of course, your letters are also invaluable and carefully studied; but not everybody has the time or inclination to sit down and write a letter. Hopefully, just about everybody will have the time to answer our reader survey. Simply clip the page (or photocopy it if you can't bear the thought of cutting up this issue), and send it in to us as soon as possible.

The second important function of a reader survey is to help advertisers decide whether Polyphony is the right medium in which to spread their message. Advertising revenue is important for a small publication like ours, as it allows us to expand, start new projects (such as publishing our own books), and take out advertising in other publications to let more people know about Polyphony. However, it's important that we match the advertisers to the readers. For example, if we find out that 90% of you have some type of home recording studio, then it makes sense to solicit ads from tape manufacturers, tape recorder companies, and the like. We only want advertisers who get results from Polyphony, because that builds up long-term support that benefits you, us, and the companies.

So, take the time to complete and send in the reader survey. This will insure that you'll get the kinds of articles you want, and also help us get a better "feel" for the wants and needs of our readers.

* * * *

While we're on the subject of advertising, here's another way that you can help us and also help those companies that support what we're doing. If you see an item in Polyphony that piques your interest, and decide to write or call for additional information, please mention Polyphony in your correspondance. These companies need to know which ads are pulling for them, and the only way they'll find out is if you tell them. With the present economic state of the music business, companies can't afford to throw away money by advertising in non-productive or non-cost-effective media. Polyphony happens to be one of the best deals going for advertisers right now; let them know that you're getting the message.

* * * *

So much for the business end of things - now for an opinion.

I recall being told back in 1975 that within 5 years, this entire industry was going to be all-digital and that analog circuitry as we know it would cease to exist. Of course, that hasn't happened; but what has happened is a polarization among some people into analog vs. digital factions. Why people feel it necessary to associate themselves exclusively with one technology is something I don't quite understand; yet, it happens. So, on the one hand you have people saying that digital is the only way to go because it's predictable, the prices will "eventually" come down, and that making changes in software is a lot easier than making changes in hardware. These are all valid points.

Those who say that analog is the only way to go cite inexpensiveness, easy implementation, and "naturalness" of sound. These are also valid points; after all, think of all the things you can do with a single op amp compared to how many digital circuits it would take to construct something as simple as a filter. The analog camp also says that digital circuitry isn't presently fast enough to generate high frequency waveforms, that entering parameters through a keypad is not as musical as twisting a knob, and that the power consumption of a typical digital system dwarfs that of any analog system.

But to me, the question is not whether analog or digital will prevail: the question is why people don't recognize that BOTH forms will prevail, and probably co-exist harmoniously in systems that utilize the best of both analog and digital technology.

Obviously, some people already recognize this fact. John Simonton's Lab Notes series in this magazine described a cost-effective system that combined analog audio processing modules with digital control; or, how about the Prophet synthesizers? Their combination of analog modules and computer control has proven to be both commercially and artistically successful.

The future seldom follows a single, neat, specialized path; as digital circuitry evolves, so does analog circuitry. If you're into digital, take the time to learn some analog techniques (it might even help you design digital equipment more efficiently). And if you're into analog, you might be surprised at how inexpensive and easy-to-use today's logic families have become. But whatever you do, don't turn the subject into "us vs. them". It's only by selecting a synthesis (there's that word again!) of the best of all possible worlds that we end up with the best of all possible worlds.

Please fill out the survey → →

For you, is musical electronics or music:
_____A full time occupation
_____Part time/supplementary income
_____Hobby
_____Interested bystander

What is your principal involvement with music?
_____Gigging musician
_____Roady
_____Recording engineer/producer
_____Technical/repair
_____Equipment manufacturer
_____Employee of manufacturer
_____Instrument/equipment designer
_____Educator
_____Other_____

How do you obtain most of your equipment?
_____Build it myself
_____Buy it manufactured
_____Buy and build more or less equally
_____Mostly build
_____Mostly buy
_____Have a friend build it for me

Are you ____male or ____female?

How did you learn about Polyphony?
_____
_____

How long have you been a reader?
_____Less than a year
_____1 to 2 years
_____2 to 3 years
_____3 to 4 years
_____4 to 5 years
_____Since Polyphony's inception

What other magazines do you read regularly or semi-regularly?

_____Guitar Player	_____Modern Recording
_____Rolling Stone	_____Syne
_____Sound Arts	_____Keyboard
_____Radio-Electronics	_____Recording Engineer/Producer
_____Popular Electronics	_____Broadcast Engineering
_____Modern Drummer	_____Electronotes
_____Frets	_____Guitar World
_____Interval	_____AES Journal
_____Trouser Press	_____Canadian Musician
_____Creem	_____Music Sound/Output

_____Other_____
_____
_____

Which instruments to do you play?
_____Synthesizer
_____Keyboards other than synthesizer
_____Guitar synthesizer
_____Electric guitar
_____Acoustic guitar
_____Electronic percussion
_____Acoustic percussion
_____Vocalist
_____Wind instruments
_____Other_____

Do you own any of the following?
_____4 track multichannel recorder
_____8 track multichannel recorder
_____Other reel-to-reel recorder
_____Cassette recorder
_____Videocassette recorder
_____Videodisk player

When Polyphony starts issuing music on its own label, would you prefer...
_____Cassette format
_____LP format

How old are you?
_____5-15
_____16-20
_____21-30
_____30-40
_____Over 40

Please check which of the following you would like to see covered regularly in Polyphony.

_____Home recording
_____Recording techniques/production
_____Engineering techniques for recording
_____Synthesizer modules/construction
_____Synthesizer techniques/applications
_____Guitar synthesis
_____Guitar electronics
_____Signal processing devices/construction
_____Signal processing devices/applications
_____Equipment reviews
_____Record reviews
_____Performance reviews
_____Book reviews
_____Composition techniques
_____Electronic music circuit design
_____Patches
_____Interviews
_____Electronic percussion
_____Environmental sounds
_____Music software for PAIA systems
_____Music software for TRS-80
_____Music software for Apple
_____Music software for S-100
_____Equipment modifications
_____Fiction involving music/electronics

Since the Jan/Feb 1981 issue, which have been your favorite articles? _____
_____
_____
_____

Which articles have interested you the least?
_____
_____
_____
_____

I feel that the level of articles is:
_____Mostly too basic
_____Mostly too advanced
_____Mostly just right

Do you buy electronic components via mail order?
_____Yes, sometimes
_____Yes, almost all the time
_____No, buy parts locally
_____Buy parts both locally and through the mail

Do you have any suggestions for ways in which Polymart can serve you better?
_____
_____
_____
_____
_____

Comments/suggestions:

COMPLETE and RETURN to: Survey, Box 20305, Oklahoma City, OK 73156

CURRENT EVENTS

'Tell Them You Saw It In Polyphony'

Meet CLEM. CLEM stands for Contact List of Electronic Music, a reference for contacts in the ever-growing field of electronic music. It tries to keep current lists of all organizations, magazines, and record distributors involved in electronic music as well as covering some new wve, meditative, and other forms of music. This 8 page photocopied newsletter is available for the cost of postage (two ounces; US or Candian stamps OK) from Alex Douglas, PO Box 86010, North Vancouver, British Columbia, V7L 4J5, Canada. Alex would also like to hear about organizations, publications, and records/tapes not on the list for inclusion in future editions of CLEM.

Updated mods from Robin Whittle. Robin Whittle, who wrote the well-received article on Casio M-10 mods in the March/April issue of Polyphony, now offers an updated technical bulletin. This 14 page publication covers all the material presented in his article, plus much additional material on the M-10 and several new modifications for the Casio MT-30. There is also invaluable data on the mysterious workings of these instruments in addition to the modifications. Highly recommended for all Casio enthusiasts, the bulletin is available for $5 Australian or $6 US (send bank draft on an Australian bank or US$6 in American paper money, since money orders or personal checks from a foreign country are difficult to exchange). Address orders directly to Robin Whittle, 42P Yeneda St., North Balwyn, 3104 Melbourne, Australia. Oh yes, there's even some hot gossip - check out the middle right hand column on pg11!

Korg Tuner. The Korg (89 Frost Street, Westbury, NY 11590) Micro Six Guitar and Bass Tuner uses a meter readout together with a 6 position selector switch for open string frequencies to tune guitar or bass to pitch. The tuner is compact and features a quartz timing reference for accuracy.

New live performance synthesizer. The Syntar from Performance Music Systems (PO Box 6028, Bend, Oregon 97708) is a three octave, portable (14 lb.) "lead" synthesizer with a unique left hand controller for pitch bending, sustain, filter sweep, filter modulation, etc. Contact the factory for technical details as well as pricing and delivery information.

The case for video. TEAC (7733 Telegraph Road, Montebello, CA 90640) has introduced the CS34VU, an upright videocassette storage cabinet with sliding glass doors and capacity for up to 34 video tapes. It can store either Betamax or VHS formats. The suggested retail price is $60.

New Boss effects. The SD-1 Super Overdrive is similar to the Boss OD-1, but includes an active tone control. Designed to simulate the sound of an overdriven tube amp, the SD-1 includes level, drive, and tone controls and lists for $99.50.

The PH-1R phaser expands on the PH-1 by including a resonance control for depth of phase. Other controls include rate and depth. The PH-1R lists for $120.

New operating system from Syntauri. The alphaPlus^{tm} operating system, applied to the Syntauri 61 note velocity sensitive keyboard in conjunction with an Apple I or II 48k computer and the Mountain Computer Co. MusicSystem oscillators, provides 8 voice polyphony, over 2300 note sequencing, and quick keyboard transposition. Recording is done live at the keyboard; dynamics, expression, and rhythmic variations are digitally recorded for accurate playback. Musicians can also develop new sounds, and define any complex waveform, using built-in programs for additive sine synthesis; unlimited numbers of new sounds can be saved on diskette for fast retrieval. The alphaSystem software lists for $35 to existing and new users of the Syntauri system. A complete system, including computer, is available for under $5000. For those who already own an Apple II, the instrument alone costs $2100. A demonstration record is also available for $2. For additional information, write Syntauri at 3506 Waverly Street, Palo Alto, CA 94306 or call (415) 494-1017.

re-view

CONTINUED FROM PAGE 6

Followers of Larry Fast or Roger Powell might find Garvey's most recent cassette release a little tough on the ears too. He is still enamored of ring-modulated bell sounds, and fully one-third of the tape is taken up with dissonant clanging, squeaking, runaway tape echo and wild oscillator sweeps. Still, the other two-thirds is made up of some lovely mournful reed-like soloing, introspective undulating chords, and quiet tape manipulations. Structurally, the vignettes seem to follow no sequence except to re-use several elements in different settings. Available from Aeon Import Records, 604 Princeton, Fort Collins, CO 80525;, $7.00 plus $1 postage.

K. Leimer **Natural History/The Mind and Its Likeness**

Showing a thorough digestion of early Eno, "Zuckerzeit"-era Cluster and most of what went before, Leimer creates tuneful instrumental songs on Moog synthesizers. He uses pleasant "natural-sounding" voices, and the way in which succeeding layers interplay shows considerable attention to this detail. Leimer, who also doubles on bass and piano, seemingly has an ear for musical phrases that stick in your brain. This is intelligent music, neither beating you with a melody nor stepping outside without one. Available from Eurock Distribution, PO Box 4181, Torrance, CA 90510 for $6.00 plus $1 postage.

K. Leimer **Translucent:/Memory**

Leimer's second cassette shows a more experimental side, employing normal tape loops and the open tape loop made famous by Fripp and Eno. By keeping some elements outside of the regeneration, Leimer is able to make the technique less obvious than many of this compadres. Both sides are layered like a sandwich, beginning with a tune, then going to tracks using tape loops, and finally returning to the opening tune with some variation. This is reflected in the titles - side 1 starts with "Ceylon" and ends with "Porcelain", side 2 begins with "Sleep" and ends with "Nostalgia for Sleep". Again, an intelligent, though somewhat more introspective effort. Availability: see above.

Various **From Brussels with Love**

A sampler of several fringe-area musical acts, including some total unknowns and such well-knowns as John Foxx and Brian Eno. Unfortunately, both Foxx tracks are only seconds long and Eno's sole contribution is his most boring interview yet. The music is mostly pretty poor (screaming guitar variety) and does not redeem the $11.98 list price. Available around town at better import stores; there's no information as to who's behind it.

Ken Moore **Tempus Fugit**; Ken Moore **To Come Into Being**

One of the more interesting things happening in the private cassette market is the frequent movement away from traditional song structures into more abstract "sound-textures". Ken Moore is one artist who presents no melodies, no rhythms, no tension and resolution. What he does present are free-form tape-echoed soundscapes drawn from a broad palette of sweeping filters, short envelope voices, tape speed tricks, junk shop percussion, rumbling Moog growls and ARP String Ensemble chording. His is not as dark as most abstract stuff, but one might argue that he needs to edit and arrange more critically - most of the pieces are too long for their content, and the ever-present tape echo becomes self-defeating. Still, once he takes the next step he'll be one to watch. These two tapes, plus two others by Moore, are available from Anvil Creations, 4215 Parkton Street, Baltimore, MD 21229; $5.50 each postpaid.

Mikail Graham/Tom Reddock **Acoustics #1 (June 1981)**

Mssrs. Graham and Reddock have undertaken a very ambitious task. "Acoustics #1" is the first in a projected quarterly "audio magazine" of contemporary music. This first issue consists entirely of electronic music by either Graham or Reddock, and it is quite promising. Reddock is a guileless musique concrete composer who takes such simple ideas as a walk through the streets of New York with a tape recorder, and turns them into marvelous "compositions". Graham is a synthesist who bridges the gap between "music" and imitations of natural sounds, weaving the two into tuneful soundscapes. In later "issues" Reddock and Graham hope to present works by other artists in addition to themselves. "Acoustics" is at PO Box 384, Grass Valley, CA 95945. Single issues are $9.50, back issues are $12.00, and a year's subscription (4 cassettes) is $28.50, all postpaid thank Heaven.

John Di Stefano **Compos Mentis**; John Di Stefano/Joel Graham **Drift**

Sometimes you can hear the echoes of a person's influences in his music, and I'd guess Di Stefano is a big Vangelis fan. I can also hear much of the German movement (Schulze, T. Dream, Cluster, et al), but none of these really overpowers any other. Di Stefano takes the technology and vocabulary developed during the last decade and carves out his own musical territory. He draws on a deep well of techniques such as imitative synthesis (instrumental and "noises"), musique concrete, tape work, vocal and percussive avant garde, and of course tune writing. He trades off thick cerebral soundscapes with slow majestic hymns and ponderous tape collages. Just when you think you have him pigeon-holed, he pops up in another context altogether. What makes these tapes so delightful is not only the variety but also the skill with which each style is offered. One other Di Stefano tape, as well as several by Graham, are for sale through Octron Productions, PO Box 15434, San Francisco, CA 94115 or Lion's Mane Music Productions, 1486 Delores St., San Francisco, CA 94110 for $8.00 each plus postage. *f*

Applied Synthesis: The BRASS Family

by Bill Rhodes

In this article we will attempt to shape the synthesizer's sound as closely as possible to brass acoustical instruments. Granted instrumental sounds cannot be exactly duplicated on the synthesizer (too many parameters have to be controlled simultaneously), but we can come extremely close if we pay attention to certain variables.

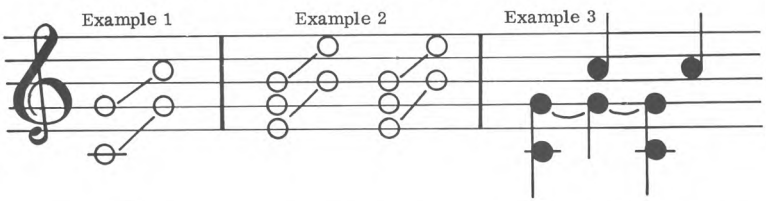
Brass Characteristics. Remember, trumpets have valves and an embouchure, which gives the capability of doing what piano players call "playing in the cracks". Unlike keyboards, these instruments do not have the physical boundaries of uneven levels of keys (white keys lower than black keys); thus, we must design note phrasing that does not sound inhibited in its melodic contour because of the physical limitations of keyboard playability. We can bend notes or glide notes with the synthesizer to approach the intervalic qualities of the brass family. Also, chromatic passages are very prevalent in trumpet technique; sometimes the fastest way from one note to a note further away is to play the notes in-between. Keeping the above in mind, we can sound more like the instrument we are trying to duplicate rather than a cheap imitation.

Getting Started. The sawtooth waveform is most useful for brass synthesis. The higher the range of the instrument (i.e. D trumpet or piccolo trumpet), the more "bite" there will be in the sound; as a result, not only must you play in the correct register, but the amount of filtering is crucial as well. Playing in the upper registers with correct articulation and phrasing can produce either trumpet sounds, or with slightly less brightness, the sound of a flugelhorn.

Articulation involves the envelope (attack, decay) of the sound. Remember, brass instruments change their timbre (tone color) quite dynamically according to the way notes are played. Keeping your filter attack time slightly higher than the volume attack time (experiment for best results), and using some reverb and no release time, will give creditable results. A trumpet has a short attack time, a French horn (in less "notey" phrases) has a longer attack time. A piccolo trumpet uses a very staccato-ish (detached) attack in most of the literature written for that instrument. A trombone has a longer attack time, is played in a lower register, has a deeper filter sound, glides constantly in note phrasing, and "flutters" its sound according to the passages being played. We can duplicate this flutter with the LFO set for amplitude modulation at a slow rate of modulation, or use a faster rate of modulation for more of a "growl" effect. The tuba can be approached in the same way, but since this instrument is the brass "bass" of the orchestra it need not be played as articulately or melodically as a trumpet or trombone.

Polyphonic Techniques. If you are lucky enough to use a polyphonic synthesizer, or are using a multi-track recorder to build up harmonies, remember that classical harmonies of the brass section mainly involve alternations of fourth and fifth intervals played consecutively. Mozart called these harmonies played on his piano "horn fourths and fifths" because they duplicated what the brass section was doing. See the simplified examples given below.

Use French Horn or low Horn synthesizer patch



"Horn" 5th - 4th

Maj. triad - 4th

Octave alternation with pivot note held

The fourth and fifth intervals are what makes Copeland sound like Copeland, Beethoven sound like Beethoven, and Mozart sound like a piano-playing horn section. Now if Wolfgang only had a synthesizer...

Vibrato. Vibrato depth and rate makes the synthesized brass sound human, and heightens the illusion that you're actually playing a trumpet. Don't use wild modulation in classical phrases, because the ear of that time was acclimated to vibrato alterations of a half-step or less. Trumpet or trombone growls using fast LFO rates can be useful, but the depth of modulation must be very precise or the sound will take on a distorted character. Stay away from filter modulation unless you want a more electronic sound or a more avant garde/20th century sonority.

Now it's your turn to take the above hints and start experimenting. Feel free to write to me c/o Polyphony if you have any tips or ideas for this column that will help make us all better players. *f*

INTERVIEW: HARALD BODE

BY JAY LEE

(Editor's note: With this issue, we begin a series of interviews conducted by Jay Lee. Jay has studied with Karlheinz Stockhausen and Morton Subotnick; consulted to Moog Music, Eu, and Oberheim Electronics; composed commercial music for Pepsi-Cola, Frito-Lay, IBM, Time-Life, and others; worked with musicians from Jan & Dean to Ornette Coleman; and produced artists such as Blue Oyster Cult. He is currently completing a solo album, due out later this year on Blue Light Records. He sent the following comments along with his interview:

"While electronic music may still be considered in its infancy - or at least childhood - several people working in the field have emerged as what may be called true pioneers. In this issue and in issues to come, I will be interviewing some of the engineers, musicians, and composers who have made major contributions to the field of electronic music. These are the people who have shaped the field as we know it today, and who will influence the way things will be tomorrow: in other words, the true pioneers of electronic music.

This first interview is with a special man whom I have been fortunate enough to know personally. He is Harald Bode, whose electronic music activities and innovations span over five decades. I think that you will find him fascinating and his ideas as young as ever.")

Jay Lee: What led to the design of your first electronic music project? Was it successful?

Harald Bode: First, I must describe how I came to be interested in electronic music, and how that led to my involvement in electronic music design. My background is as a musician; my father was a performing musician and composer, and his sister was a scholar of Franz Liszt. So, I was born into quite a musical family. Also during my formative years, which I consider the early teens, radio had just started and that also fascinated me. I became so interested in both electronics and music that very early on, I thought that it would be kind of nice to have a keyboard instrument that was operated through electronic means and with electronic tone generation. I did a lot of paper work, and among other things I would say that I re-invented the Cahill organ before I knew anything of its existence. All this occurred in the early 1920s.

In the early 30s, when I was 21, my girlfriend and I danced to rather good big bands. I still remember one band we heard that had an electronic lead instrument named the Emicon - something long since forgotten, but similar to what we would call a lead synthesizer today. It had a very mellow sound and a nice vibrato; and you could hear it anywhere in the dance hall, which left quite an impression on me.

Now I got to thinking that instead of having a melody instrument, it would be better to have a polyphonic instrument. As time went on my ideas matured, and by the late 1930s I came up with the

"A YOUNG STUDENT BY THE NAME OF ROBERT MOOG CONTACTED ME."

concept for a keyboard assignment instrument that used 4 oscillators, assigned to a 44 note keyboard. I finally was able to build this instrument when a gentleman by the name of Christian Warnke, who was a very fine violinist, was willing to finance the project. He had good ideas on specifying what an instrument like this should do. The tone colors were done with formant filters, something which is well understood today; we also had attack and decay features on the instrument, and provided manipulation for individual treatment of the 4 voices. This instrument was called the Warbo (War nke + Bo de) Formant Organ. In April 1937 I got the go-ahead to build this instrument, and it took until November of the same year until I was able to display it in public. It made its debut in front of a select group of the press, and I'll never forget their reaction. We started the demonstration at 8 PM, and were scheduled to conclude at 9 PM; but at 1 AM, the press was still asking questions (laughs). The next day, all the major newspapers covered the event, and the news travelled through all Europe.

In an ideal sense, the project was successful, but materially, it was less successful. But most importantly, I had demonstrated something useful, and had made a contribution to the art. (For more on the Warbo organ, see Tom Rhea's column in the December 1979 issue of Contemporary Keyboard magazine - Ed.)

HARALD BODE TUNING HIS FIRST MELOCHORD (1947)

JL: Who were you influenced by, and what came after the Warbo formant organ?

HB: I've already mentioned what was of greatest influence: the Emicon, since it influenced me to look for something that would build upon a sonic image. Who was of greatest influence? Christian Warnke, by demanding that instruments do certain things, exerted a certain influence on me. Later on I became pretty much independent of any outside influence.

To design the Warbo formant organ, I had done much research into making oscillators more stable. I had to develop resistance controlled oscillators that were good enough to make a four voice instrument work - which anybody who works in this field knows is not an easy task, especially back then when we used tubes and temperature sensitive components. Building upon the results of the Formant Organ, I created a monophonic instrument (the Melodium) which had a four octave, touch sensitive keyboard along with some very complex and musically attractive filters. The Melodium became quite successful; it was played with the Berlin Philharmonic orchestra as a solo instrument, and was also used prominently for motion picture music. At this time, though, World War II had started which handicapped me with respect to doing what I wanted with electronic music, so I had to wait for the finish of the war before continuing.

The next instrument I designed was the Melochord, a two note melody instrument which went through several phases. All of the Melochords were touch sensitive and had formant filters; later on they had individual attack and decay characteristics. Then, in the late 1940s or early 1950s, I was commissioned by the electronic music studio in Cologne to build the Melochord for Karlheinz Stockhausen, which helped greatly to publicize the instrument. By this time, the Melochord had developed into a modular instrument that included a lot of sound processing devices such as ring modulators, reverberation, tape loops, and what not.

After the Melochord, I got involved in electronic organs. In Germany I created the Bode organ, which later became the Estey organ when I came over to this country, and we went through several different models and concepts. But by the late 1950s, I thought that organ development was in a rut. The whole business had become very monotonous, so I decided to get more heavily into pursuing sound modification devices. I created a multiple module signal processor in late 1959/early 1960 which had multiple filters, ring modulation, voice or event trigger/gating, and of course, amplifiers and mixers, pitch selectors, octave couplers, and some other things associated with a tape loop repeater that made quite interesting effects. I presented a paper late in 1960 at the AES convention and talked about this sound modification device, and presented a number of tape recordings that I had made with it. This presentation, which was followed up by an article in Electronics magazine, was quite highly regarded by a number of professionals and I therefore came into contact with other people in the field.

"EVEN THE 4 NOTE ASSIGNMENT KEYBOARD, WHICH I DID BACK IN 1937, WAS A CONTRIBUTION."

JL: In your relationship with Robert Moog, who influenced whom?

HB: Let me answer that with a story. After publishing the story on the multiple sound processor, there was a great deal of interest in this device and among others, a young student by the name of Robert A. Moog contacted me. He was very interested in getting together, but somehow this fizzled out. At a later date, in 1964 when I was chairman of the AES session on music and electronics, Robert Moog presented a paper on his new modular devices. I immediately recognized the potential of this young, very shy gentleman, and was quite impressed. We stayed in touch. He already had formed his own company; at a later time, we arranged a royalty deal under which the Moog

HARALD BODE PLAYING SOLO WITH THE STRING ORCHESTRA OF RADIO MUNICH (1947)

HARALD BODE PLAYING HIS POLYMOOG

company produced my frequency shifters and ring modulators. I think this pretty much describes our relationship and who influenced whom. He stated at a later time that he was quite impressed with the work I had done, and had picked up on the modular idea which I had initiated. His claim to fame is, of course, the development of a set of voltage controlled modules.

JL: How do you envision the future of electronic sound modification devices?

HB: This question would be answered differently by each authority on the subject, depending on taste, opinion, background and so forth. Of course, today we're mainly talking about technology, digital and analog technology and so forth. I would limit myself to saying that both technologies are now established; digital is here to explore, while analog will be here to stay because it can do some things less expensively than digital circuitry. What there is in the future of electronic sound modification - it's hard to say; it's an unlimited future...there are things which I personally could envision and implement right now that no one else has dreamt of.

JL: Are you working on any new projects and can you talk about them?

HB: I can, but I have been very careful not to talk about these new projects too much because for one thing, I want to keep some credit for myself, and secondly, I want to keep some business for myself. I have just completed an infinite phaser, which I'm going to present at the 70th AES show. The final unit will have lots of bells and whistles to keep it from simply becoming a "fad" device. (Ed. note: I heard a sneak preview of the infinite phasing effect superimposed on a pink noise generator; it sounds amazing, like a jet taking off with engines whining, except that the whine of the engine just keeps getting higher, and higher, and higher in pitch - like a barber pole type of effect, but with all kinds of resonances and other effects that take it well out of the "another phaser" category. I look forward to hearing it with program material).

JL: What do you consider the most important breakthrough in sound modification?

HB: Honestly, I believe that this infinite phaser opens a new era - maybe, I don't know! - but I do think it's at least a significant breakthrough in sound modification for the year 1981. So much for that (laughs).

JL: Reviewing your career, what do you consider your most important contribution?

HB: Every time I did something new, I thought that was my most important contribution. I think that even the 4 note assignment keyboard, which I did back in 1937, was a contribution of some significance. Later, the Melochord of Stockhausen was quite interesting. The modular sound processor of 1959-60 was a most useful contribution. I am also

HARALD BODE SETTING UP CROSS PATCHES ON HIS VOCODER

personally in love with some creations which may not be major contributions, like my Vocoder - although I think I did something to the Vocoder that transformed it from a speech compression device to something more musically useful. I very much like my frequency shifters, which are keyboard compatible, and now of course I think the infinite phaser is quite a significant contribution.

JL: Would you care to name any composers who have used your equipment to good advantage?

HB: Well, probably the name that means the most in this country is Stockhausen. With respect to my organs, they didn't really excite too many composers. As the saying went at one time, "a Hammond is a Hammond is a Hammond" which is of course not true, but is a prejudice in the minds of many people. Going to composers who used my later creations, Vladimir Ussachevsky extensively used the ring modulator and frequency shifters, as have Barton McLean of the University of Texas and Jacob Druckman of Yale University. Wendy Carlos uses my frequency shifters in very subtle ways almost all the time. Then there's Peter Baumann and Chris Franke, who were both associated with Tangerine Dream (Franke still is). When Peter Baumann visited me here, I had my prototype Vocoder set up and showed it to him. He insisted on buying the prototype, since the production models weren't available yet; he wrote me a check and packed the Vocoder in his suitcase.

The first musician to use my Vocoder was Daryl Dragon, of Captain and Tennille, and there are quite a few names associated with the use of my vocoder - Suzanne Ciani on the East Coast, Michael Boddicker on the West Coast, the Beach Boys...one hit record, "Funky Town", uses my vocoder very proficiently. The list of names can go on and on.

JL: Besides electronic music instruments and signal processor design, do you compose commercially, and if so, do you pursue it as a hobby or as a business?

HB: At one time, I thought I would go into composing, and at one time I actually did. I made background sounds for commercials and several of my compositions were heard nationwide over television about 10 years ago. I also made compositions that were played publicly at various places that were interested in avant garde music. But I do not compose commercially to a large extent at this point, although I do have the equipment now to do many musical things. At present I'm just too busy, so I pursue it as a hobby and concentrate mainly on the completion of my sound processing projects. But at some later day, I think I'm going to write compositions which will be as interesting as my technical designs - but this might have to wait until I retire.

"I THINK I DID SOMETHING TO THE VOCODER THAT TRANSFORMED IT FROM A SPEECH COMPRESSION DEVICE TO SOMETHING MORE MUSICALLY USEFUL"

JL: Thank you very much for the interview, I'm sure Polyphony's readers will enjoy hearing what you have to say.

LIVE PLUS Tape NEW TECHNIQUES

by Chris Meyer

For synthesists, live performance can be a problem. Solo performances are often unsuccessful or unsatisfying, and the logistics of real time control of large amounts of synthesis equipment prevents many others from even trying. Polyphonic, programmable, and particularly digitally controlled synthesizers are making live performances at least feasible, but the cost of such machinery is prohibitive to most musicians.

Forming a group or ensemble of synthesists is a great idea on the surface; but it can be extremely hard to locate other nearby synthesists. And assuming that you do eventually find compatible musicians, the purely physical problem of transporting around so much equipment (and coaxing it to work once you get to where you're going) is enough to put a damper on any amount of enthusiasm that you might have. I find it far easier to carry around a guitar and a few effects boxes than to lug my modular from place to place, and expect it not to fall apart.

A possible live performance solution is to employ a surrogate performer - namely, tape. However, many people seem to have a strong psychological aversion to using tape live. One common argument is that this technique is too fixed and limited, while others vehemently oppose its supposed dishonesty. Perhaps one of the biggest problems is a sublimated dislike by many modern synthesists for avant-garde music, which relies heavily on the use of tape. However, many of these attitudes are due to only thinking about the use of tape in a narrow way; with a little imagination, the tape-plus-live performance can take on many unusual varieties and forms...as the following list will demonstrate.

Traditional. In this case the tape and performer are separate, independent entities (figure 1). The tape is prepared ahead of time and usually contains the backing and rhythm tracks (percussion, sequences, drones, etc.). These are typically the parts of performances that are either too mundane or too complex to reproduce live. The live performer usually assumes the role of a lead player, which is exactly the kind of set-up that Tomita used on his live tour of Europe. Karlheinz Stockhausen often prepares multitrack tapes of electronic sound for use in his performances, and rock bands have even used this technique as early as the late 1960s.

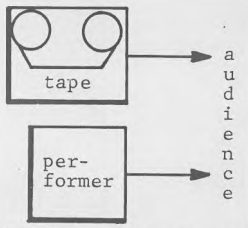


Fig. 1 Traditional

Tape modifying performer. In this set-up the tape plays an active instead of passive role, since it adds either a loop or echo to whatever is performed (see figure 2). Perhaps the most well known examples of this technique are Robert Fripp's "Frippertronics" guitar system and Eno's ambient music experiments. One variation of this system that I've used successfully involves a guitar, two tape echoes, and a flanger (figure 2A). The instrument feeds the first tape echo using sound-on-sound, while the output of this echo unit passes through a flanger before going into the second tape echo. As I laid up layers of riffs on the first echo, a friend would occasionally vary the speed of the tape; I would then have to seek out the new key and improvise against the now changed rhythm. The piece finally dissolved in a wash of white noise as the quality of the sound-on-sound deteriorated through multiple iterations.

Remember, too, that not everything has to be looped at all

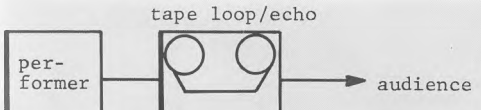


Fig. 2 Tape modifies performer

Fig. 2b "M-Tronics" loop system

times. For instance, Fripp occasionally uses a foot switch to kick himself out of the tape loop to solo, and then cuts himself back in when the backing tracks start to thin out.

Performer modifies tape. Now we have our first real departure from traditional techniques. Considering that most synthesizer modules are actually signal modifying devices, it is perfectly valid to replace the usual signal sources (oscillators, noise, etc.) with external inputs of some sort - namely, tape (figure 3). The performer can modify

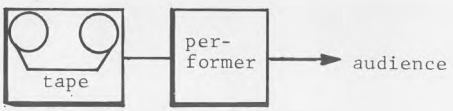


Fig. 3 Performer modifies tape

the whole tape, or selected tracks at selected times. Paradoxically, this is a case where a modular synthesizer is better for live performance than a preset type. An added plus of this method (especially for the inexperienced performer) is that since all of the actual music is recorded ahead of time, it's impossible to screw up the performance (unless the recorder breaks down!).

An alternate approach to this technique replaces actual music with control voltages and timing references recorded directly on the tape (these are usually in the form of modulated tones which may then be "retrieved" through a pitch-to-voltage converter). This is a technique Morton Subotnick used in composing "Until Spring". All the performer is responsible for, then, is setting up the patches and manipulating them live.

Performer source/loop interaction. This technique (see figure 4) combines the previous tech-

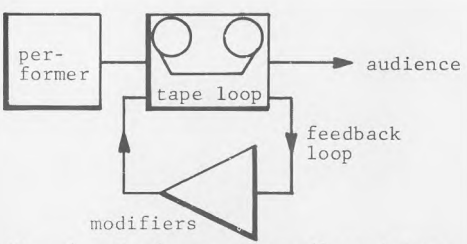


Fig. 4 Performer source/loop interaction

niques, since now the performer is both source and modifier. Various phrases and riffs can be layered up on a tape loop, and a separate synthesizer can be used to process the signal via the feedback loop. A multi-channel tape recorder would work best here so that straight, echoed, and modified sounds could be mixed or looped as desired. With this process, a single sound source can create interesting and thick textures.

Multiple performers modifying tape. This is an extension of "Performer modifies tape" in that several performers (instead of a single performer) would add their own unique colorings to the taped source material (see figure 5). A suitable setup

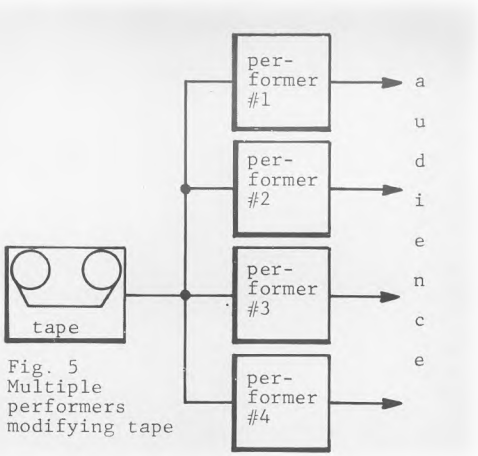


Fig. 5
Multiple performers modifying tape

would use a multi-track recorder, where the performers would choose which track(s) they wanted to modify. This also provides a solution to finding musicians who could work together live - since all the actual music is prepared ahead of time, the piece couldn't fall apart in performance. Also, since this technique uses only modifying devices, relatively inexpensive guitar effects could be used. This technique also creates a new kind of "scratch orchestra"; since little technical or musical knowledge would be required of the performers, virtually anyone would be able to "play".

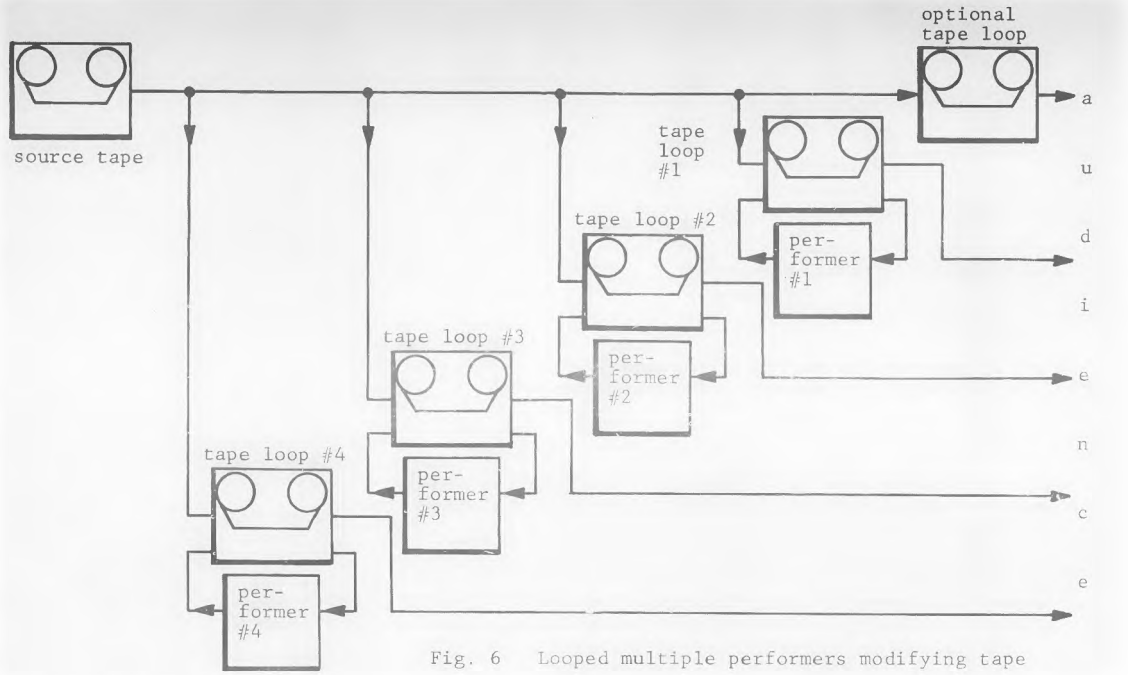


Fig. 6 Looped multiple performers modifying tape

Looped multiple performers modifying tape. As with the preceeding setup, several performers modify the material that exists on tape, but this time they do it during the feedback portion of a subsequent tape loop. A tape source (again, preferably a multitrack recording) is simultaneously fed to the audience and to the performers (see figure 6). Each performer then decides which track or tracks they want to work with, and feed it into the loop. They are then free to modify the "captured" segment as they see fit. Since there is more than one performer, odds are that several different segments will be in the process of being looped and modified at any given instant, all augmenting the original source. A possible extension of this technique would be to loop the original sound source too, with a slightly different time constant. This would give the modified loops the illusion of slowly peeling off and spinning away. Integral multiples of the time constant (such as having the original repeat twice as fast) would also yield useful results.

Separate multiple source/loop performers. The final technique we'll discuss in this article is a variation on the "Performer source/loop interaction" technique discussed earlier. The signals from the source performers would be fed to the modifying performers, who select the material they want, loop it, and then modify it (see figure 7). This would lend itself to a "performance in the round" setting where the source performers are located in the middle of the room and the modifying performers, each with their own separate amplification, located in the corners. The source performers would not have to carry the continuous burden of playing all the time - they could sit back and adjust to the mood of the piece, and when they felt the time was right, add more thoughtful and considerate additions to the piece. In the meantime, the modi-

(Continued on page.....32)

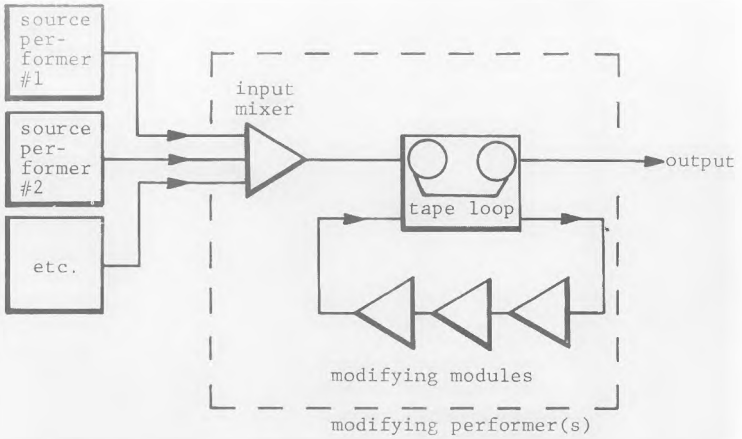


Fig. 7 Separate multiple source/loop performers (one modifying performer shown - repeat)

Synful Sound!

The Crumar Stratus is the first polyphonic synthesizer that satisfies the needs of both the creative synthesist and the multi-keyboard player. It offers a powerful array of sound, from the explosive to the expressive, and yet the majority of control comes from the keys you play, not the dials you turn.

The heart of this outstanding versatility is found in the six actively engaged Filters and Envelopes that span the keyboard. These generate true polyphonic capability, letting you depress as many keys simultaneously as you want. Most polyphonic synthesizers are limited by their 4 or 5 voice capability. Go beyond that and notes drop out.

The Stratus also features unique trigger modes (both Multiple and Mono) which allow you to turn on the Oscillator Glide, reset the LFO delay, and alternate between the sawtooth and square waves all directly from the keyboard. You can retrigger a particular effect whenever a new note is played, even though other keys are depressed.

There are other noteworthy qualities to the Stratus, like two independent oscillators, continuously variable and invertable envelopes and polyphonic resonances. But, we suggest you experience this "synful" sound for yourself at your local Crumar dealer. At a price under $2000, it's a devilishly exciting way to burn up a stage.

For complete product information, write to: Dept. M, Music Technology, Inc., 105 Fifth Ave., Garden City Park, N.Y. 11040

Features and Specifications

Unique Filter & Envelope Control System

The Stratus combines the power of a fully polyphonic synthesizer with the performance features of the world's best lead line synthesizers, the result of its Unique Circuitry. Six separate, 24 dB lowpass filters, six independent, 4 parameter envelope generators, and six high performance VCA's span the keyboard, controlling the two independent oscillators and convincing you at least six lead line synthesizers are all playing at the same time. Unlike many polyphonic synthesizers that limit you to 4 or 5 keys, you're not limited to even the six we just mentioned. Lay 10 fingers across the keyboard and all 10 keys will sound.

Invert Your Filter

Most synthesizers let you span and close the Voltage Controlled Filter in only one way, with a positive voltage. The Stratus also lets you apply a negative envelope to the filter—doubling your sonic possibilities. The sounds are unbelievable using this format.

Waveform Selection/Oscillator Bank

Waveform Selection lets you choose from the brassy sawtooth, hollow square wave, or mix of both. Alternate Saw/Sq lets you automatically go from one waveform timbre to the other. This is great for sequential sounding lines.

Pitch Control Network

Pitch Control allows you to tune and slightly detune the oscillators using the fine and coarse tuning controls. The oscillators range anywhere from unison to a perfect fifth, or can be detuned to anything in the middle. You can see the degree of detuning with the LED tuning indicator, so you can tune by sight on stage, before you even play a note.

Octave Transpose lets you select between 2 octave ranges for each or both oscillators. Octave Modulation causes an octave trill of oscillator 2 when sync is off. Sync tunes both oscillators to a perfect unison for lead line playing and thinner tone quality. A Sync Pedal is available for controlling quick changes.

Oscillator Glide

This is used to bend the pitch of the oscillators. It serves as an automatic pitch bend and portamento function, and is effective in exaggerating attacks and producing ensemble effects.

LFO Modulation Section

Low Frequency Oscillator causes vibratos, tremelos and filter sweeps. Routing determines which synthesizer section is effected by the LFO. The Modulation Section includes Rate, Slope, Delay and Depth.

Special Keyboard Control Features

For years, synthesists have pointed out the advantages of single and multiple triggering. The Stratus is the only synthesizer that lets you choose several triggering modes at the same time, each assigned to a different musical effect. For example, multi-triggering can be used so that each key resets the delayed entry of vibratos and filter sweeps from the LFO. It's like having a delayed vibrato on each key.

This resetting capability can also be applied to the Oscillator Glide and the Alternating Waveform function.

Joystick Modulation

One of the most popular controls is the 4-axis joystick, because you can harness 4 effects with 1 control. With the Stratus' joystick you can bend up, down, and do VCF or VCA modulation, or circle all 4 at the same time.

Cathedral Organ

Anyone who's kept current on the music scene has obviously noticed the resurgence of the organ as a prime component. That's why we incorporated a traditional pipe organ sound into the Stratus as a separate feature. There are four different footages, and a volume control for the section. The four footages can actually be combined to generate different waveforms. Each footage is a square wave. When these squarewaves are mixed in the right proportion, new waveforms are produced. This gives you an endless array of possible sonic foundations upon which you can add the polyphonic synthesizer.

Outputs: An Expanded Rear Panel

On the back of the Stratus, you'll find separate outputs for polyphonic synthesizer, organ and a special one called Signal Out, designed for connection to any effects or processing devices. Collectively, these outputs offer the musician maximum flexibility for setup (Stereo or Quad systems), with the added ability to have individual equalization and signal processing per output. The Signal Out can also be used with the Master's Touch, an accessory that lets you trigger the third section with your breath (like a horn player), giving a big band backup to all the other sounds.

Pedal Controls

The Stratus comes equipped with a sustain pedal and a VCF filter pedal.

Optional Accessories

Sync pedal, optional custom stand, Master's Touch wind controller.

VIEWPOINT: 2 Essays on Xenharmonics

by Ivor Darreg

Xenharmonics (i.e., pitches, intervals, and chords which do not sound like the 12-tone equal temperament generally in use on standard keyboard and fretted instruments) has "snuck" in through the back and side doors to reach the public ear. It's not a question of whether we shall or shall not tolerate new pitches and scales; rather, it is a matter of being intellectually honest and acknowledging the existence of that which some have carefully ignored for so long.

Case in point: The familiar rotary dial on telephones is being gradually and relentlessly replaced by a pushbutton keyboard with 12 keys instead of ten dial holes. Depressing any of these buttons sounds two tones which are not related in terms of the 12-tone equal temperament. Thus, more and more people hear these sounds every day, and this will cause a subconscious change in attitude - all the more powerful in the long run because it is subliminal.

Case in point for a much longer period of time: In this part of North America, the hum of alternating-current power lines and electric equipment such as motors, transformers, and radio sets is 60 Hz (or a multiple such as the octave above, 120 Hz). These pitches fall almost exactly on the quartertone between B-flat and B-natural - the discrepancy is far smaller than the usual errors in tuning which we will find on most instruments. It is virtually impossible for any normal-hearing person to escape this pitch. In other parts of the world the power-line frequency is 50 Hz, a just (i.e. exact and untempered) minor third below our American standard. This falls close enough to the quartertone between G and G-sharp.

An unavoidable result of all this is that when ordinary music is heard against those hums, and this occurs much of the time whether we are aware of it or not, all the intervals of the quartertone scale will be heard, albeit subconsciously. This endures throughout our lives. Under many common conditions, the odd-numbered harmonics, 1:3:5:7:9:11:13 etc. of this power line/machinery hum will be heard also, thus creating many notes and intervals which do not occur in the "standard" scale.

Such affairs as gear ratios that must be used in machines produce musical intervals not in the 12-tone scale, and thus these sounds are impressed upon the public - often loudly. Train-whistles and auto-horns of more than one tone at a time may also have accidental tunings not in the 12-tone scale.

This takes us back to another important subject: Early in this century, Russolo and Marinetti, the Italian Futurists, proposed the "intoning of noises", creating a new Art of Noise based on the element of pitch in many of the mechanical noises which had recently come into their environment. They invented instruments called Intonarumori for consciously controlling and manipulating these ideas. By now, some 70 years later, all their dreams have come true with a vengeance. The problem is not how to get to hear these effects; it is how to escape them so that you can have some sleep.

I feel that musical-instrument manufacturers and music-teachers spend a lot of time inducing their customers and students respectively to expend much needless and futile effort ignoring the facts just presented above.

* * * *

In late August I attended an all-percussion concert at Exposition Park in Los Angeles. The only unorthodox item was an electric bass - all the rest of the ensemble was acoustic, with more drums than I could count, vibes and marimbas galore, one grand piano, tubular bells, and the usual traps. The youngish conductor did only his own compositions and obviously had rehearsed a very tight ship with all the absolutely simultaneous attacks.

One sure missed the strings and the horns...two hours without stopping once for breath, since there were no wind instruments to compel phrasing. No singing either. But this was a most important acoustics lesson: the inharmonic partials of piano bass strings and the noise of hammering on the top notes of the piano blended perfectly with chimes, glockenspiel, xylophone, marimbas, and vibes, since these too have inharmonic components, and some of them are as loud as the nominal pitches of the tones in question. At the top end of the piano keyboard, the hammer noise is lower-pitched than the strings are and is actually louder - it is the piano-tuner's nightmare to hear the evanescent high-pitched tones through all that distracting noise. The longitudinal and possibly torsional vibrations of wound bass strings, especially in a new piano, are loud and clear and this is incidentally why all the electronic imitation pianos can't quite make it. You can put in the right amount of noise and have the right envelope, but still not have these inharmonic longitudinal vibrations which are NOT in the 12-tone scale. Of course, the different kinds of tubular chimes and metal and wooden bars in the other percussive instruments have assorted inharmonic pitches that are not in the 12-tone scale either. This causes an unexpected surprising blend with the piano, which is shown to be primarily a percussion instrument, not the singing stringed instrument that the music critics of piano recitals and the teachers of Romantic period pieces keep arguing that it is.

(Ivor Darreg is well-known for his work in non-12 tone scales. The inventor of the Megalyra and a specialist in refretting guitars for non-12 tone scales, his work has been written up in Guitar Player, Interval, Omni, and other publications. The above is reproduced with permission from his newsletter "Beyond 12" and from personal correspondance with the editor.)

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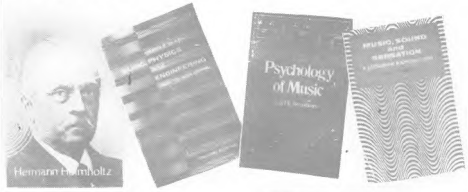
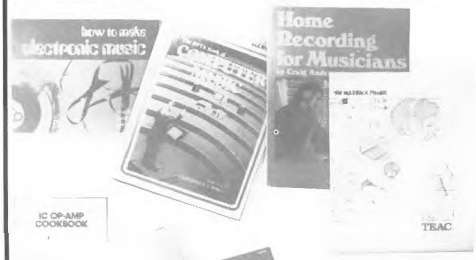


SCIENCE

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.

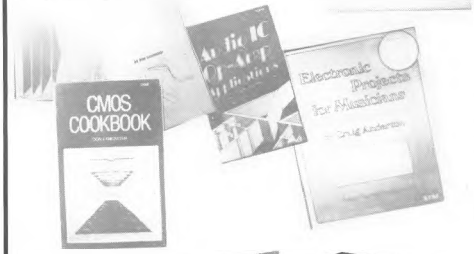
#SENS On The Sensation Of Tone	**$7.50**	**#PSYCH** Psychology of Music	**$5.00**
#MPE Music, Physics & Engineering	**$6.00**	**#MSS** Music, Sound and Sensation	**$3.50**



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 synthesis 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 19 projects with PC patterns and a demo recording of the effects.

#OACB Op-Amp Cookbook	**$14.95**	**#CMCB** CMOS Cookbook	**$10.50**
#AFCB Active Filter Cookbook	**$14.95**	**#EPFM** Electronic Projects 2nd edition	**$11.95**
#AUOA Audio Op-Amp Applications	**$7.95**		

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**
#CYCLO	Audio Cyclopedia	**$39.95**
#EMS	Music Synthesizers	**$6.95**
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#SLB	Studio Log Book	**$4.95**
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#DEVICE	Complete set (12) Device Back Issues	**$18.00**

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The wide variety of practical applications and construction projects in past issues make a binder full of Polyphonys a frequently used reference to keep near your synthesizer, home studio, or workbench. Most back issues are still available for $2.00 each ppd. Check the issues desired on this coupon and add the total to your PolyMart order (other side), or order by volume and issue number (0304, 0402, etc.) on the PolyMart form.

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☐ #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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☐ #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.

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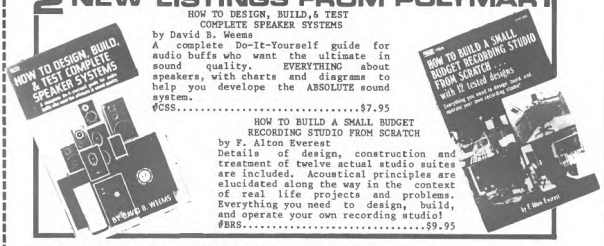

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CONSTRUCTION TIPS FOR BEGINNERS

by Denver Jones

After building one or two electronic projects, you may have noticed that your completed projects don't always work the first time that you try them. So, here are a few tips I've learned from my mistakes that I'd like to share with Polyphony readers.

• **Neatness counts.** Always be neat, it makes troubleshooting a lot easier. To assist you in this goal, try breadboarding your circuit on an experimenter's socket strip first. These strips comprise a grid of interconnected holes into which you can insert electronic components and #22 through #30 solid wire (the wire can serve as jumpers between components). Radio Shack and Calectro both make experimenter's socket strips with matching circuit boards, so that once you get the circuit breadboarded correctly you can transfer it over to the circuit board with a minimum of fuss. Radio Shack stock numbers are: socket, 276-174, matching circuit board 276-170; Calectro numbers are: socket, U4-402, matching circuit board U4-404.

You should do all your modifications and parts placement on the socket strip, since it's much easier to change around a part or two on the socket strip than on a permanent circuit board (trying to change a part on the circuit board might damage the conductive traces). When the time finally comes to solder parts on to the matching circuit boards mentioned above, be careful to avoid solder bridges across the traces as they are quite close together.

In addition to using solid wire to jumper between parts, you can also use stranded wire to go from the socket strip to outboard potentiometers and jacks, if you twist the stranded wire together and tin the ends. This way the pots and so forth won't have to be re-wired when you transfer everything over to the permanent board.

One other tip: If you snap two or more socket strips together, you can build larger and less crowded circuits.

• **Soldering tips.** Try to keep a clean, well tinned soldering iron; it's a good idea to wipe the tip on a damp sponge just before making a connection (leave the solder on after you make a connection, since this helps keep the tip from oxydizing). Radio Shack sells a sponge cleaning tray, #64-2087. If you need a new soldering iron, you can buy a cordless rechargeable iron or one with changeable heating elements and different size tips. They both work well.

A desoldering tool is necessary for removing parts and solder bridges from your circuits. The vacuum bulb type is all right but for complete solder removal, try some desoldering braid. This sucks up the solder and does an excellent job.

• **Helpful tools.** If you are a newcomer to the world of electronic effects, there are a lot of products on the market that make building projects easier.

You probably use heat shrinkable tubing in some of your projects. After I burned my fingers a few times, I decided to try something different from matches. A hair dryer works very nicely.

When you need an approximate 15V DC power supply, use two rechargeable 9 Volt transistor radio batteries in series. Their output is rated at 7.8 Volts and they deliver 7.2 Volts average (until they need to be recharged). Mallory and General Electric both make rechargeable batteries, and General Electric makes a double charger so that you can charge two at once.

A resistance wheel is a handy tool for experimenting. GC Electronics makes one that has 36 different values from 5 Ohms to 1 Meg. To use the wheel, simply attach its two alligator clips to the part of your circuit where you want to vary the resistance and dial in the resistance that works the best. Then remove the wheel and solder in a standard resistor.

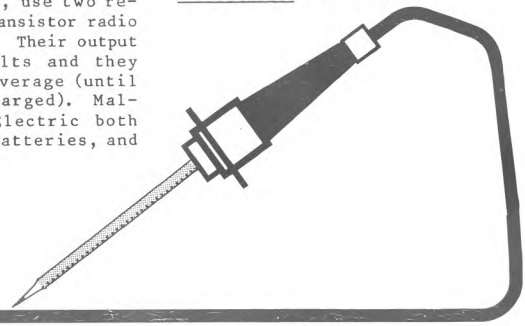
An inserter/extracter tool is helpful for inserting and removing integrated circuits; it also straightens the pins on the IC.

If you haven't yet memorized the resistor color code, you can buy a pocket size color code guide. It gives you a numerical and corresponding color readout of resistor values and tolerances.

To make experimenting on your wa-wa pedal or fuzztone easier, buy a set of test leads. They are color coded and have insulated alligator clips on both leads.

The list goes on, and so does the fun. I hope that you build some great musical projects.

(Editor's note: for some more helpful tips, see the article "Useful Troubleshooting Hints and Tips" by Elliot Kanter in the September 1981 issue of Radio-Electronics magazine.)



KRAFTWERK LIVE

by chuck pogan

●Imaginative use of electronic instruments is something that all modern musicians strive for today, and perhaps no band is more original in their approach than Kraftwerk. Armed with an arsenal of synthesis equipment (much of it of their own design), the boys from Berlin wowed 'em at the Santa Monica Civic Center last month.

This was a "festival" type seating arrangement (no seats on the lower floor); but no one seemed to mind standing for the duration of the two hour concert, simply because of the energizing effect of Kraftwerk's pulsating sequences.

With the curtains closed, the audience heard five minutes of sample and hold effects as a teaser. The random notes built in intensity until they mutated into a snappy sequenced drum. As the curtain drew open, the crowd was literally stunned by the sheer volume of equipment. Dressed more like technicians than musicians, the band was standing in front of a huge, futuristic, modular rack mounted unit (see the liner of their latest record, "Computer World"). Sequencer LEDs flashed across the units, further enhancing the overall effect. The racks seemed to be extremely good examples of the "human engineering" so much in demand today. They were compact, with sloped fronts so that no bending or excessive reaching was required; the scene resembled four pilots during take-off. This system is a prime example of the DIY (do it yourself) philosophy embraced by so many Polyphony readers.

Then, with their backs to the audience, the band broke into "Numbers", a cut from their latest album. In this piece, they count from one to four in various languages, assisted by vocoders, heavy reverb, and humorous use of pitch shifter which made them sound like little Japanese girls (shades of Mothra!). All of this was further enhanced by the tasty use of four large futuristic-looking video monitors, each with a slightly different tone color.

The throbbing percussion of "Numbers" soon developed into "Computer World", the title cut from their new album. By now the band was facing the audience. Left to right stood Ralf Hutter, the master-mind of the band. In addition to his personal rack, he played a conglomerate poly keyboard and a mono Moog unit; to handle vocal chores (which he did very well), he wore a combination headset and microphone which enabled him to keep both hands free to play keyboards. Contrary to the mannequin image portrayed by album covers, Ralf is actually the kind of guy who bobbed and jived during the intense sequences.

Next to him stood the versatile Karl Bartos, who handled everything from syndrums to sequencer and often accompanied Ralf on keyboards (again, a Moog).

Wolfgang Flur's percussion set-up, however, was the most unusual set-up of them all. Armed with only two joystick controllers, he supplied the rhythmic drive. Simply by "throwing" the levers in a combination of movement (one back, one forward, side to side, etc.) he was able to achieve a wide variety of percussive sounds. His obvious mastery of this unusual system was a real treat to watch.

Finally, on the far right stood the darling of the crowd and the backbone of the band, Florian Schneider. Flor really plays up the robotic image for which he is famous. He showed no real acknowledgement of the pulsating electronic beat, but never missed a beat himself. His equipment consisted of Moog units and some unusual alternate controllers. One such device was an instrument shaped like a small wooden football with holes in it! Fingering the holes and tweaking a pressure sensitive knob emitted synth-flute sounds.

During the concert, Kraftwerk played just about every one of their "hits". On "Autobahn", the pace was much faster than the recorded version. Florian supplied the honking car horns and the doppler effect car screaming by at top speed. Ralf supplied much of the cathedral type "organ" on this and other songs during the performance, and Karl and Wolfgang cooked on percussion. On "Trans-Europe Express" the video monitors showed a camera angle from the front of a train chugging along. Tasteful use of the monitors (controlled by Florian) was the icing on the cake. The images were serene and romantic.

During the performance the temperature soared to over 90 degrees in the auditorium, affecting both the band and the equipment; after the superbly performed "Showroom Dummies", there was a time-out due to Florian's synthesizer becoming inoperative from the heat. Ralf explained that it would be a few minutes before they could resume playing. The crowd became impatient but were quickly put in line by Ralf who commented, "One of our American synthesizers has gone out on us. It's hot up here!". The audience then applauded wildly, probably out of appreciation that the band had been as hot as the temperature.

After a few minutes everything was all right again, and the boys broke into a medly of "The Model", "It's More Fun to Compute", and "Home Computer". On the latter they demonstrated their robotic precision by starting and stopping a sequenced arpeggio without missing a beat. Once again the LEDs added visual interest.

The band closed the show with the popular "We are the Robots". On this song they were assisted by life-sized "androids" of themselves. After setting up sequences and computer generated drums, the real band left the stage to enjoy the concert that their cyborg relatives supplied. The curtains closed, only to re-open slowly as the strains of "Pocket Calculator" were quickly recognized by the crowd. But then came the surprise: They were standing up front, no longer dependent on their gigantic system but actually playing small mobile, portable musical devices. Too much! Ralf supplied the main riffs with a hand-held keyboard no more than ten inches long. Next to him stood Karl with a small ribbon-controlled unit similar to the Gnome synthesizer. Wolfgang pounded out percussions on a gizmo the size of a pack of cigarettes, and Florian, ever the joker, punched out bizarre note patterns on a Casio musical calculator! And just in case nobody believed that this stuff was real, Ralf handed his keyboard to the audience and they supplied the solo while the rest of the band grooved along. This was definitely the most unusual encore that I've ever seen performed.

After the concert ended, the audience appeared shell-shocked - and with good reason. They had just witnessed the most original, energetic, and technically advanced show one could hope for. If you get a chance to see the "power-plant" in action, go for it...it really is "More Fun to Compute"!

MORE ON SN76477-

If the VCO, VCF, and VCA form the heart of a synthesizer, this module is surely the brain! It gives you most standard controller options (LFO, noise source, and sample and hold), but also includes some extras that have no real precedent on commercially available synthesizers.

The Super-Controller Module (SCM) incorporates many of the SN76477 tricks discussed previously in this column. Since this is a BIG circuit, I can't waste much time or space in introductions, so let's get right into the design analysis. (see figure 1)

Power supply requirements. The SCM requires a regulated and well-filtered source of +15, -15, and +5V DC. Carefully note which points on the schematic connect to which power supplies; incorrect connections will keep the SCM from working correctly.

Noise source. This is basically set up in the same way as described in the last installments of "Practical Circuitry". An external control voltage, attenuated by R2, controls the noise clock frequency. The noise output is buffered via FET Q7; R60 helps cancel some of the offset inherent in the FET source follower configuration. The noise out is a standard, 10V p-p voltage centered about ground, with an output impedance of 1k.

LFO. The LFO has lots of options, so let's examine them one by one. To simplify matters, we'll ignore Q1 and its related circuitry for the moment.

As discussed in a previous installment, the triangle output of the SN76477 is tapped off at pin 21 and buffered by bifet op amp A2. The signal then branches off in two directions: the path through R33 is amplified by a factor of about 3.9, and level shifted by R35, which presents a 10V p-p (centered about ground) triangle wave at the output. R35 sets the approximate offset of the output; trimmer R37 centers the output exactly about ground. An LED at the output of A4 monitors the LFO rate.

This same triangle wave feeds comparator A6 and its related components. R41 adds 0.1% of hysteresis, which gives the re-

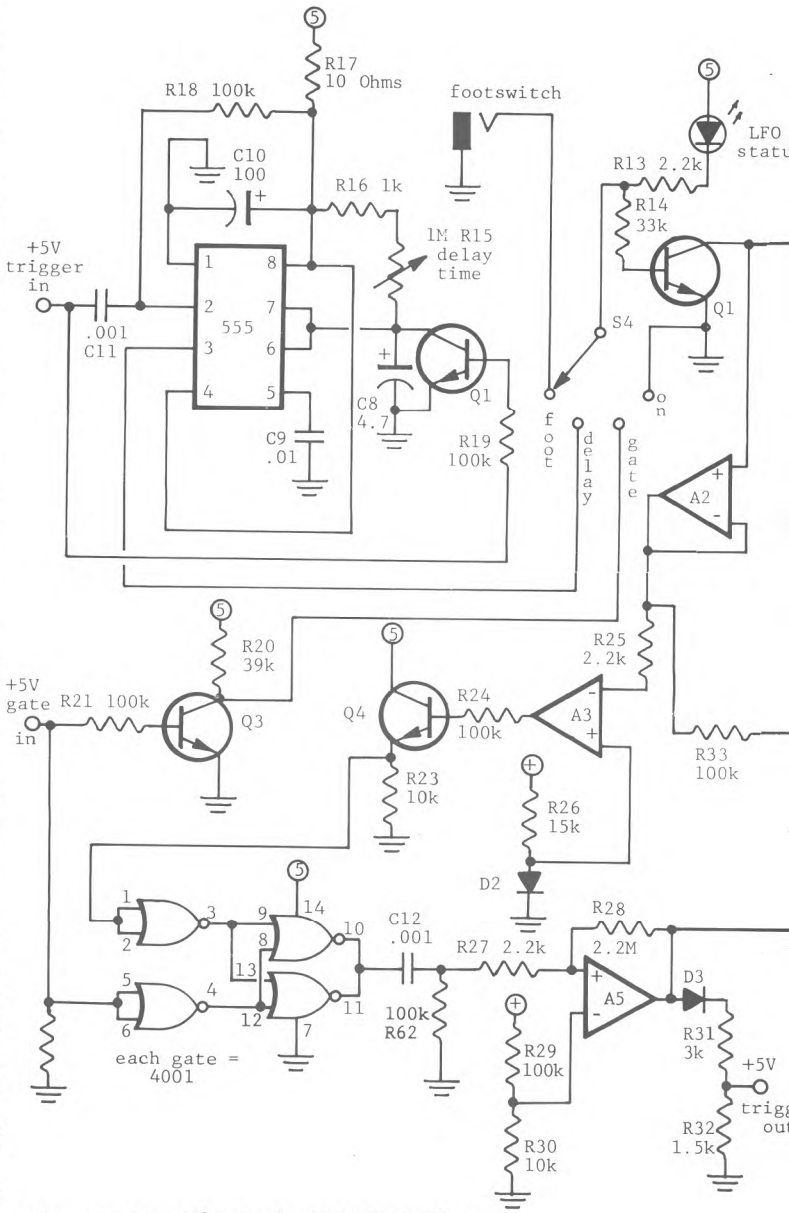
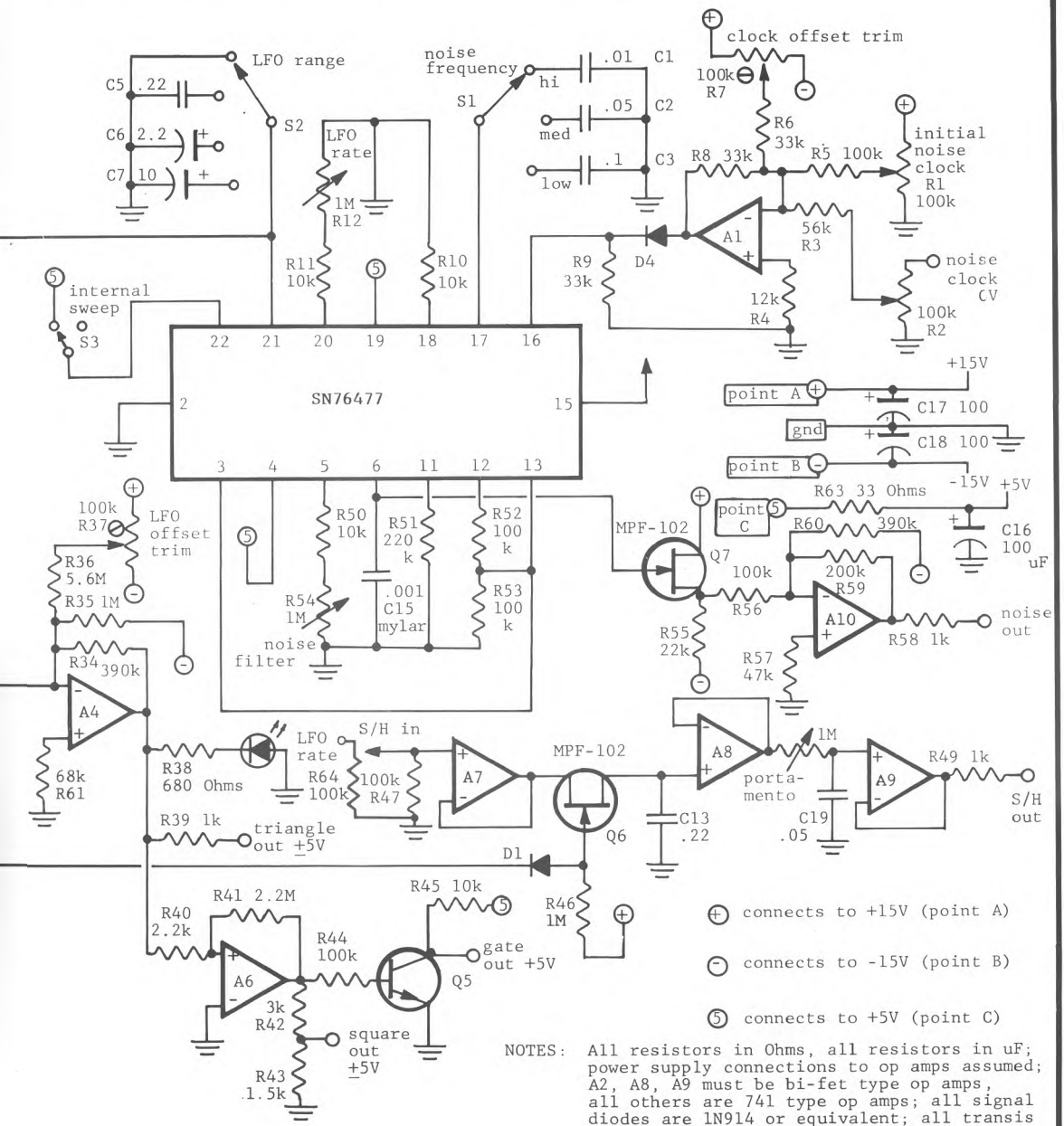


Figure 1: Schematic for the Super Controller

-THE SUPER CONTROLLER



NOTES: All resistors in Ohms, all resistors in uF; power supply connections to op amps assumed; A2, A8, A9 must be bi-fet type op amps, all others are 741 type op amps; all signal diodes are 1N914 or equivalent; all transistors are 2N5129 except as noted.

THOMAS HENRY

sulting square wave a nice clean edge. R42 and R43 attenuate this signal, giving a standard 10V p-p, centered about ground, square wave output with a 1k output impedance.

Since there are many times in synthesis when a bipolar 5V signal is inappropriate, a gate signal going from 0 to +5V is also derived from this square wave and is available at Q5's collector (the transistor is powered off the +5V supply, hence the 5V swing). This gate would typically be used for driving ADSRs or the like in sync with the LFO.

Now let's shift our attention to the circuitry associated with Q1. This is set up as a switch that can discharge whichever LFO timing capacitor is selected by S2. Not only can Q1 discharge the timing cap, it can also hold the LFO waveform output at 0V.

If S4 is **on**, then the junction of R13 and R14 is pulled to ground. This does two things. First, it shuts off Q1, meaning that the capacitor selected by S2 is free to charge and discharge normally, which lets the LFO run as usual. In addition, a current flows through R13 to ground, turning the **status** LED on. Whenever this LED is on, you know that the LFO is running.

With S4 in the **footswitch** position, and an ordinary SPST push-on/push-off footswitch plugged into the footswitch jack, closing the footswitch ties the junction of R13 and R14 to ground; thus, the LFO runs normally, and the **status** LED is lit. However, opening the footswitch releases R13/14 from ground, which initiates two events. First, the LED is extinguished; second, Q1 is turned on, and this shorts the LFO's timing capacitor to ground. In other words, the LFO is in a "hold" state and the extinguished LED indicates this. Footswitch control of the LFO, while simple to implement, can really add a lot of versatility to your sound.

Now consider another patch. First, set S4 to the **delay** position; then, take a 5V trigger out from your keyboard to the DELAY trigger input at C11. Patch the LFO of the SCM to an FM input of a VCO. Now let's follow the chain of events. Push a key down on the keyboard - a trigger enters C11, thus turning the 555 timer on for a time determined by C8, R15, and R16. This is a one-shot circuit, and so pin 3 goes high. Note that pin 3 is connected via S4 to the R13/R14 junction mentioned above. Since this junction is high, Q1 turns on and therefore turns the LFO off for the delay time set by the one-shot. After the one-shot turns off, the R13/R14 junction is brought to ground and the LFO turns on again. The result is a pleasing delayed vibrato effect, which I have found to be extremely well suited to creating string effects.

Note that C8, the timing capacitor for the one-shot, is bridged by Q2, in the same way that the LFO capacitor is bridged by Q1. This guarantees that each trigger coming in to the delay circuitry shorts out C8 momentarily, so the charging of C8 always starts from 0V. In more technical terms, the one-shot is retriggerable. Thus, as long as your keyboard is putting out triggers, the LFO is off (remember, each new trigger discharges C8 and starts the one-shot all over again). But as soon as the triggers stop, and as soon as the one-shot turns off, the LFO turns on again. And of course, the **status** LED monitors the whole thing. R15 adjusts the delay time.

Now it's time to consider the gating function of the LFO. To give you an idea of where we're going with this, we're going to set the LFO so that when we push a key down on the keyboard, the LFO puts out a series of triggers, suitable for driving an envelope generator. The result is repeating envelopes under keyboard control (pluck-a-pluck-a-pluck banjoes, anyone?).

Put S4 in the **gate** position and connect the gate output of your synth to the GATE INPUT jack near Q3. Suppose that no key is depressed. With no gate present, Q3 is off, and its collector is at +5V. The collector is coupled to the junction of R13/R14 via S4, hence Q1 is on, and the LFO is in a HOLD state. Now, depress a key. This sets up a chain reaction; current flows through R21 into the base of Q3, thus turning it on. This pulls the collector (and the R13/R14 junction) down to ground, which shuts off Q1, and allows the LFO to run. Hence the various LFO outputs are off and running.

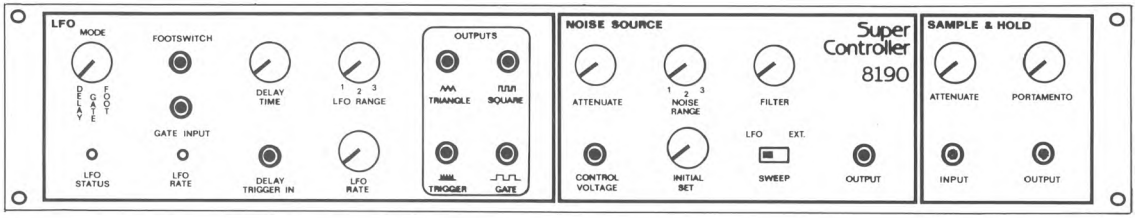
Now consider the trigger output. Suppose the gate input is off (no keys down); this holds the LFO triangle wave at pin 21 at 0V. This is buffered by A2, and this 0V output is applied to the inverting input of A3. A3's non-inverting input is held at 0.7V by virtue of the voltage drop across the diode in series with the current limiting resistor, R26. Since the non-inverting input voltage exceeds that of the inverting input, A3's output is high. This "output high" condition is chopped down to a +5V level by Q4 (which is configured in a non-inverting manner) and the output of Q4 is coupled to an AND gate composed of the four sections of the 4001. The AND gate output is differentiated by C12 and squared up to a nice 1 msec pulse by A5, which is then clipped and attenuated by D3/R31/R32, presenting a 5V output trigger.

However, remember that we said the GATE input is off. As a result, the other input of the AND gate is low (pins 5 and 6 of the 4001), so no triggers appear at the output yet. But - push a key down (GATE on), and the AND output goes high, which allows triggers to pass to the output.

This may seem like an elaborate scheme for generating triggers under keyboard control, but it is necessary. Without this logic scheme, there would be a perceptible delay time between pushing a key down and the appearance of the first trigger. Trust me, other ways of attempting this fail miserably (I should know; it took me a half year to get all the bugs out of this project!).

The triggers at A5's output also clock the S/H. A7 is an input buffer for the S/H, and its output is applied to FET Q6 which acts like a switch. With no trigger applied, R46 keeps the FET pinched off, hence no current flows through the FET channel. But when a negative going trigger hits the FET's gate, it turns on, allowing whatever voltage is at the output of A7 to pass to the hold capacitor, C13. Then the FET turns off again and the charge is safely "sealed in" by the FET on one side and A8 on the other. A8 must be a bifet type op amp. The output of A8 reflects the charge on C13, and that charge passes across R48 into C14. R48 is a portamento control that can "glide" or "slur" the sampled voltages together. The output is buffered by bifet op amp A9, and is then presented to the S/H output.

Construction. I built my version on a printed circuit board, and since this is such a large project perhaps that is the best way to go. However, there is absolutely nothing critical about the circuit so there is really no reason why you couldn't build your version with perf board and flea clips. When I made my circuit board, I used photographic techniques since I had a notion that I might want more than one in my synthesizer system. That hunch



RACK PANEL: 3.5"X 19" -¼" PHONE JACK -POT or ROTARY SWITCH - LED -SLIDE SWITCH

Figure 2: Panel graphics of the Controller

paid off! I think you'll find that with two Super-Controllers you can do both incredibly complex and amazingly subtle sounds.

I built my prototypes behind standard 3.5" by 19" rack panels. Figure 2 shows the layout I used. The circuit board is supported on angles behind the front panel and the whole construction has a nice solid feel to it.

Tuning the SCM. Tweaking the Super-Controller is quite easy. First let's set R37, which is the DC offset trim for the triangle wave output. The fastest way to set this is to simply monitor the triangle wave on an oscilloscope and set the control so that the triangle wave is symmetrically oriented about ground. If you don't have a scope, monitor the triangle wave with a center-zero Voltmeter (most inexpensive VOMs have such a function). Then, set the trimmer so that the needle on the meter swings an equal amount on either side of zero Volts. Or if you're not fussy about zeroed out triangle waves, simply set the trimmer to mid-position and leave it. This will give sufficiently close results.

To adjust the clock offset trimmer, R7, monitor the noise source with an amplifier. Turn R1 and R2 completely down, then spin R7 around a few times to get familiar with its effect. At one extreme you won't hear anything through the monitor amp; at the other extreme you will hear a very shrill white noise sound. Starting from a no-noise position, ease the trimmer up until the noise just starts. This is the optimum position. By setting the trimmer in such a way, the initial set pot, R1, will have a full range effect.

Well, that's it...all built and all tweaked up; we're ready to make some music!

Using the SCM. There are zillions of possible uses for the Super-Controller, and hardly a week goes by that I don't see some new, off-the-beaten-path way of using this machine. But I've had over a year now to play with the thing, and experience is what really counts. To help you get started on collecting your own experiences, I'm going to detail four very simple patches. But let me reiterate, these simple patches are for example only. Once you're familiar with these, I'm sure that you'll find many more.

Delayed vibrato. Figure 3 shows the first patch, a delayed vibrato effect. Follow this patch chart carefully, with your own system and the SCM. Note that triggers come from the keyboard to the delay trigger input. To make this more fun, you might want to set up the VCO, VCF, and VCA to approximate the sound of a violin.

Now push a key down and hold it. At first the note will appear without any vibrato, and after a certain amount of time the vibrato will enter. Experiment with various settings of the delay time pot, R15. You will note that since the delay time

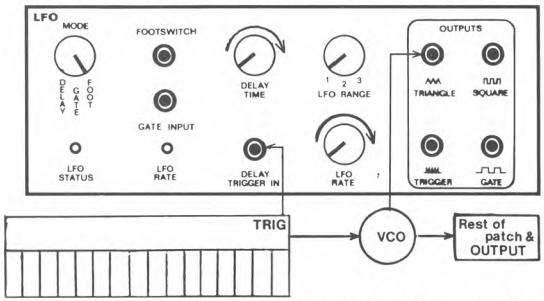


Figure 3: Delayed vibrato

is retriggerable, a series of triggers will keep firing and refiring the timer for as long as you keep playing. The upshot is that as long as you keep your fingers moving on the keyboard no vibrato will occur, but as soon as you stop and hold a key down, the vibrato will appear after the delay time has elapsed. This can be very useful when you want no vibrato until the last note of a passage.

Gated repeating ADSR effect (see figure 4). In this patch the gate from the keyboard determines when the LFO is on, and gate and trigger signals from the LFO fire the ADSR. Push a key down and you get a series of repeating sounds; let up on the key and they stop. As mentioned earlier, you can do some great plucking banjo sounds with this patch if that's your bag.

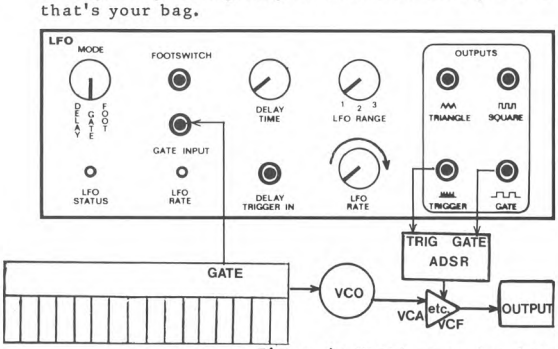


Figure 4: Gated repeating ADSR

Basic noise source patch (see figure 5). The ADSR (besides modulating the VCA) also sweeps the noise source. You'll note that there isn't any filter in this patch, and yet push a key down and what do you hear? A sound very much like a low pass filter being swept! Adding a filter to this patch really intensifies the sound. This basic patch can form the basis of some really far-out percussion effects.

Sample and hold (see figure 6). The noise source is sampled by the Sample and Hold unit, and the output is then sent to the VCO. The result is a series of random pitches, with the SCM's own LFO controlling the rate of these pitches. Add some portamento by turning up R48 and these random pitches become slurred. If you're into movies, you'll find that you can do a great "R2D2" from "Star Wars" with this patch, especially if you add some portamento.

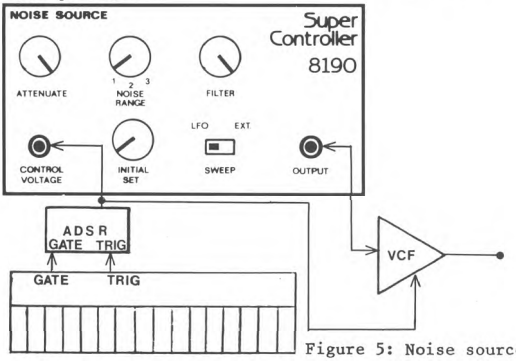
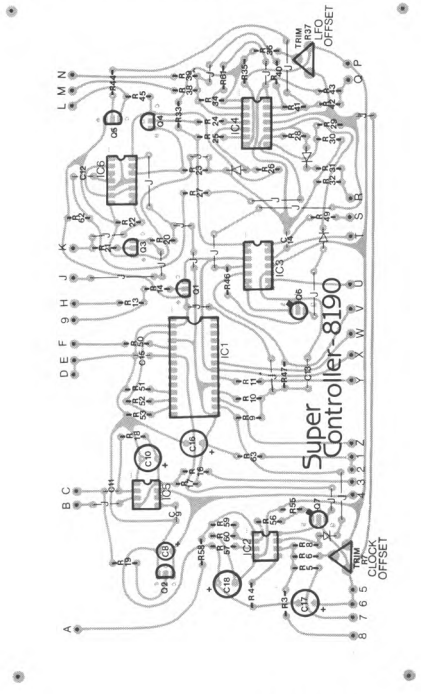


Figure 5: Noise source



SCALE: 1/2" = 1'
SUPER CONTROLLER circuit board pattern and parts placement graphics.
NOTE: the circuit board pattern is reversed to show parts placement.

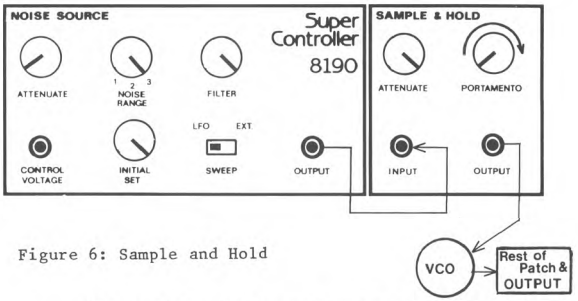


Figure 6: Sample and Hold

Conclusion. Well, sad to say I'm out of time and out of space again. This is such a fun module that I could go on and on telling you about some of the neat patches that I've come up with...but since I can't, you'll have to find them yourself (which is at least half the fun of this kind of project anyway). The best way to really discover new patches with this thing is to understand the circuit thoroughly. Once you know how it works, you'll be well prepared for applying the module intelligently and creatively.

Be sure to stop back next issue, when I'll present another exciting new synthesizer module. Until then, happy Super-Controlling! *f*

The following are available from Polymart (use order form page 25):
Etched and drilled circuit board with parts placement graphics...#8190pc.....$22.50.
Punched, painted, and screen printed Rack mount Front Panel...#8190fp.....$19.95.
Please add $4.00 postage and handling to your order.

LIVE PLUS TAPE - NEW TECHNIQUE

Continued from page.....20 -fying performers (who would hopefully be in some form of contact with the source performers to pick up their cues) could build dense and complicated textures with their loops.

Complications? Particularly with the last two techniques, it may seem that I wandered quite a bit from my original goal of making live performance easier and in particular less expensive. However, consider that a pair of four-track decks would work fine to handle the oft-illustrated four loops. Since live performance does not always demand studio quality, a pair of 7.5 IPS decks (such as two TEAC A2340s) would not only do the job, they could be bought used for less than $1000 total - cheaper than many synthesizers. In those techniques requiring a synthesizer, something as simple as a minimoog or Korg MS-20 would be satisfactory. With techniques requiring modifiers, certain selected modules could be easily configured in a case. All of this is considerably cheaper than buying a couple of programmable poly machines or even some digital behemoth. These techniques also tend to be less demanding of a performer's skills, which would not only give less-experienced performers a chance to play but also make the music a more intuitive and interactive piece that matches the mood of the occasion.

I am sure that there are many other live performance techniques other than the ones that I have mentioned, and that we're dealing with an open-ended field. In the even that you feel demented enough to try any of these ideas, let us know the results and what you've learned. Let's keep those information channels open! *f*

Details: Dirt, Rocks, Earth, and Ground

by Dennis Bohn

Last issue I wrote about ways to reduce system hum caused by improper input and output amplifier grounding (**The Story of Gozinda and Gozouta,** July/Aug). This issue I want to outline the problems caused by improper circuit component grounding.

Failure to observe the golden rule of grounding causes many circuits to go needlessly down the dumper, with mutterings of contempt for the devices involved. Soft whispered obscenities about "lousy hum rejection" and "inadequate phase margin", when, in fact, the problem is poor layout and grounding techniques.

Ideally, a ground is a ground is a ground (sure, and Lee Ritenour plays fine accordian too). For all grounds to be equal, their conductors would have to have zero resistance - which is no problem if the ambient temperature happens to be zero degrees Kelvin, but is a big problem under all other circumstances. Real-world ground leads possess finite resistance, and the currents running through them will cause finite voltage drops. Therein lies the rub. For example, 0.01 Ohms with 1 mA flowing through it produces a voltage drop of 10 microVolts. Now, an uninvited 10 microVolts showing up on a mixing summing line going to a 5534 op amp will yield a big surprise at the output: about 250 milliVolts of surprise! This surprise will take the form of hum, noise, spike, or whatever it was that caused the lousy 1 mA of current in the first place.

Figure 1a shows a common-ground example where the positive input ground and the load ground are returned to the supply ground point via the same wire. The addition of the finite wire resistance (figure 1b) results in a voltage difference between the two points as shown. Load current i_L will be much larger than input bias current i_1, thus V1 will follow the output voltage directly, i.e., in phase. Therefore the voltage appearing at the non-inverting input is effectively positive feedback and the circuit may oscillate. If there were only one device to worry about then the values of R1 and R2 would probably be small enough to be ignored; however, several devices normally comprise a total system. Any ground return of a separate device, whose output is in-phase, can feed back in a similar manner and cause instabilities. Out-of-phase ground loops are also troublesome, causing unexpected gain and phase errors.

The Golden Rule of Grounding: Always use a single-point ground system.

Figure 2 shows a single-point ground system applied to the example of figure 1. The load current now returns directly to the supply ground, without inducing a feedback voltage as in the previous example.

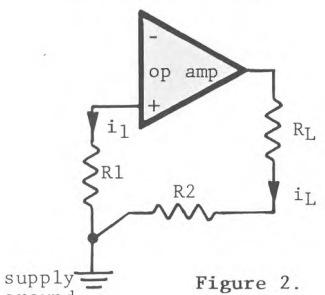


Figure 2.
Single-point ground system

The single-point ground concept should be applied rigorously to all components and all circuits. Violations of single-point grounding are most common among printed circuit board designs. Since the circuit is surrounded by large ground areas, the temptation to run a device to the closest ground spot is high. This temptation must be avoided if stable circuits are to result.

Many schematics are now showing "star" grounding symbols such as the one shown in figure 3.

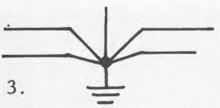


Figure 3.
"Star" ground symbol

They are trying to tell you that single-point grounding is a necessity for the circuit to perform as designed. The printed circuit board must be designed with separate paths for each ground drawn to the "star".

Another tip is to make all ground returns low resistance and low inductance by using large wire and wide traces.

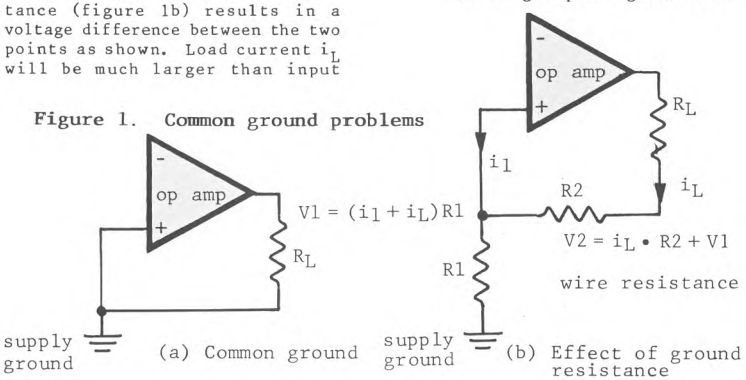
Now, you may be wondering, do a I really run separate paths for every component that goes to ground? No. But what must be done is to think about where the currents are running and what possible harm they can do. I always lay out circuit boards with at least two ground paths: clean ground and dirty ground. There is nothing wrong in running lots of things to ground **if there is no active circuitry involved.** For instance, LED and relay return paths go to dirty ground, while op amps, inputs, and outputs go to clean ground.

As a final note, there is an application note on this subject that is particularly good, and I strongly recommend it for anyone involved with op amp applications. Its cumbersome but intriguing title is "An I.C. Amplifier Users' Guide to Decoupling, Grounding, and Making Things Go Right for a Change". The author is Paul Brokaw, and he has a way of writing that is at once informative and entertaining. It may be obtained, free, from ANALOG DEVICES, Route 1 Industrial Park, PO Box 280, Norwood, MA 02062 (telephone 617-329-4700).

To close, I'd like to quote from this application note:

"The only generally applicable rule is attention to detail, and remember that you can always trust your mother, but..."

Figure 1. Common ground problems



PSYCHO-ACOUSTIC EXPERIMENTS

by Charles Lauria

One of the most attractive aspects about synthesizers is their capacity to produce a virtually unlimited range of aural effects. The mere thought of such a machine - a "universal sound creator" - is often enough in itself to spark a stream of creative ideas in the imagination of the operator. But most people, I think, never fully explore the world of the synthesizer.

Probably every synthesizer in existence has, at one time or another, been used for musical applications - creating a "new" voice for orchestrating a composition, or perhaps imitating conventional instruments for building up an orchestral sound. And when it comes to sound effects, I can't seem to imagine anyone who has not yet tried to synthesize the ultimate thunder or explosion sound. But, there is so much more a synthesizer can do; for example, I have used my equipment to help time various isotonic exercises. These exercises call for a maintenance of tension for various short intervals (7 seconds, 10 seconds, etc.). Instead of using a clock to time myself, I set up my synthesizer to produce beeps at 1 second intervals. Therefore, timing each isotonic position is simply a matter of counting the appropriate number of beeps! I know that may sound a bit eccentric but the point is, if the equipment can perform a function - even a function usually not associated with synthesizers - why not take full advantage of it?

The function I'll be talking about in this article involves psycho-acoustics. For years I've been intrigued by the effects that sound can have on mind and body; recently this interest has led me to experiment with various sounds and their short- and long-term effects. Naturally, a good collection of synthesizer modules becomes an invaluable tool in these experiments, but for some of the sounds I describe you will need some other equipment such as a phase shifter or flanger. You may also need to modify your ADSRs and ARs for some longer time constants, which usually involves switching a larger capacitor in parallel with the normal envelope generator timing capacitor. This modification is both simple and inexpensive to perform (see figure 1). So much for introductions...

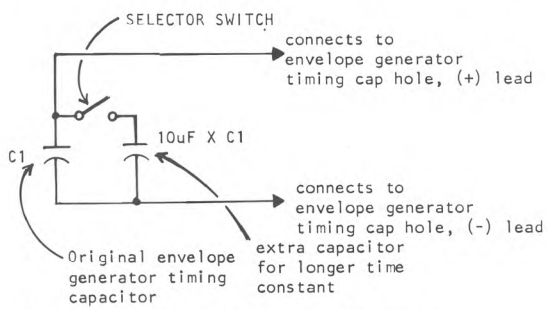


Figure 1: Outboard circuit for lengthening ADSR or AR time constant

The sounds which I have found to be "psycho-active" can be categorized into two main groups: Tonal and Atonal. These groups can be further broken down into two sub-groups: Natural (or imitative) and Non-Natural (non-imitative). The atonal sounds seem to have their greatest effect on a subconscious level of the mind, and often work best when the conscious mind is occupied with something else - such as reading, studying, or anything that keeps you from concentrating on the sound itself. Tonal sounds, on the other hand, work their magic on the pre-conscious mind, that area between the deep subconscious and the superficial conscious. These sounds have their best effect when you concentrate on them - listening intensely to them as if they were a meditational mantra. Of course there are exceptions to all rules, and these rules are no exception! Depending on your particular mental make-up, your condition at the time, etc., the sounds can behave in unpredictable ways, and may sometimes have no effect whatsoever. You will need to experiment on your own - but this article should point you in the right direction and provide you with the starting point for your own explorations.

Natural Atonal Sounds. This group is one of the easiest to synthesize and a good place for the beginner to start. These sounds include natural environmental sounds like wind, surf, and rain. If you've had your synthesizer for more than 24 hours, you undoubtedly know that all these sounds have a common source: noise. It has long been known by the scientific community that white and pink noise can have a beneficial effect on the human mind; as a matter of fact, PAIA produces several kits based on this principle (Chatter Jammer, Surf Synthesizer, the Wind, etc.), so psycho-active sounds of this type are no secret. If you have even a modest collection of modules, you can have all of these

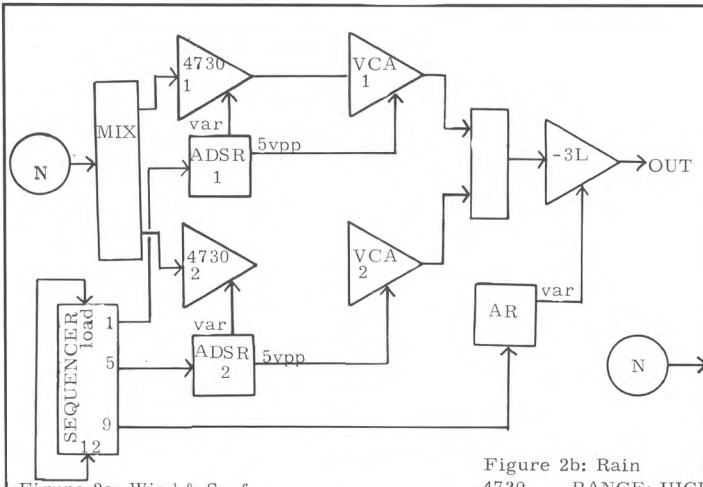


Figure 2a: Wind & Surf

SEQ. - RATE: 0-50% 12 STAGE RECYCLE

4730 1/2 -	WIND	SURF
OUTPUT:	BP	LP
RANGE:	HIGH	LOW
INIT. FREQ:	100%	80%
"Q":	0%	0%
SW/TR:	SWEEP	SWEEP

ADSR 1/2 - A: 100% D:100% S: 100% R: 30% VAR OUT: 50-70%
AR - A: EXPAND/100% D: 30% VAR OUT: 30%
(ALL ADSR/AR SETTINGS ARE FOR MODIFIED TIME CONSTANTS)
MIXER - ANY INPUT, LEVEL: 10% PAN: 50% L out/R out: 100%
REVERB - INP. MIX: 50% REV.: 0% REVERB SWITCH: off

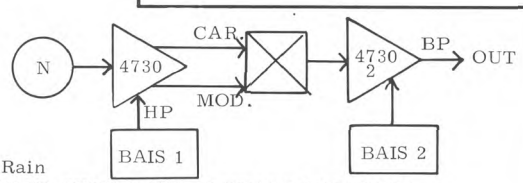


Figure 2b: Rain

4730_1 - RANGE: HIGH-RAIN AS HEARD OUTDOORS
LOW-RAIN AS HEARD INDOORS
FREQ: 100% "Q": 50% SW/TR: SWEEP
4730_2 - RANGE: HIGH FREQ: 100% "Q": 50% SW/TR: SWEEP
MODULATOR - LED SHOULD FLICKER DIMLY
BAIS 1: ≐.5v BAIS 2: ≐.25v
ADJUST AMPLIFIER TONE CONTROLS FOR BEST EFFECT

curity that we all experienced during the first nine months of our lives. Hearing them again at any age seems to bring back the subconscious memory of that security, especially if you take the effort to find a tuning of this patch that "clicks" with your particular psyche.

When I listen to this sound, my body automatically tries to synchronize its breathing rhythm with that of the synthesizer. I suppose that this patch could therefore serve as a tool for learning breath control and relaxation-response techniques, but I haven't yet tested this idea. As always, remember the extreme effects at your disposal without having to own each individual environment machine. I've included some patches for these sounds (see figure 2), but use them only as guidelines - always experiment with the parameters of a sound to find something that works well for you.

Another sound in this category could also be classified under the non-natural group, depending on how you tune the patch (see figure 3). It is the sound of human breathing, and although it is certainly natural enough, there are some equally effective tunings of this patch which can hardly be described as sounding human! I prefer the human-sounding tuning because it seems to have a more intense effect.

Next to the sound of your mother's heartbeat, the most dominant sound in your pre-natal environment was the sound of her breathing. I can't help but think that this explains why it is such a powerful psycho-active sound. After all, in our subconscious these sounds are synonymous with the feelings of comfort and se-

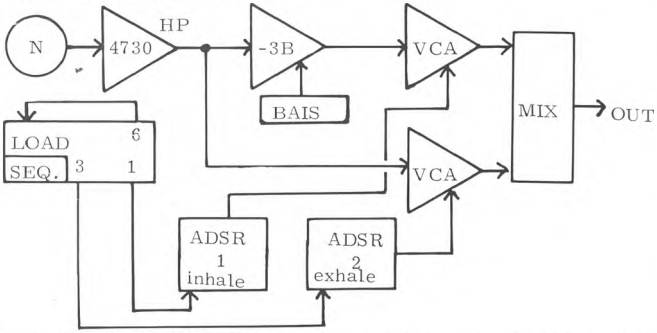
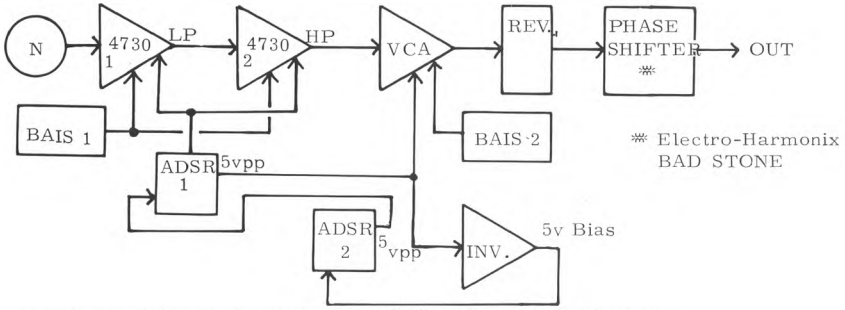


Figure 3: Human Breathing

4730 - HP OUT, RANGE: HIGH FREQ: 50-70% "Q": 70-90%, SWEEP
-3B - "Q": MAX (100%) BAIS: 5v or TO TASTE
SEQ. - RATE: 0-40% 6 - STAGE RECYCLE
$ADSR_1$ - A: 50% D: 100% S: 100% R: 30% VAR OUT: 100%
$ADSR_2$ - A: 30% D: 100% S: 100% R: 30% VAR OUT: 100%
MIXER: BALANCE INPUTS FOR EQUAL VOLUME OF INHALE AND EXHALE SOUNDS. PAN: TO TASTE
TRY USING THE LOW AND BAND PASS OUTPUTS OF THE 4730 FOR A DEEPER, LESS HUMAN-SOUNDING EFFECT.
ALSO PLAY WITH THE FILTER FREQUENCIES/"Q" SETTINGS.
IF YOU VARY SEQUENCER RATE, YOU WILL NEED TO JUGGLE ADSR CONTROLS TO MAINTAIN REALISM.

Figure 4: Peace Storm



4730 1 - RANGE: HIGH FREQ: 80% "Q": 50% SW/TR: SWEEP
4730 2 - RANGE: HIGH FREQ: 100% "Q": 50% SW/TR: SWEEP
ADSR 1 - MODIFIED TIME CONSTANTS, A: 50% D;S;R: 100% VAR OUT: 50% or TO TASTE
ADSR 2 - NORMAL TIME CONSTANTS, A;D;S;R: 0%
INVERTER - 5v. Bais BAIS 1: 1.5v or TO TASTE BAIS 2: 2.5v or TO TASTE
REVERB: 50% or TO TASTE
PHASE SHIFTER: ELECTRO-HARMONIX BAD STONE
RATE: 0%, FEEDBACK: SLIGHT RESONANCE, TUNE: 0%, AUTO MODE
IF USING A DIFFERENT MODEL OF PHASE SHIFTER, CHOOSE SLOWEST RATE OF

importance of experimenting with variations in tunings. Believe me, in some cases a fraction of a degree difference on a control knob can make the difference between "a sound" and "a psychoactive effect".

Non-Natural Atonal Sounds. Since you're not aiming to imitate a specific sound, you will be even less restricted in setting the parameters of non-natural sounds than you were with the natural group. While I'll be giving some general guidelines, you can (and probably should) carry my ideas to the limits of your own imagination.

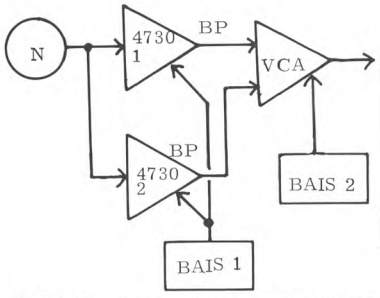
The first sound I call "Peace Storm" (figure 4), because there is no way you can be with this sound and not feel a calming "downpour" of quiet all around you. It is easy to forget that this sound is playing, but it is hard to forget its effect on you. Try leaving it on for about 45 to 60 minutes at a time while you're reading, studying, assembling a project, or whatever. It may take a couple of these "sessions" before you become accustomed to the sound and become tuned in to its effect on you, but don't give up. When you finally get into it you'll be glad you made the effort! It is truly a natural high.

The second sound is simply steady pink noise (figure 5). Pink noise is hard to beat for blocking out extraneous noise, but for maximum effect tune the filter(s) for approximately the same frequency range as the unwanted environmental noise. For example, if you were bothered by a nearby airport or highway, tune the frequencies low since these noises consist mostly of low frequency components. For blocking out household noises, a mid-range filter tuning works best. Of course, the blocking effect works best with headphones; but ordinary speakers give respectable results, since we're dealing with a psychological as well as physical effect.

Tonal Sounds. Anyone who has studied meditation techniques knows that the key to the whole process is concentration: If one's concentration is focused on the "right" thing, the mind will automatically "transcend" into the complex world of the subconscious. The desired result is a level of rest/relaxation that is so pure and intense that a mere 20 to 30 minutes of such a state has the revitalizing effect of a full night of normal sleep! A person taking a meditation course is given a carefully selected focal point on which to concentrate. In the case of TM (transcendental meditation), this focal point takes the form of an abstract vocal sound called a mantra ("om" is a widely known example of a mantra). To meditate, the person thinks of this sound; this concentration puts both the body and mind in a peaceful, restful state.

The reason I'm going into all this is that all of the effects in the tonal category can, to some extent, be thought of as mantras. They are sounds on which you can concentrate. The end result, as with TM, is often a restful state of mind and body. You've probably guessed what I'm going to say next

Figure 5: Pink Noise Generator



4730 1/2 - RANGE: HIGH FREQ: TO TASTE "Q": TO TASTE
BAIS SUPPLIES: TO TASTE
USE INIT. FREQ. AND "Q" CONTROLS TO ALTER TONAL SPECTRUM

that although all of the sounds in this next group can be used as mantras, they also have other uses. Let my suggestions merely be a starting point for your own explorations.

Natural Tonal Sounds. A good example of this is the sound of crickets (figure 6). The idea of using cricket sounds as a relaxation/meditation vehicle is not original. One side of the "Environments" series of recordings is titled "Dusk at New Hope, Pennsylvania" and contains 30 minutes of cricket chirping. Upon listening to this sound, whether on record or from my synthesizer patch, there is an immediate quieting of the spirit. Concentrating on this sound further exaggerates the effect and can turn your room into the summer countryside...even if you're living in the middle of a metropolis in the dead of winter! There have been times when I've kept the sound on in my room throughout the night - for a very refreshing night of sleep. Those of you with insomnia should definitely give this one a try.

Non-Natural Tonal. The first effect here uses the Pink Tunes program, which is designed to run on PAIA's computer-controlled synthesizers. This program creates a pseudo-random tune in 4 part harmony. Depending on the selection of notes you enter into the computer, the psychological effect will vary. If you enter a table of notes which are musically compatible, you'll probably get a pleasant melodic effect which, if listened to for an extended period

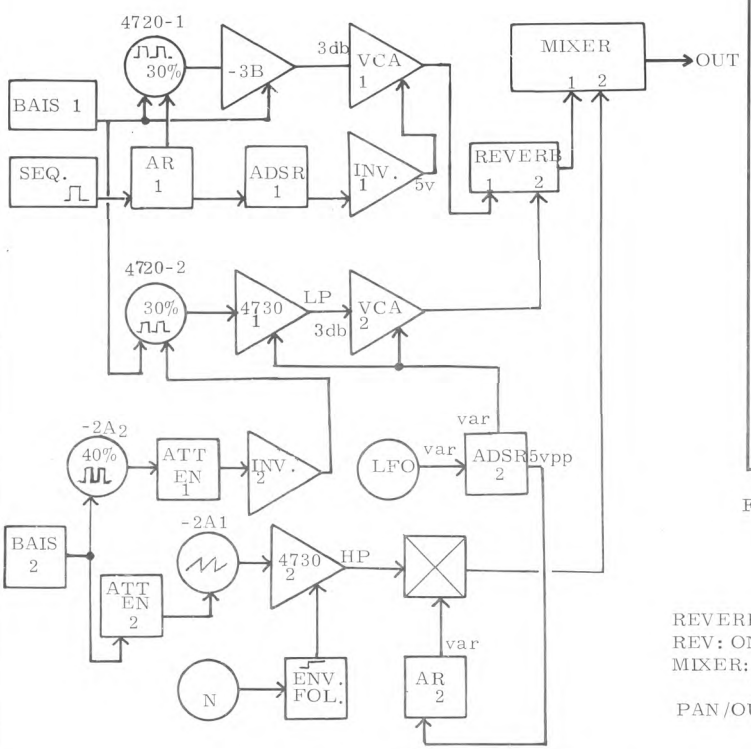


Figure 6: Super Crickets
(Night in the Country)

REVERB: MIX: 20%
REV: ON, DEPTH: 80%
MIXER: INP 1: 10%
INP 2: 60%
PAN/OUTPUT: TO TASTE

SEQ. - RATE: 100% T. WIDTH: 50% MODULATOR: CAR. INPUT, LEVEL: VCA
LFO - RANGE: MED. FREQ: 0% VAR. OUT: ADJUST FOR SHORT CHIRPS: 70%
BIAS 1 - 2.5v BAIS 2 - .5v ENV. FOL.: STEP TRIG. OUT, SENSITIVITY: 100%
4720_1 - P.W.: @30%, RANGE: 50% 4720_2 - P.W.: @30%, RANGE: 20%
$-2A_1$ - RAMP OUT, (NORMAL RANGE) $-2A_2$ - PW: @40%, (NORM RANGE)
-3B - "Q": 100% INV. 1: 5v BAIS INV. 2: 5v BAIS
4730_1 - RANGE: HIGH INIT FREQ: 60% "Q": 0% SW/TR: SWEEP LP OUT
4730_2 - RANGE: HIGH, INIT FREQ: 100% "Q": 100% SW/TR: SWEEP HP OUT
$ATTEN_1$ - ADJUST FOR DESIRED "TRILL" DEPTH: @ 20%
$ATTEN_2$ - CAN BE ANY POTENTIOMETER - TRANSPOSER WORKS WELL BUT IS'NT NECESSARY. ADJUST TO TASTE (CLICK RATE).
$ADSR_1$ - ADJUST CONTROLS FOR AN IRREGULAR TRIGERING PATTERN
suggest: A: 40% D: 100% S: 100% R: 15% VAR OUT: 40%
$ADSR_2$ - A: 10% D: 100% S: 100% R: 10% VAR OUT: 100%
AR_1 - A: EXPAND/10% D: 10% VAR OUT: 100%
AR_2 - A: EXPAND/100% D: 0% VAR OUT: TO TASTE (VOLUME OF CLICKING)
NOTE: AR_2 USED MODIFIED TIME CONSTANTS WITH SETTINGS SHOWN

of time, can have an almost hypnotic result. Use the patch in figure 7 for a full-bodied sound, but make sure that all four oscillators track accurately over at least a 3 octave range. Otherwise, any mistunings will lead to an extremely irritating effect.

To begin, after loading the Pink Tunes listing, set the Tempo variable for $FA. This will be a moderately slow tempo and can later be altered to taste, but it's a good place to start. The 16 notes I usually enter are: C2, F2, A2, C3, Bb1, D2, F2, Bb2, C2, F2, A2, C3, Bb1, D2, F2, Bb2. When combined, this sequence creates an F major chord and a Bb major chord which work fine together and rarely combine in a dissonant way. By changing the sequence to a pentatonic scale (all black keys), the effect becomes unmistakably oriental, and very conducive to meditation or deep thinking. Try various combinations of notes, but make sure you listen to the sequence for quite a while. What often sounds meaningless at first can sometimes turn out to have a profound long-term effect. For more details on the Pink Tunes program, see Lab Notes in Polyphony Vo. 4, No. 1, 1978.

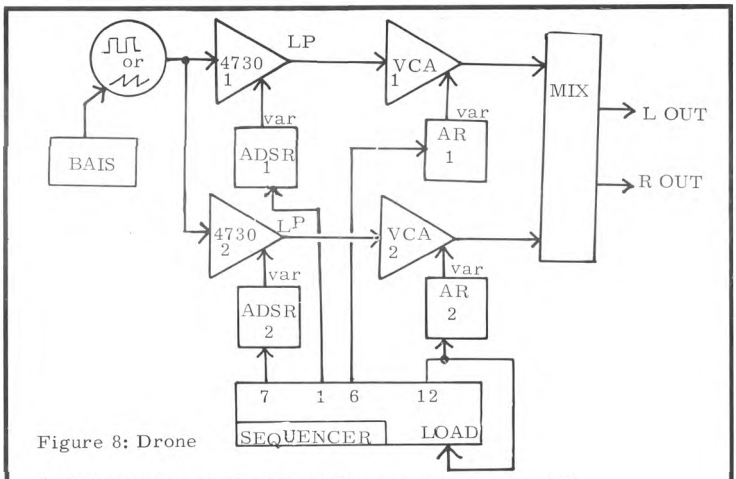


Figure 8: Drone

SEQUENCER - 12 STAGE RECYCLE RATE: 20 - 60%
VCO - ANY WAVEFORM BAIS - TO TASTE
4730 1/2 - RANGE: HIGH FREQ: 100% "Q": 80% SW/TR: SWEEP
ADSR's/AR - MAXIMUM ATTACK, SLIGHT DECAY (@10%)
MIXER - LEVEL/PAN TO TASTE

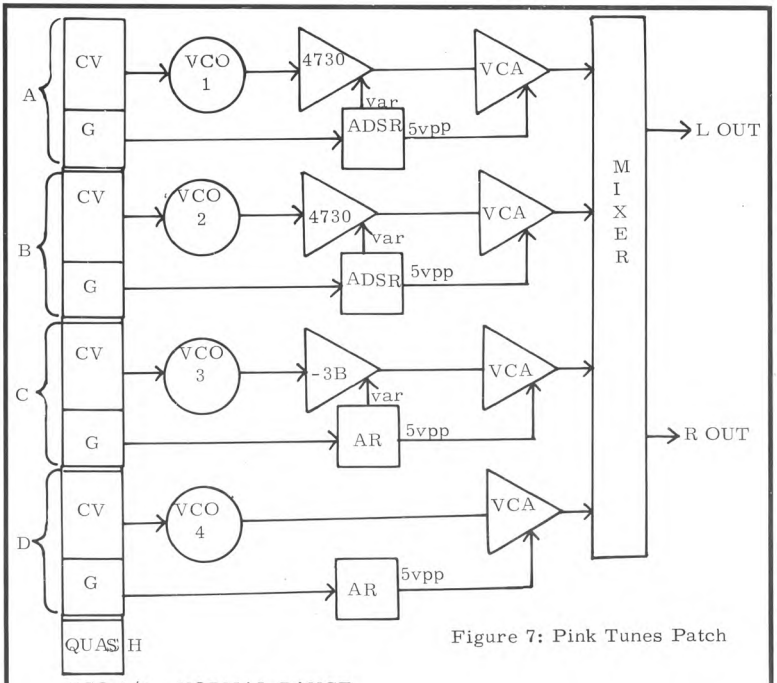


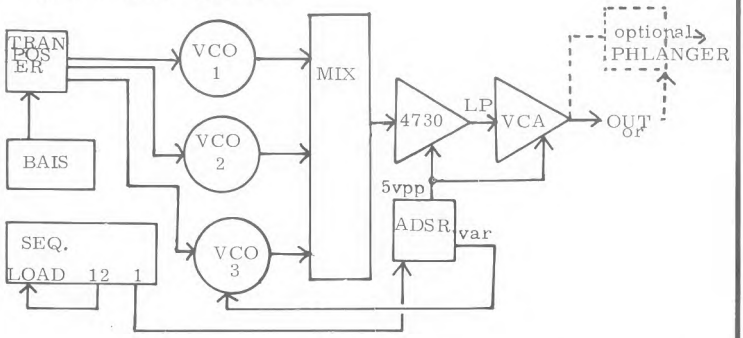
Figure 7: Pink Tunes Patch

VCO 1/2 - NORMAL RANGE
VCO 3 - 1 OCTAVE BELOW NORMAL (VIA TRANSPOSER/POT)
VCO 4 - 1 OCTAVE ABOVE NORMAL
VCF's - TO TASTE
MIXER - LEVELS/PAN/OUTPUTS TO TASTE
ADSR's/AR's - ATTACKS: MODERATELY QUICK (0-10%)
DECAYS: MODERATELY LONG (50-100%)

Another non-natural tonal effect, the steady low frequency drone, is very simple to patch and very flexible (see figure 8). For the sake of variety and interest, I usually modulate the filtering and/or volume parameters with an extremely slow sweep (such as the modified ADSRs described before, being triggered by a very slow running sequencer). Waveforms rich in harmonics are naturally better candidates for filtering, and give the most interesting effects. One VCO is fine, but 2 or more set for unison adds more dimension to the sound. Set one VCO for a low frequency tone in the 50 to 100 Hz range; set all other parameters according to your personal taste and listen to the sound for several minutes. Somewhat reminiscent of the "om" chant, this effect can calm and also energize you, much the same as a meditation session.

A variation of this effect uses multiple VCOs (at least 3) tuned in such a way that when this patch is set up, it produces a chord which drifts from a minor key to a major key repeatedly (figure 9). For example, let's set up a C chord. Tune VCO 1 to some low C, and tune VCO 2 to the

Figure 9: Resolving Chords



VCO's - SEE TEXT FOR EXPLANATION OF TUNINGS
TRANSPOSER - SEE TEXT
BAIS - SET TO TASTE, LOWER FREQUENCIES PREFERED
SEQUENCER - RATE: 0% 12 STAGE RECYCLE
MIXER - ALL INPUT LEVELS EQUAL, PAN/OUTPUT TO TASTE
4730 - HIGH RANGE FREQ: 50-100% "Q": 0% SW/TR: SWEEP
ADSR - A: SET ATTACK SO THAT MAXIMUM AMPLITUDE IS REACHED AS SEQUENCER REACHES STAGE 11. D;S: 100% R: 10%
VAR OUT: SEE TEXT
NOTE: IF PHLANGER IS USED ON THE OUTPUT, USE MODERATE RATE/DEPTH SETTINGS SO AS NOT TO DETUNE THE CHORDS EXCESSIVELY

G above that C. Now, with the variable output of an ADSR/AR plugged into VCO 3, but with the ADSR cycle off, tune this VCO to the Eb between C and G for a C minor chord. Now with the ADSR in its "on" state, adjust the variable output so that VCO 3 is producing E natural, making a C major chord. Next, trigger the ADSR from a sequencer or LFO and set its controls for a very long attack and a short decay. The result will be a melancholy C minor chord which "floats up" to a more cheerful C major, and then drops down to a C minor again, only to repeat the cycle. The result of this continually resolving chord seems to be an uplifting of your mood. I suppose that if the ADSR is set for a short attack and a long decay, the effect will be rather sobering as the major chord continually "falls" into the minor key.

That just about wraps things up; remember that my ideas are only guidelines - experimentation is a must in order for you to find your own sound. And if you come up with something profound, or have any questions or comments about this article, feel free to drop me a line c/o Polyphony. In the meantime, have fun with your psycho-acoustic experimentations.

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proto board AP Products proto board - ACE 201K 2/$24.95 (half price!)

Books: Old standby, soon-to-be-extinct "Electronic Projects for Musicians", 1st edition, closeout at $5.95. "Home Recording for Musicians" $9.95

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