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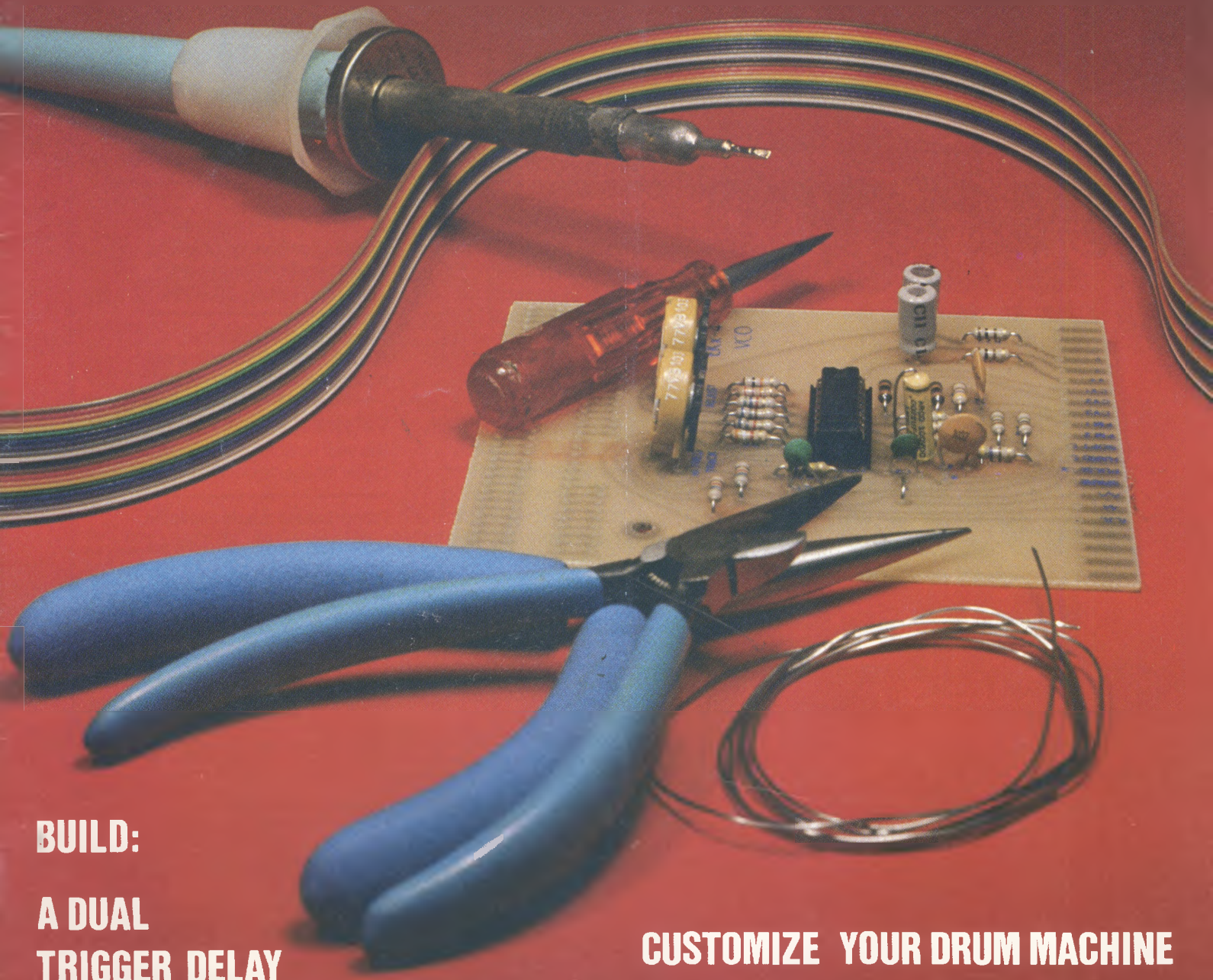

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AN INTERVIEW WITH JOHN FOXX

ISSN: 0163-4534

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Robert Carlberg's re-view

In order to summarize and celebrate the past year, I hereby establish the **FIRST ANNUAL POLYPHONY AWARDS.** Not all of these releases were recorded in 1983, but all have been reviewed this year, as indicated in parenthesis.

ALBUM OF THE YEAR: Peter Gabriel -- Security (February). Beautifully recorded, fully developed, accessible yet challenging. This album's got it all -- even a hit single, which wasn't even one of the strongest tracks. The production work and synthesis are simply gorgeous.

SONG OF THE YEAR: Peter Gabriel -- "Lay Your Hands On Me" (from Security). The best of the best. Interesting construction, great synthesis, thought-provoking lyrics.

ARTIST OF THE YEAR: Kit Watkins (album Frames of Mind reviewed June). This year's award goes not to Mr. Gabriel (who had plenty of help on his album), but to this Virginia native who plays keyboards, flute, pan pipes, autoharp and digital drum unit on his album. He did the cover and produced and engineered too. All of these are done extremely well.

BEST POPULAR SYNTHESIZER ALBUM: Bill Nelson: The Love That Whirls (Diary of a Thinking Heart) (April). A warm electrobeat album, something I never thought I'd see. Runner-up: The View -- **In a Strange Land** (e.p., April). Three tasteful, catchy tunes which just happen to be by an independent. Lost out to Nelson only because the Prophet 10 isn't featured more prominently.

BEST JAZZ SYNTHESIZER ALBUM: No winner. If there was one, I missed it.

BEST AVANT-GARDE ELECTRONIC ALBUM: Heliograms (September). Manages to be both majestic and beautiful while being totally abstract. Nice packaging too.

BEST CONCEPT: Robert Rich -- Sunyata (cassette, June). This is Music for Sleeping -- ambience for unconsciousness -- and it's pleasant enough not to disturb the descent into nappytime.

BEST ALBUM TITLE: Brute Reason by Bernard Szajner (Oct). Runner-up: **Music to Wash Dishes By** by Tom Cameron (Aug).

BEST SONG TITLE: "TMIU-ATGA" by Brand X from Is There Anything About? (Feb). It stands for "They're Making It Up As They Go Along".

BEST ALBUM COVER: Inquietude by the Electronic art Ensemble (April). Sorry I can't show it to you.

BEST ENGINEERING: Thomas Dolby -- The Golden Age of Wireless (Aug). Engineered by Wally Brill, Chris Birkett, Tim Hunt, Chris Stone, Mike Hedges, Graham Carmichael, and Martin Levan. No wonder There's so much variety.

DEBUT OF THE YEAR: Ricky Starbuster -- Starburst (cassette, Aug). Good programming, good performance, and good composing -- with high hopes for the future.

COMEBACK OF THE YEAR: Peter Baumann -- Strangers In The Night (Oct). After last year's Repeat Repeat, it's good to see Baumann back on Quality Street. Runner up: Mychael Danna -- **A Gradual Awakening** (cassette, Oct). He wasn't ever really "gone", but it's good to see him doing original stuff now.

MISTAKE OF THE YEAR: Blade Runner Soundtrack by the New American Orchestra (Feb). If they couldn't release Vangelis' original synthesizer score, whose bright idea was it to release an "orchestral adaptation"? What could have been the motivation?

IRONY OF THE YEAR: 50's-style rock-a-billy is now being played on all the New Wave stations. Circular circulation, it circles continuously.

It's been a good year. Have a happy new one.

Editor's Notes

Mods are a great way to increase the usefulness of a piece of equipment without having to spend gobs of money. Case in point: The E-mu Drumulator mod in this issue, which, by adding one switch and breaking one trace, gives a completely different set of drum sounds. (The effect is not unlike running the original drums through a pitch transposer set for one octave up transposition.) Or how about the Roland Drumatix mod, which lets you add individual outputs for the various drums as well as sync pulses for arpeggiating a synth (or triggering other synchro-sonic events). And for all you PAIA fans, there's info on how to upgrade the snare and bass drum voices for the Programmable Drum set, as well as everything you need to know to turn the EKx-40 VCO experimenter's kit into a quality synthesizer module or expansion VCO. (By the way, with respect to the Drumulator mod I would like to thank the people at E-mu for keeping us up to date on the latest Drumulator news and mods. All manufacturers are urged to use Polyphony as a bulletin board for getting out news of this nature).

I've done quite a few mods myself, the most recent of which were done to a Roland GR-300 guitar synthesizer (these mods are described in the January 1984 issue of Guitar Player magazine). As always, it was an intimidating experience to drill holes in the case of an expensive piece of equipment; however, I was one of the lucky ones -- I had a schematic. Many experimenters have to work on mods without schematics, which is kind of like driving in a foreign country without a road map.

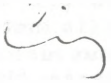
Although some manufacturers are very helpful to experimenters and provide schematics at a nominal fee, the majority of companies seem quite secretive about their circuitry. I have never been able to figure out why this secrecy is justified. If the companies are concerned about the competition finding out about proprietary designs, I have news for them -- most new equipment has been disassembled by any interested competitors within days, if not hours, of the time the first unit hits the streets. And if you're concerned about hobbyists building circuits from schematics, forget it. In most cases, it's cheaper to buy new equipment than to try and copy it (manufacturers have the buying power to get parts for far less than individuals can).

So how about it, manufacturers. If you make your schematics available to owners, you will be encouraging those owners to take full advantage of their equipment. This doesn't just benefit the owners, but the manufacturers as well -- more than one of my mods has ended up being adopted by a manufacturer on later production runs. Go ahead and charge a couple of bucks for the schematic, or several dollars for a service manual; that's fair. What's not fair is depriving musicians of the one tool they really need -- documentation -- to customize equipment to their particular application.

If any manufacturers would care to give a rebuttal as to why they are so reluctant to let schematics out into the world, please write in. Of course, we all understand that manufacturers are not set up to help out those people who get in over their heads; but still, if someone is willing to void a warranty and risk blowing up a substantial investment, that person deserves at least a little assistance. I don't think that providing a schematic to someone who has already bought and paid for a piece of equipment is asking too much.

* * * * *

Speaking of assistance, you'll notice a new name on the masthead, that of assistant editor Vanessa Else. Vanessa comes to us from the University of Illinois with a background in music, electronic circuit design, and writing -- just the kind of combination you need for a magazine like this. She is making her Polyphony writing debut next issue in an article on building a Just Intonation Generator. This device simultaneously generates all 12 tones of a just intoned scale (see David Doty's article in the August 1983 issue of Polyphony); the just intoned scale is inherently more "in tune" than the conventional even-tempered scale. Based substantially on ideas and circuits from my lab notebook as well as some theoretical work by David Doty, this board is suitable for use as a stand-alone just-intoned top octave generator; or, you can run a header from the just intonation board into a conventional 50240 top octave generator socket, thus retrofitting 50240- based instruments (such as Organtua, Stringz & Thingz, and Oz) to just intoned operation. We think this is a pretty interesting article for anyone who wants to delve into alternate tuning systems -- watch for it.



Craig Anderton

Polyphonic Keyb

Roland Juno 6 & Juno 60

By: Eric Meye

ROLAND JUNO-6 and JUNO-60

The Roland Juno-6 was the first of the under-$2000 polyphonic synthesizers. It has a five octave keyboard with a good, fast action; and while the actual tone generating apparatus is rather sparse (thus contributing towards the low price), clever design on the part of Roland's engineers has compensated for much of what is missing.

The secret to the Juno's good sound is the Digital Controlled Oscillator (DCO), which produces three simultaneous outputs: variable pulse, sawtooth, and sub-pulse (a square wave one octave lower than the note actually being played). These three waveforms can be combined in any combination; but there is no mixer and only the sub-pulse, along with an additional white noise source, have amount controls.

While each of the six voices has only one oscillator, the sub-pulse helps fill out the sound, as does a built-in chorus effect (with two intensities). However, the chorus produces faint white noise sweeps which are audible when the keyboard is not being played, so judicious use is advised. Also, because there is only one sawtooth wave, "brassy" sounds seem rather thin. All waves are, of course, in phase; there is no detune.

The Juno has both a high and low pass filter, which when combined give a bandpass response. The filter can be made to oscillate, thus providing another tone source. There is only one envelope generator (ADSR), shared by the VCF and VCA. The envelope contour of the VCF may be inverted and can also be used to modulate the pulse width in the DCO.

A low frequency triangle wave oscillator provides the only other source of modulation. The range, however, is wide enough (0.3 Hz to 20 Hz) to produce useful effects. Modulation can be routed to the DCO frequency, pulse width, or VCF cutoff frequency; there are separate amount knobs for each. There is also a delay slider, which causes the modulation to fade in over an adjustable period of time after a note has been played. However, a note must be released before playing the next for the delay to be retriggered, as there is only one LFO for all six voices; otherwise, the modulation will continue as normal, with no fade-in. The LFO can be triggered automatically, or by a touch pad to the left of the keyboard.

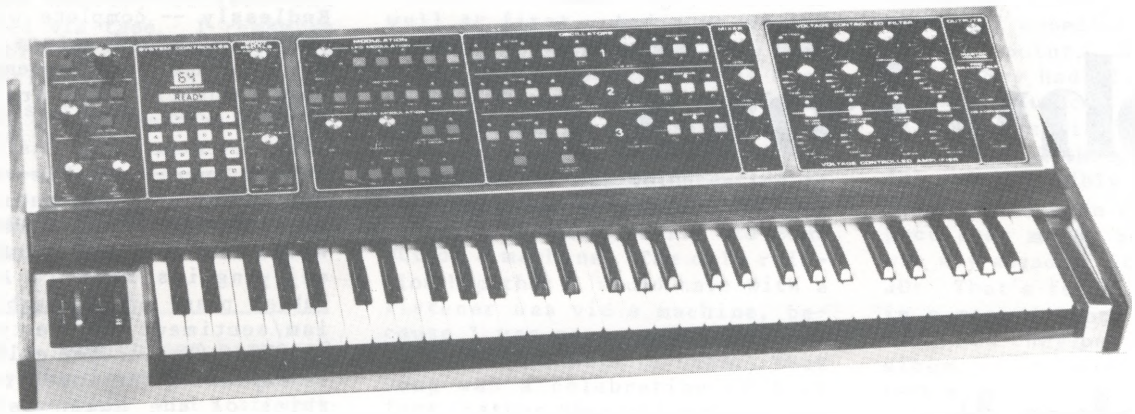
Also left of the keyboard is an octave transpose for switching the entire keyboard up or down an octave. Most patches do not hold up well in the lowest octave. The bender is center-sprung (sometimes it would be nice if this could be defeated) and can bend the pitch up or down, and/or open and close the VCF. I found it easier to use than the standard pitch wheel configuration.

The arpeggiator will play up or up/down, and will arpeggiate over one, two or three octaves. A hold button will memorize notes, chords or an arpeggiator pattern, and a transpose button allows you to use key of C fingerings in any key. Jacks are provided for a VCF pedal, hold footswitch, arpeggiator sync, headphones and stereo output.

The Juno-60 is basically a Juno-6 with a built-in computer. It can store 56 patch programs and communicate with other Junos or computers.

While the Juno-6 (or 60) is not as versatile as the more costly performance-oriented synthesizers, it is a well made, quality instrument. It is especially suited to those needing an inexpensive addition to a keyboard stack, or for people who want to learn about synthesizer basics. The panel layout is clear, and patches can be created quickly and easily (making it useful in a studio environment). The sound is definitely of professional quality. Several other manufacturers

oard Reviews



Moog Music Memorymoog

have produced synthesizers in the same price range, but I have yet to play one which significantly surpasses the Juno-6.

The Juno-6 lists for $1295, the Juno-60 for $1750. You may obtain more information on these and other Roland keyboards by sending $2 to RolandCorp, 2401 Saybrook Ave., Los Angeles, CA 90040.

MOOG MUSIC MEMORYMOOG

Moog Music has based their latest synthesizer on the famous minimoog. The programmable six-voice Memorymoog has three oscillators per voice, each with simultaneous variable pulse, sawtooth, and triangle wave outputs. VCO 2 can be synced to VCO 1, and VCOs 2 and 3 can be detuned ± one octave. There's also a useful pink noise source, and the low-pass filter will oscillate, thus providing a third audio source. Both the VCF and VCA have individual ADSR envelope generators.

A master wide-range (0.1Hz to 100Hz) low frequency oscillator has four waveforms and a sample-and-hold (S & H). It can modulate the individual VCO frequencies or pulse widths, or the VCF cutoff via a modulation amount knob. Unfortunately, there is only one knob for both the VCF and VCOs.

VCO 3 may be operated as another LFO for making click tracks, or used in the voice modulation section in either its low situation. Also, the arpeggiator patterns cannot be saved in the memory.

The programmer monitors all functions, and tells the keyboardist (among other things) the patch number in use, the keyboard or arpeggiator mode, and, if one edits a program by turning a knob, what the old setting was and what the new one is. The MemoryMoog stores up to one hundred patches, along with ten program sequences of up to twenty programs that can be stepped through with a footswitch or buttons on the panel. The latter storage method makes changing sounds easier, as the program numbers needn't be memorized -- just their location in the sequence.

The 5 octave keyboard, though not velocity-sensing, has a remotely piano-like feel. Left hand controls include an octave transpose switch, modulation wheel, and pitch bend. While the bender is not center-sprung, it will lock into that position (albeit a little tightly for my tastes).

There are several trigger modes to suit different playing styles and effects. Keyboard tracking can vary the envelope settings and LFO rate. Keyboard or audio range. The VCF envelope is also available for voice modulation.

The extensive modulation capabilities not only provide the standard chorus, echo, vibrato, and trill effects; you can obtain especially unusual effects by switching VCO 3 to low, turning on all three waves, then modulating it with the LFO. Overall, the modulation section allows for much musical creativity.

The Memorymoog's monophonic mode is as impressive as the polyphonic mode. The player can choose between low, high or last-note keyboard priority, one to six voice cards (which lets you stack up to 18 -- yes, 18 -- oscillators on one note), and two trigger modes.

The arpeggiator will play from very slow to very fast, and boasts several modes: up, up/-down, down, auto trigger (which repeats a note or notes over and over) and first-to-last-to-first note played, all with latchable keyboard. Essentially, the arpeggiator is more like a mini-sequencer, but it is hard to enter notes into the first-to-last mode -- an extra note or two will turn up from time to time -- making it unreliable in a live performance

continued on page 19.....

An Interview With John Foxx

By: John K. Diliberto

When Karlheinz Stockhausen and Otto Luening started synthesizing sound out of sine waves and cutting up magnetic tape into unworldly configurations in the 1950s, their critics probably never suspected that the work and techniques of these electronic music pioneers would ever penetrate the public consciousness. But now, some thirty years later, electronic sounds are scurrying up and down the popular record charts; in the last three years hordes of synthi-pop artists (Human League, Flock of Seagulls, Berlin, Afrika Bambaata, and so on) have come to dominate contemporary music.

Curiously enough, synthi-pop evolved not from the spacescapes of Tangerine Dream, nor from 60's groups like Silver Apples, Fifty Foot Hose, or Lothar and the Hand People. Instead, electro-pop segued nicely out of the anti-technology sentiments of early punk, and one of the first groups to make the transition was Ultravox.

Put together by singer/composer John Foxx in the mid-seventies, Ultravox has always represented styles in transition, rather than epitomizing any one stance or aesthetic. Their first LP, **Ultravox!** (Island ILPS-9449) shuffled punk imagery and power chording with classical violin, and subtle electronic manipulations courtesy of producer Brian Eno. Synthesizers and rhythm machines entered on **Ha-Ha-Ha** (Island ILPS-9505) and dominated the haunting "Hiroshima Mon Amour." Veteran German electronic producer Conny Plank (Kraftwerk, Neu, Cluster, DAF) was brought in for **Systems of Romance** (Antilles AN 7079), a slow dive into Foxx's subconscious. Songs of alienations and short-circuited communications like "Dislocation" and "Someone Else's Clothes" were enveloped in electronic textures and synthetic screams.

Systems was also Foxx's swan song with Ultravox. The band then recruited popster Midge Ure and recorded the icily lush and successful **Vienna** (Chrysalis CHR 1296) with prominent use of synthesizers. Foxx, instead of forming another band, just got a couple of synthesizers and rhythm boxes and recorded the starkly skeletal **Metamatic** (Virgin V 2146) on an eight track machine. With Kraftwerk as the obvious musical blueprint, Foxx unveiled the elusive patterns of memory ("Underpass") and technological ennui ("He's A Liquid").

His follow-up, **The Garden** (Virgin V2194) saw the return of conventional instruments, but was still dominated by electronic textures, treatments and rhythms. While the sound of **Metamatic** was cold, angular and urban, **The Garden** was bright, mystical and verdant by comparison.

Now Foxx is readying his third LP after several engaging singles, including the psychedelic **Endlessly** -- complete with backwards tapes and sitars. Unlike his punk/new wave contemporaries, Foxx's musical roots are in late-sixties psychedelia and later, the Glam movement (Roxy Music, Ziggy-period Bowie). So his viewpoint and lyrics are more mature, than, say, Heaven 17 or Duran Duran. While new wave and synthi-pop is enjoying its Frankie Avalon & Fabian phase of disposable hedonism/sentiment and the tyranny of the beat (dance uber alles), Foxx is exploring the inter-relationships of the human psyche and technology.

The current image of John Foxx is more in line with the real John Foxx. In Ultravox he sneered and looked menacing, but now he's friendly, highly refined and eloquent. He's careful in his speech, with its lilting northern England accent (he was born in Liverpool) and often says things two or three different ways to make sure he covers all the angles. Of the dozens of artists I've interviewed in the last year, he presented some of the most thoughtful insights into how electronics has changed music and our own relationship to the creation of art.

John Diliberto: How was Ultravox formed?

John Foxx: It was the 70s, and I wasn't really interested in rock music. At that time it was mainly heavy metal in England or very sinisterly bright pop music, or over-professional pop music like Queen and Genesis and Yes. I must say I don't hate that at all, but it had become uninteresting to me. Also, the bands in England were imitating American bands -- even singing with American accents, which I thought was ludicrous. I mean, I'm not really chauvinistic about being English, but I don't want to adopt someone else's accent when I go on stage.

So I decided to design a band that incorporated Englishness but looked over to Europe, rather than America, for influences and ideas. Also, I wanted to pursue a tradition of electronic music that started with the Beatles that had

never been exploited after they broke up. I think "Strawberry Fields Forever" was one of the first electronic records ever that was popular in England. And it was electronic; there were acoustic instruments on it, but everything was heavily treated and reorganized via tape. I remember that record as being one of the most exciting things, in fact one of the first things, that affected me musically.

"We couldn't afford to be (electronic)."

Then a few things happened like Roxy Music that I thought were very exciting. And Kraftwerk were the first people who had isolated all the elements of pop music and synthesized them; they were using no acoustic instruments, or very few. There was also The Velvet Underground who were using feedback and accidental by-products of guitar/amplifier relationships, and that interested me as well -- howling feedback, you know, is very exciting. I like that kind of intelligent crudeness and I wanted to incorporate all that into a band.

I put ads in the Melody Maker (an English pop-music weekly) and interviewed about 250 people and chose the band. I didn't ask them to play or anything because that wasn't important, that wasn't part of the theory. It was based on amateurism. I didn't want very slick or professional players. In fact, if anyone acted professional, that was it, that was the end.

JD: This was in 1972 and 1973. The band wasn't very electronic then, was it?

FOXX: No. We couldn't afford to be; we didn't even have a keyboard then. We later got Billy (Currie) because I wanted to get a violin or something like that, and Billy was a friend of a friend who played violin, and he could play keyboards. He was interested in using the violin in different ways. He'd get feedback and make all kinds of amplifier noises.

JD: So it was nearly five years between getting the band together and getting the first album out.

FOXX: Yeah! It took a long time. What we were doing wasn't really fashionable; it was almost anti-fashion, the opposite of what was popular.

JD: But even when that first Ultravox album came out, it was associated with the punk explosion which you had clearly preceded by a few years.

FOXX: We always seemed to be out of phase with what was happening. I wanted to make angry music as well at first. And some of the first songs were, though they were mixed in with songs like "I Want to Be a Machine". In fact, that song was kind of the basic idea of the band, because I did want to be a machine. I was volunteering to be a machine, because it acknowledged that music really did come out of a machine. The only relationship that I would have with a listener was via a machine, because I was never going to meet with them or talk to them. That song was a celebration of that fact, rather than hiding or denying it like most of the music did, pretending to be down-home and personal. So I wanted to say "this is great" that I can have a voice of mine coming out of a piece of black vinyl simultaneously, hopefully, in a few thousand

"I did want to be a machine. I was volunteering to be a machine, because it acknowledged that music really did come out of a machine."

or million homes all over the world or planet. It's nothing to do with vanity; it's just a fact that this kind of thing happens, and I wanted to enjoy it, and I wanted people who listened to it to enjoy it too.

JD: Did you always play an instrument? Because in the early days you're never credited with playing anything.

FOXX: Yes! I wrote all the basic formats for the songs on the first albums, mainly on guitars because I didn't have access to keyboards. Then I'd take the songs to the band so they could do the specific lines. I'd often just whistle the lead line to people and they'd play that.

JD: The first album didn't have that much electronics, but the production was very electronic.

FOXX: Yeah, with Eno! I really wanted to work with Eno because of what he'd done in the past. I thought his work was magnificent.

JD: You were compared frequently to Roxy Music (Eno's ex-band) in the early days.

FOXX: Unfortunately, yes. But I didn't mind because as far as I was concerned that was pretty much a compliment. I thought -- still think -- that they were the only original force to come out of England for years. Even Bowie, for whom I have a lot of respect, was still embedded in rock 'n roll at that point. Roxy Music was not. They had all kinds of different influences and all kinds of different music, film themes and so on, that I thought were wonderful and incredibly imaginative. I wasn't that keen on the glam aspect that much, but overall, it was way ahead of its time.

JD: That's funny, because I was in a record store the other day and when they put on an old Roxy album, it sounded very contemporary.

FOXX: It could be a hit record if it was released now, and be very current indeed. Everyone I know who's interested in this phase of music refers back to those early Roxy albums constantly. Ferry and Eno, all of them in fact, were very diverse and two of the main forefathers of what's happening now. I can't say how much respect I have for them.

JD: It seems that each Ultravox album became increasingly more electronic and finally culminated in your first solo album, **Metamatic**, which was all-electronic. The electronics seemed to actually change the shape of the music.

FOXX: That was the thing that fascinated me most about synthesizers. Whenever you get a new instrument it changes the shape of the music completely. You write your music, and you write to accommodate the qualities of the machines. Like drum machines: you can play parts that a drummer would need three arms to play, or play in very strict time; the machine relieves you of those tasks so that you can go on to other things.

Every machine alters people's perceptions, like a string machine. When string machines first

"Every machine alters people's perceptions."

came out, people made them imitate orchestras, made them try to sound like strings. It's a bit silly because they're not strings. I always had this analogy with plastic. When plastic was first in-

"That was the original problem with synthesizers: they were used to imitate other instruments, and thus lost any inherent dignity that they might have had."

vented people tried to make it look like wood, and that made it very kitsch and cheap and people had no respect for plastic. But recently we've come to see that it's a beautiful material that can be made to do things that other materials can't do. So, it has inherent qualities that are unique to that specific material. That was the original problem with synthesizers: they were used to imitate other instruments, and thus lost any inherent dignity that they might have had.

I was interested in trying to find the unique qualities of the synthesizer, and the only band that seemed to be doing that was Kraftwerk. They had this kind of design intelligence where they could see what these machines were capable of doing.

JD: But why, on **Metamatic**, did you go all-electronic?

FOXX: I wanted to see how much, and in what direction, it would change the music. I mean, I really let the machines do the album for me. I designed the album very strictly within the limits of my machines. It was recorded on an 8 track recorder so all the tracks (songs) had to function with just eight components. The human voice would be the only air-carried sound. It was a design concept really.

JD: Do you find that you relate to a synthesizer differently from an acoustic instrument?

FOXX: Well, the common link for both of them is that you need a certain amount of mental agility to play either one. If you were missing a few fingers on your left hand, you would never be a great guitarist (well, Django Reinhardt did okay -- Ed.), but you could be a great synth player. You could organize the sound through sequencers or whatever, but finally, you would rely on your human ingenuity. That's the lovely thing about the synthesizer; it doesn't make you into some kind of inhuman person, it actually does the reverse. It frees you from what I feel are petty problems in dealing with, and getting sounds from, other instruments. Like with a violin, you must practice for a long time to become just adequate. That means that most of your youth will have disappeared. And the discipline is so intense that much of your originality and ingenuity will disappear as well, except in a very few cases. But with the synthesizer you can employ ingenuity without having it worn out of you or disciplined out of you. I also have that problem with classical musicians. They're wonderful players and capable of doing anything, so they do nothing. They aren't excited about generating sound, because they spend so many years generating sound that it no longer excites them. Whereas for someone like me who's very naive, I only had to touch a keyboard and I was wildly excited. And I wanted to organize it into a pattern that would excite me even more. It's that enthusiasm and excitement that's the fundamental thing about making music. Once you lose that it doesn't matter how good your dexterity is; if you don't have the initial excitement, you won't do anything.

JD: It seems that the electronics have also influenced the content of your songs.

FOXX: Yeah, but that was a mistake though, I think. It was almost kitsch, what I did with that album. But I felt like that. It was a very kind of alienated thing that I was feeling at the time. So it reflected how I was, it was a very selfish sort of thing.

JD: Do you really think it was selfish? Don't you think that music is a reflection of where the musician is at a particular moment?

FOXX: Oh, we're getting philosophical now (laughs). Yes to both questions. But I think what a good musician does, or any kind or "artist", is act as a kind of receiver for what's going on around you. You're a kind of filter or medium and you receive information, probably unconsciously most of the time, and you organize it into a pattern and put it out again. That's why people like music: It's a kind of code which by some miracle, human beings can receive. It's a wonderful means of transmission. It's non-specific. It's not a language and it's not precise in a linguistic sense, but it is precise in an emotional sense. Music is much more accurate in that way than any of the other arts.

JD: Your next album, **The Garden**, is very different. Where **Metamatic** was stark, **The Garden** is lush and also has conventional instrumentation. Why the move back to conventional instruments?

FOXX: Well, first of all I don't think it was a move back. For me it was an advance. After I'd come to grips with synthesizers, I realized that they're only one more instrument in the bank of things that we have to work with, and I wanted to acknowledge that. I wanted to sit the synthesizers comfortably among all the other things that I like and see how that affected the music. Also, I was feeling a bit more lush (laughs). I was trying to open myself up a bit more to different music. In order to make **Metamatic**, I had to set myself very strict limitations and ignore certain aspects of music in order to bring in a purer sensibility and discover what synthesizers could do. Now, after clearing the air, I wanted to look at old instruments in the light of that album.

I discovered a lot of exciting things about instruments, and even acoustic spaces, making music. When I did the track "Pater Noster" on **The Garden**, I got a couple of machines that you could sing into in order to make a huge

"That's the lovely thing about the synthesizer: it doesn't make you into some kind of inhuman person, it actually does the reverse."

"That's why people like music: It's a kind of code which by some miracle, human beings can receive."

"All the other composers had cathedrals and huge choirs and lots of acoustic instruments with good players to play them. But in this poverty stricken age we've got a few machines and digitally created spaces."

bank of voices. I always thought it was very surreal to have a lot of mechanical voices, but very beautiful ones. I was brought up as a Roman Catholic as a kid so that kind of choral music was, in fact, more my roots than rock 'n roll. I had also just gotten a Lexicon digital reverb, which creates a computer-analyzed acoustic space; with the touch of a button, it can give you a cathedral sound, because the sound is like what it would be if it was released into a cathedral. By putting the various machines together, I had a church choir at my fingertips. Immediately, in the space of an hour, I did the "Pater Noster" piece. It just happened.

It was a lot of memories coming out, again, without me particularly intervening. It organized itself perfectly without me even thinking about it. I also realized that a lot of the timing that I was doing was determined by the acoustic space. There were certain things I couldn't do, certain rhythms I couldn't play because the delays would stop me. I realized that a lot of church music was made that way because of the huge acoustic space. For instance, if a priest said "Pater Noster Quiestem chelis Sanctum fer cheli..." very fast, the audience a hundred feet away would just hear a mish mash of delays and not be able to hear the words distinctly. So the priests began to sing "Pater Noster qui'est um chelis" (sung in beautiful, choirboy style) and make the whole thing flow by using the qualities of the reverb and echoes. The priests accommodated the acoustic space and made a mode of music out of this. People began to compose for that space, like Mozart and all the great composers. In a sense, that whole mode of music was largely created by a piece of architecture, by a mathematical structure. It was a wonderfully exciting discovery for me. I realized that I was doing exactly the same thing with synthesizers and electronics; I was just reacting to what I had to work with. All the other composers had cathedrals and huge choirs and lots of acoustic instruments with good players to play them. But in this poverty stricken age we've got a few machines and digitally created acoustic spaces. I'm sure that if those people were alive today they'd all have synthesizers and they'd be composing for them in a very synthetic way, or what's known as a synthetic way.

JD: Are things a lot quieter for you now than when you were with Ultravox?

FOXX: Oh yeah! It was a mad time then. The atmosphere, the city, the whole life that I was living was just crazy. I never really wanted to join in on that life. Very briefly, I thought it would be romantic and it was in a sense. But it's also counter-productive and not very human. I'm more interested in the subtler aspects of human beings rather than the crasser side of people. So being in a rock band wasn't for me at all.

JD: Your earlier lyrics and music were often very psychotic and also had a certain psychedelic overtone to them.

FOXX: Yes. I don't really know what psychedelic means, but I've always been interested in the way people perceive things...also the way memory affects the way you look at things. In lots of songs I was trying to see people through memories. For instance, if I see an old lady in the street, I just see an old lady and that's it. But her husband will see layers and layers of her extending backwards in time from now to when she was a young girl that he was in love with in the summer of 1920. It's a very beautiful way of looking at someone. He doesn't just see this moment, but endless successions of moments. We all do this to varying degrees to people we see, and the more we know them, the more multi-faceted the perception of them becomes.

"Being in a rock band wasn't for me at all."

It's that kind of event, when we're not quite in control of the moment and we're surprised by what's happening behind the subconscious, that I find fascinating. I always try to write from that point of view -- it's almost like letting go of the reins. I often write lines like, "I'm driving somewhere without steering", or "I'm driving fast without the will to steer" in some of the car songs. It also implies a kind of trust as well. It's a trust that some people don't have, in relaxing their hold on the moment. It can be frightening, but it's one of the things that I find fascinating.

JD: Was the song "Systems of Romance" (from **The Garden**) written back with Ultravox?

FOXX: Yes, that was the title song for that album, in fact, but it wasn't finished. It needed a theme. But I used the title for the album because I liked it. It was also a reaction against punk. I was tired of very violent titles and violent names. That's another reason for the name "Ultravox"; it was a reaction against the Sex Pistols, The Stranglers, The Damned, which were all good names I think, but I didn't particularly want to be slotted into that category. I wanted something a lot wider than that, something that would last a lot longer.

The idea of "Systems of Romance" was that I was interested in systematic music and systematic ways of making music as well as more instinctive ways. I was interested in a kind of romance with technology and the present day world. It's meant to be a paradoxical title, with systems and romance. There's a tension between those two words which makes it an interesting couple of words.

JD: The Garden is interesting because the music is very modern, but it seems to evoke a lot of past images and the booklet reinforces that feeling.

FOXX: What kind of past images?

JD: Ancient and historical images. There's all this stained glass and shadows going into mystical photographs.

FOXX: Good! Because that's what I wanted to do. I thought that The Garden was a good analogy with making music. In England, everyone's got a back garden to a greater or lesser degree -- the aristocracy have back gardens that are 50 miles square and the poorer people have a back garden that's 10 feet square or something. I love the idea of investing some of your time and personality into nature and creating something that pleases you, where you can spend an hour or two of quietness. Of course, the aristocracy goes out there hunting and shooting and fishing, as well. I took a walk around England to look at these gardens and my favorite ones were the ones that were in a state of decay.

It gave me a lot of childhood memories because the place I was

brought up in was fairly new, Liverpool, and it was on the edge of the sort of horrific Victorian industrialization. The towns would stop and there'd be fifty miles of moorlands and you could walk out of the town and this horror of industrialization. There was a beautiful abandoned country garden out there with rhododendrons and vines all tangled together and streams running through it. When we were kids we either played behind the gas works or this place -- a complete contrast.

JD: Do you approach your electronics and synthesizers from a keyboard standpoint?

FOXX: Not really, because I never played keyboard. I just got a piano, though, which I find is a wonderful instrument. Everything that I learned on synthesizer stands me in good stead on piano. So I come from the reverse direction.

JD: Ultravox, since the split, has toured heavily but you don't tour at all.

FOXX: Well, they enjoy that kind of lifestyle and I don't. It's as

"I'm nowhere near as strong or intelligent as (the) John Foxx (I created)."

simple as that. I find that being on stage and touring just depletes me. I come back feeling like a shadow or shell. It takes me weeks to recover and remember who I am and what my real desires are...it sounds pretentious to say that it's a psychic drain, but it is. Some kind of osmosis takes place between the audience and me that leaves me feeling absolutely exhausted. But it's intensely pleasurable as well at the time it happens, which I also can't explain. There's no other area of my life where I get the same kind of feeling as being in front of an audience. I almost feel as if I'm irrelevant, again, this mediumistic kind of thing. It doesn't have much to do with me; I'm just the sum of their desires. I think that people design their stars. The stars think that they're responsible for the people being there, and it's exactly the opposite. I think the audience designs and controls the stars very carefully, in a completely unconscious way.

JD: So are you the sum of their needs right now?

FOXX: Well, I'm trying very hard not to be, but it's difficult. The design of John Foxx was from an audience's point of view, and the audience is me because I watch him doing what he does and I designed him out of desires that I had, to create someone that I'd like to be. But I'm nowhere near as strong or intelligent as John Foxx. Yet when I made him, he could do all those things for me.

JD: How important is commercial success to you at the moment?

FOXX: Well, I honestly don't think about it that much. Things just seem to happen around me. I don't design singles or think that something will be a Top Twenty record. I try to do things as I feel. But I think that because I am a member of an audience, that it works.

JD: When electronic music first started with Edgar Varese, Subotnick, Stockhausen, etc., one of their underlying philosophies was that it would liberate sound from the diatonic scale, the restrictions of history. Do you feel it has done that?

FOXX: No, I honestly don't. I think those are very grand phrases, "liberating sound", etc. It's like the parallel in poetry when people tried to get away from linear language. Most of those things didn't work. What they actually did was make people aware that there was another way of working and it's possible and permissable to work in that way. For instance, the way William Burroughs works is pretty much classical English now, dislocated classical English. In doing that he's made it much more subversive to people's thinking than some very avant-garde experiment that most people will never receive.

I think a lot of similar things happened with music. There are elements that are influential from a theoretical point of view, but the actual music that they produce doesn't affect many people at all. For instance, Stockhausen's theories are far more attractive to me than his music. I love to hear the theory of his music, but I don't much enjoy listening to the music itself, though I will on occasion. But the theories and ideas make me review what I'm doing in another light.

"I like listening to rivers running ... that's a very corny thing to say, but it's true."

"I use lots of sounds that are not in tune."

JD: Don't you think that that kind of music can present a different way of listening and hearing? We've all been brought up to hear music in half-tones, whereas in Japan, it's quarter-tones. Now maybe the Stockhausen style of music is still a different way.

FOXX: Certainly! I like listening to rivers running. I get as much pleasure out of that as I do listening to a symphony. That's a very corny thing to say, but it's true. I've never thought that music had anything to do with quarter-tones or half-tones, because I didn't know what they were. When I played things, the keyboard that I happened to get was divided that way so I used it. If it had been divided into quarter-tones I would have used it just the same and I wouldn't have even considered those things.

I use lots of sounds that are not in tune. I work with classical keyboardists occasionally and they tend to be horrified at some of the things that I do, but it sounds right to me. It's not because of any lack of perception on my part; I've just never had the prejudices, because I've never been educated into them. I think that's a tiny aspect of what people like Stockhausen are trying to do, to break down the conservative framework and open things up a little.

But rock music is pretty atonal in some sense, isn't it? It's not even all music. In fact, sometimes the music's fairly irrelevant. A lot of it has to do with stances and imagery and a kind of instinctive understanding of what's required. In order to look at music fully you have to look at the whole spectrum of fashion and the way it affects peoples' lives. And the words are important; after a couple of years people still remember lyrics. I think that the difference between music and songs is that: A song is an expression of how people feel. They can sing it and when you hear a song you like you can sing along to it. But you tend to listen to music and feel it. You don't sing along with music. That's probably a clumsy way of saying it, but it's true. The best writers reflect how things are at the time, whether it's trivial or silly or whatever.

JD: What can we expect from your next record? Are you playing with other musicians?

FOXX: Yeah! I've invited Steve (Coe) from Monsoon and some of his players, a tabla player who is really excellent. I was thinking, in fact, of getting some tabla sounds and putting them into the Linn Drum So I can play tabla on the Linn.

I also want to get away from the dominance of the bass drum, which I've gotten heartily sick of over the last few years, having been one of the people who isolated it in pure pop music and used it ruthlessly. I can't stand the damn thing now, even though I spent a lot of time working with it in studios to make the bass drum massive and round and hit you in the chest and synchronize your heart to it so you'd want to dance. A lovely interaction of technology and human beings. It still is, but it's so hypy now: Every record goes boom-boom-boom. It's such an easy way to organize the hierarchy of the sound that you have in a song; first, you have this massive bass drum and then you base everything else around it. It's such an easy solution. It's too facile to be true.

I was listening to some old Beatle records the other day. The thinking, the intelligence and the hierarchy of layers of instruments in that was stunning. There was nothing common to any of those songs. Now you get an album and all the way through there's a bass and drum up front in the mix. It's too easy. But if you look at those Beatle songs, every single song has a completely redesigned hierarchy of sound in it. That's wonderful thinking. So I want to try, in my little way, to get back to that thinking. I think people deserve it because everyone else must be sick of thumping bass drums by now.

I want to try to make music that makes you want to sway and move to it in a less direct way that is more subtle...something that makes you want to sing instead of pummeling you into the ground with a big thump every few milliseconds.

"(Producers have been) less important to me than other musicians."

JD: Have producers been very important in your music?

FOXX: Less important to me than other musicians, but that was mainly because I could never find a producer that was good enough to work with. I didn't respect any of them apart from (Brian) Eno and Conny (Plank). Steve Lillywhite (producer of **Ha-Ha-Ha**) has become a very good producer since we worked with him. He was very young then, well, we were all very young together and we just went into the studio and hardly knew what it was for at first. But now he's very experienced and he's a wonderful producer indeed, one of the best in England.

But Eno was the good one because he had a more outrageous sense of how to use studios than anyone else I've ever met. He wasn't conservative at all in the way he did that. We used a Phil Collins bass drum on "My Sex" (from Ultravox!). It was on an old Eno track. I said we need a pulse and he said, "oh, I've got this old bass drum part by Phil Collins." So we put that on and we did it. I hope he doesn't come back for the royalties.

JD: Do you write the lyrics before or after the music?

FOXX: It varies. I think the songs are really like little movies...sort of mood pieces. I find a musical or verbal phrase that typifies the mood and that becomes like the title or theme of the film. I organize it like that with the theme and characters being announced, then the themes rejoin them and that's it. I hope that's not too cliched but that's the way it happens.

"(The synthesizer) frees you from what I feel are petty problems in dealing with, and getting sounds from, other instruments."

I collect phrases that people say around me or read in newspapers or see on film. They kind of attract each other into songs without me doing that much about it. They just shuffle themselves together. It's quite fascinating to watch. I'm always surprised by it because it does seem that I don't have a lot to do with it. I just say "Oh, that's great! Play it again!"

(This John Foxx interview is taken from the "Metal Beat" segment of **Totally Wired: Artists in Electronic Sound**, a 26-part radio documentary examining the artistic development of electronic music through interviews and music of the artists. The series is currently running in most major markets on public radio stations through the fall and winter of '83-'84. **Totally Wired** was produced by John Diliberto and Kimberly Haas. It was funded by Sequential Circuits, Inc., makers of Prophet synthesizers, Yamaha Corp., manufacturers of electronic and acoustic instruments, the Pennsylvania Humanities Council, and the Pennsylvania Council for the Arts. For more information about **Totally Wired**, or to obtain cassettes of the programs, write to: **Totally Wired**, Box 5426, Philadelphia, PA 19143.)

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BUILD A DUAL TRIGGER DELAY

By: John Mitchell

When generating electronic sound, it is sometimes desirable to have a second sonic event (filtering, pulse width modulation, etc.) occur at some point in time after an initial event, which is usually, although not necessarily, pitch generation. One way to do this is to use three transient generators. The first would vary the parameters of the initial event, while the second would provide the desired time delay. When the output voltage from the second generator reached a preset level, it would trigger the third generator -- the one providing the control envelope for our second event. One could also set up a transient generator and an envelope follower/comparator combination so that the latter provides an output pulse when its threshold voltage is crossed. This pulse would then trigger a second generator, which would provide the contours for our second sonic event.

While the above methods will work, they have several obvious drawbacks. They are time consuming -- dangerously so for a live performance situation -- and they do not provide for relatively long time delays, or accurate short-duration delays. Worst of all, they tie up modules which may be put to better use elsewhere.

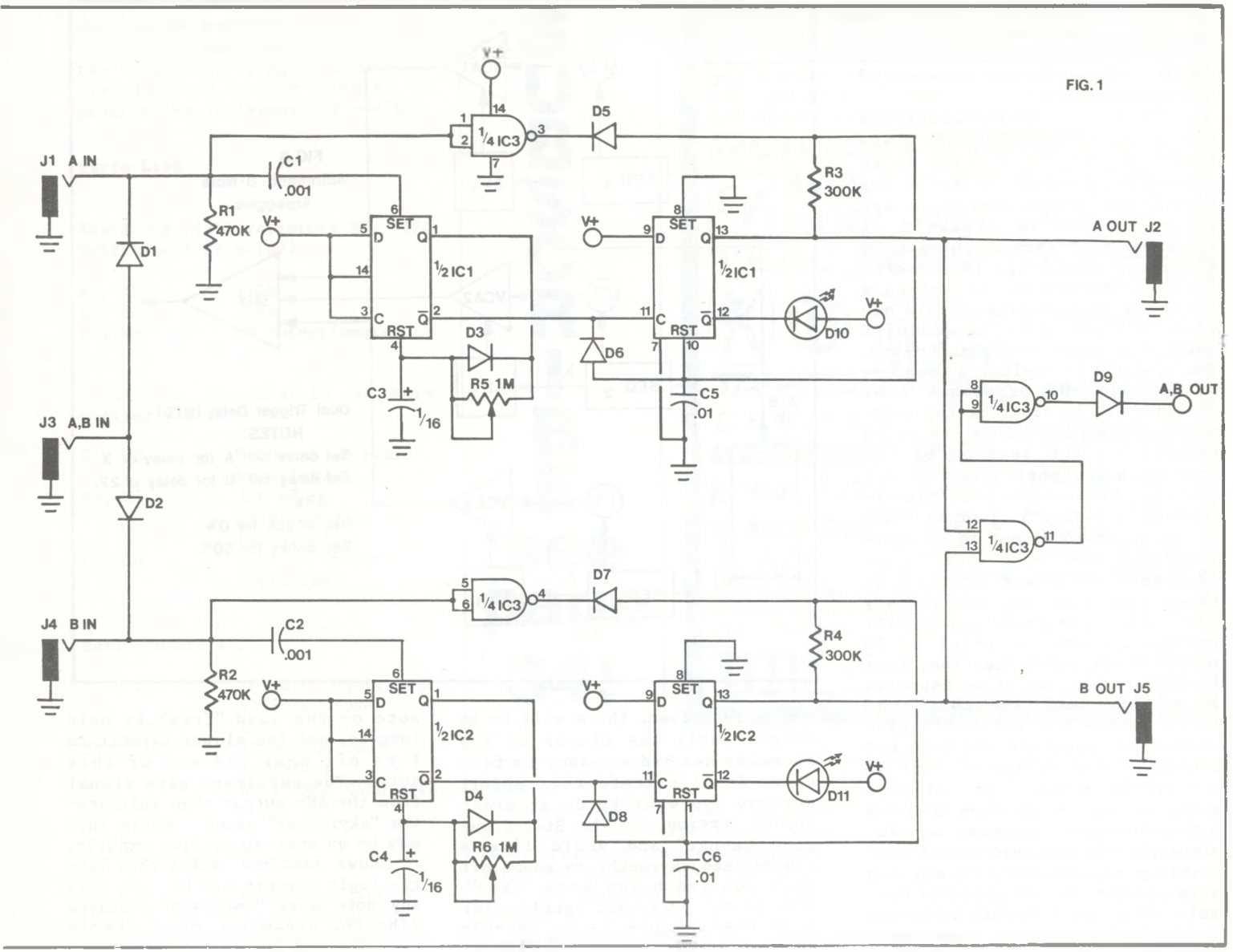
The circuit shown in figure 1 overcomes the above-mentioned problems by providing an inexpensive, accurate, and straightforward trigger delay. Upon receiving an input trigger pulse (as from a keyboard), the circuit produces an output pulse with nearly identical characteristics -- however, this output pulse is delayed by the period of time specified by R5. The amount of time delay is continuously adjustable from "practically zero" to about one second for the given R and C values. A gate voltage at the circuit's input will also appear at the output after the pre-determined amount of time set by R5, and will remain high for as long as a key is held down. It is quite important that the output pulse track the input pulse characteristics. That way, when used in conjunction with a keyboard the trigger and pulse outputs will respond exactly as they would when a key is normally pressed, but delayed in time by a specified amount. (This circuit is also a highly recommended addition to the AMS-100 signal processing system -- Ed.)

How it works. Conceptually, the circuit couldn't be more simple. The input pulse feeds a monostable that triggers on the pulse's leading edge. The monostable stays high for a time determined by R5 and C3. When the monostable goes low, it causes a second monostable (which is negative edge triggered) to go high for a very short time period. It is this second monostable which provides the trigger pulse.

So far, the circuit will provide an output pulse that rises and falls quickly regardless of whether or not the input stays high. This is fine if we are using a trigger pulse as the input, however, with gate pulses the circuit will not remain high -- even if the key is still being held down and the input pulse remains high. To remedy this, we use a NAND inverter as a means of keeping the output high (after the initial delay) for as long as the input is held high. A positive input (key down) causes the inverter stage to swing to near-ground. This allows the timing capacitor of the second monostable to discharge, and pulls "reset" low, causing the Q output to remain high. When the input goes low (key up), the inverter output goes high and diode D5 becomes reverse-biased, isolating the inverter from the rest of the circuit.

Making it work. As the trigger delay requires very few parts, uses little power, and is also inexpensive, it is worth building a second unit on the same circuit board. Since the 4011 chip has three NAND gates to spare, we need only add an extra 4013 flip-flop (plus some associated components) to make our trigger delay twice as versatile. The two unused NAND gates are wired as a single AND gate; first, the output of each trigger delay circuit connects to an input of one of the spare NAND gates, then the NAND output feeds into the second gate (which is wired as an inverter). Our two NAND gates, functioning as a single AND, give us a positive output upon receipt of two simultaneous positive inputs. Now, if a gate signal is applied to the two delay circuits tied in tandem, and the output is taken from the AND circuit, no gate pulse will appear until both delay circuits have been triggered (have fired off) while a key is held down. Just how this feature is used will be explained shortly.

While the Dual Trigger Delay works particularly well with PAIA equipment, it should work with any system which uses a positive-going trigger or gate and operates on a power supply in the range of five to fifteen Volts. Of course, you may obtain longer or shorter delay times by increasing or decreasing the values of the decay pots and/or timing capacitors C3 and C4. To determine the length of the delay time, use the formula T =

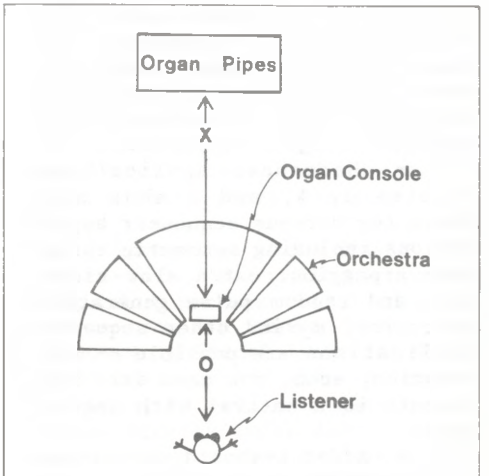


0.8RC. You might find it desirable to extend the time delay of circuit A to several minutes while keeping the delay of circuit B the same, or vice versa. A rotary switch with different values of R or C would expand the device's timing capabilities even more.

Applying the Dual Trigger Delay. Trying to present all of the applications for this unit is as futile an effort as attempting to describe all of the uses for a transient generator. Therefore, to save space, keep our respective sanities, and to whet your musical appetites, only a few (and by no means the most imaginative) applications will be explored here.

• Pipe organ delay simulation. Suppose you have a prize pipe organ simulation and want to use it at some spectacular moment to back up a multi-tracked, synthesized orchestra. If upon mix-down you find the organ lacks a certain power and presence, it could be because you are neglecting the esoteric little detail of delay.

If you have ever listened to an orchestra augmented by a pipe organ, you have probably noticed that the organ lags the orchestra by a small amount of time. This is because the pipe organ is a low-pressure pneumatic machine, which like a synthesizer, comprises many different systems. As with any machine, an organ can do no work (in this case, produce a tone) in zero time. The air from the main blower is routed via a relay machine to a wind chest and finally to the pipes, where secondary eddies in the feet of the pipes can cause a delay. This delay lasts until the air pressure has built up enough to cause a tone to be produced, preceded by



Sound from orchestra travels distance "D"
Sound from organ pipes travels distance "X + D"

FIG. 2

the characteristic "chiff" or "cough" on the attack portion of the note (interestingly, this chiff is always an odd harmonic of the fundamental).

While the above-mentioned process certainly results in a delay, it is not so long as to cause the listener to pay it any mind. The longer delay we are interested in is a result of placement more than anything else. Since the pipe organ is a pretty large instrument, it presents somewhat of a problem should one wish to place it in the woodwind section of a symphony orchestra. The problem is logically overcome by placing the orchestra some distance "x" in front of the organ pipes, while including the organ console in the section of the orchestra designated by the conductor. Now assume that the orchestra is placed 55 feet in front of the pipes so as not to be overcome by their sound (see figure 2). Because sound travels at about 1100 feet per second, any sound from the organ pipes will reach a listener at point "A" 50 milliseconds later than that from the orchestra. As it so happens, 50 milliseconds is the "echo point" where the ear-brain perceives two separate and distinct sounds. This brings us back to electronic music. To add more power to the "organ" when it joins our synthesized orchestra, we simply delay the response to the keyboard by approximately 50 ms, and play along with the piece as normal. This will beautifully and realistically set the organ apart from the other voices, but with an added power since our experience tells us that "the sound is delayed because the organ is set far back. The organ is back there because it is large, and that which is large is powerful."

• Sequencer applications. Figures 3, 4, and 5 show some ideas for various sequencer applications including automatic three-note arpeggios, extra slow clocking, and random pulse generation. Of course, myriad other sequencer applications are possible -- syncopation, echo, you name it. This circuit is a natural with sequencers!

• Added keyboard expression. Here is where that AND gate really gets put to work. The way it is typically used (as if anything in electronic music has a typical use!) is to set one delay circuit at minimum, while adjusting the other for a longer delay. When a key is held down, there will be no output until the slower of the circuits has had a chance to fire off. To illustrate this point, suppose you want to do an electronic version of "The Star-Spangled Banner" and would like a synthesized skyrocket to sound off when you reach the word "free". (You know. It's that spectacular note that no one, save Beverly Sills, can reach.) Using the AND gate, it's as easy as apple pie: Simply trigger both delays simultaneously and use the AND feature as just described. Because the note on the word "free" is held longest, set the slower circuit to fire off near the end of this note. The resultant gate signal from the AND output then initiates the "skyrocket" event. While this may be an over-simplified example, it shows just how useful this little logic circuit can be. To give any note more "emphasis" (delayed vibrato, dynamics, etc.) simply hold the key down a little longer. It's like having a third hand.

The Dual Trigger Delay is as habit-forming as any filter, and will find a million and one appli-

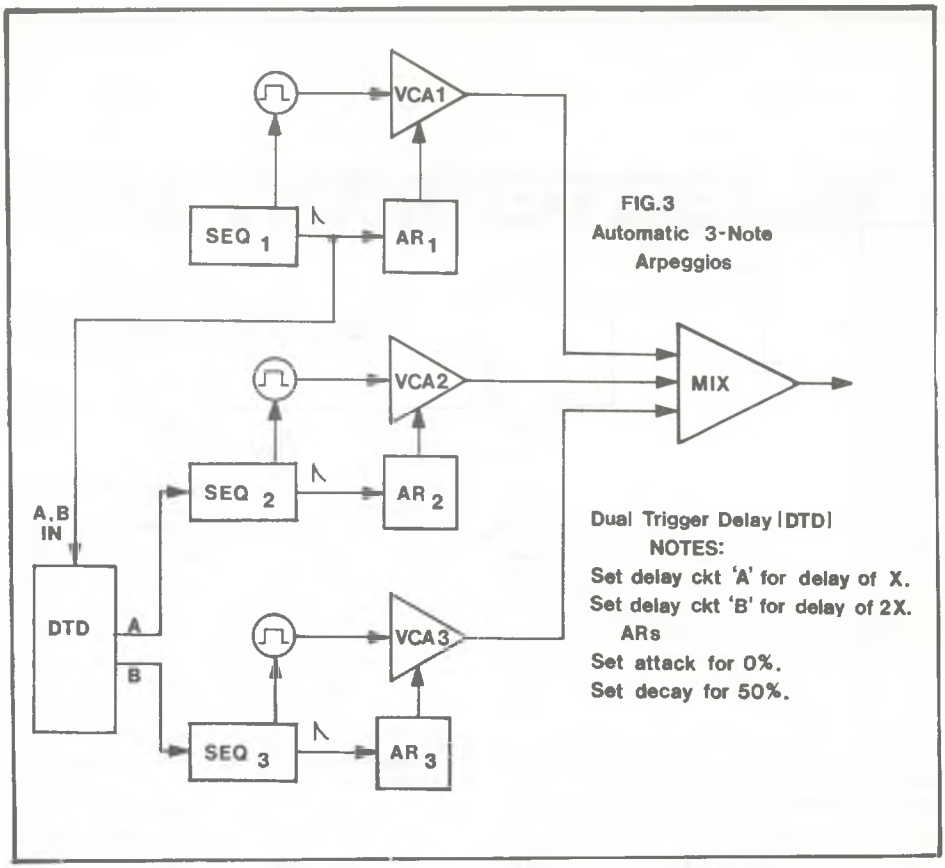
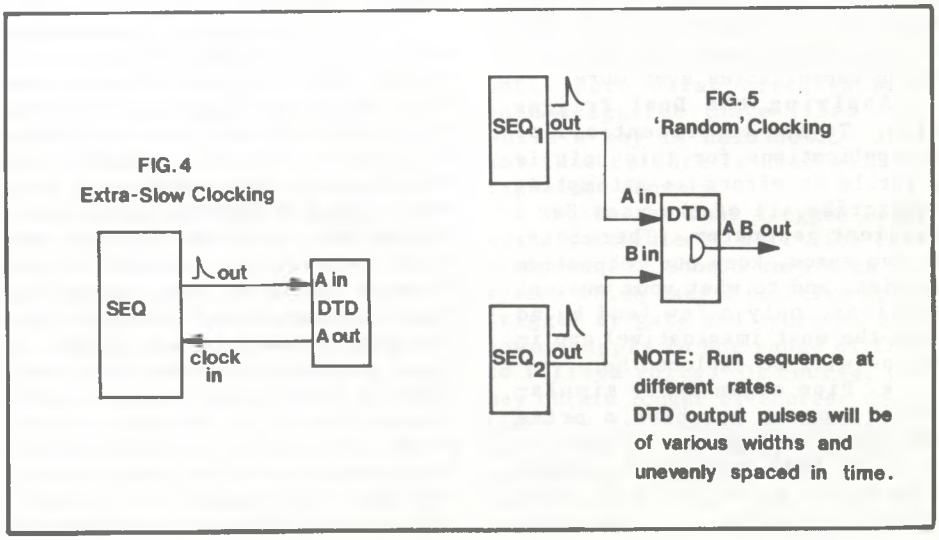


FIG.3
Automatic 3-Note Arpeggios



cations in any electronic music system. It just goes to show like the "classical" ring modulator, a circuit need not be complex in order to be indispensibly useful.

Parts List

Resistors (all resistors 5%, 1/4 Watt except as noted)

R1, R2	470k
R3, R4	300k
R5, R6	1M potentiometer

Capacitors (rated at 15 or more working Volts)

C1, C2	0.001 uF (ceramic or mylar)
C3, C4	1.0 uF (electrolytic or tantalum)
C5, C6	0.01 uF (mylar preferred)

Semiconductors

D1 - D9	1N914 or equivalent silicon diode
D10 - D11	LED
IC1, IC2	4013 CMOS dual flip-flop
IC3	4011 CMOS NAND gate

Mechanical parts

J1 - J5	Mono open circuit jacks appropriate to your system
Misc.	Solder, wire, knobs, circuit board, etc.

Polyphonic Keyboard Reviews

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follow brightens or dampens the sound, and an unconditional contour mode completes the envelope cycle regardless of whether the keys are held down or not. A programmable volume balances the patch volumes in addition to providing a master volume function. There is also a voice detune, auto tune, provision for two programmable foot pedals (not included), mono and polyphonic glide, and a headphone amplifier.

All this and more is packed into a walnut trim case, which becomes quite warm with use (some may also be annoyed by the soft whirr of the internal fan). Because there are so many features, the Memorymoog is a little taller than some of its contemporaries so it is harder to stack than other keyboards; but it sounds a lot better than most other synthesizers. From rich orchestral timbres to outlandish effects, the Memorymoog generates sounds with a real acoustic feel, whether one is simulating acoustic sounds or not.

There are some minor options which could be useful: a high-pass filter would be useful; an external trigger, so one voice could be played from the Moog Taurus pedalboard; stereo outputs; the option for a touch-sensitive keyboard, or a hold for latching the keyboard. My only real gripe is with the buttons. Some of the buttons must be pounded on before they will turn on or off; this could be inconvenient and embarrassing on stage. I was also informed some models had major problems with the tuning mechanism and required servicing, but my instrument has had no problems so far. The instrument comes with a one-year warranty.

Buttons aside, though, the Memorymoog is a very impressive and versatile instrument. You can use it to play almost any type of keyboard music, although six voices falls short for some classical pieces. There is even room for expansion: Moog Music will retro-fit a Musical Instrument Digital Interface (MIDI) plug and sequencer for about $600. The Memorymoog itself lists for $4200. It comes complete with 100 sample patches, as well as a good manual which details every aspect of the instrument -- even circuit diagrams. For more info check your music store or send $2 to Moog Music Inc., 2500 Walden Ave., Buffalo, New York 14225 for specifications.

Applied Synthesis:

Voicing Techniques

By Bill Rhodes

All the technology in the world won't make you a better keyboard player unless you know where to put your fingers on the keys. You may have a reasonable understanding of chord theory, but unless you know how to construct notes so they sound interesting in that chord, your playing will be one-dimensional. This concept of voicing has been around for ages; however, with the advent of the synthesizer -- where, with imitative synthesis, we often use orchestral voicings based on acoustic instruments -- the need to understand voicing becomes more important than ever. We will divide the subject down into twelve sections, and investigate each section in detail.

1. Double-lead block: This voicing concept is reminiscent of the early Hammond jazz and society organists. While these days double-lead blocking may occasionally seem outdated, it still has its uses; for example, lounge and cocktail piano players are fond of this voicing approach because it gives a full sound. Double-lead block chords incorporate the melody in both the left and right hands simultaneously. Between the left hand and right hand melody lines lies the harmonic structure; thus, this technique produces a "sandwich" of the chord between two melody lines (an octave apart from each other). It takes some time to learn to play this way because you need an extensive knowledge of chord inversion. That is, every time the melody ascends or descends the keyboard (whether it ascends or descends depends upon its melodic contour), the "sandwiched" chord must follow in the correct voicing. Also, if you don't use correct fingering you will be at a loss when melodic passages become more complex.

This is not necessarily a good synthesizer technique because the sound is very "organish." While it might sound good if you wanted a theater organ string sound, and does sound good on some organ and piano patches, double-lead blocking leaves much to be desired with respect to electronic brass or percussive patches.

2. Doubling of voices: This can be done by layering sound upon sound at the same octave with different instruments (as in overdub recording), or doubling at different octaves with the same instrument. Much Top 40 music uses the concept of doubling strings, piano, flute, etc. to strengthen the melody. The "Philadelphia soul sound" of many years ago used this technique with the orchestra to add richness. However, this technique eventually runs into the law of diminishing returns, since the more instruments you double, the greater the chances that this interaction will produce cancellations at certain frequencies. After all, the flute, string, and brass lines that, when played independently, have their own separate timbre, now become a composite sound if they are playing the same line. Thus, their individual personalities are obscured. A good synthesizer-based analogy is the additive waveform law: When a square wave at one footage is added to another square wave at a still different footage, ad infinitum, you end up with a totally different waveform and timbre. (In fact, drawbar organs get their final sawtooth waveform from the terracing of square wave footages.) Vangelis (of "Chariots of Fire" fame) agrees with the principle of "the law of additive frequencies":

"With a symphony orchestra you can have a really full sound with only three or four voices. You don't need twenty voices singing parallel lines -- this creates a thin sound because you cancel things. In order to leave room for each family of frequencies to grow, you have to be as simple as possible. These are basic laws." (From the Vangelis Interview, by John K. Diliberto, June 1983 Polyphony.)

Parallel fifths moving in the same direction were a no-no in the days of four-part counterpoint because of the hollowness of the interval. With synthesizer, it's just as important to use the parallel fifth motion sparingly when doubling because, as with octave doubling, the resulting sound can produce cancellations.

I'm not saying that you should stay away from doubling; use it when a point has to be made. But don't get carried away with doubling everything in your entire musical example.

3. Triad voicing in left hand using perfect fourths: This is an interesting voicing which is very popular in jazz music. It has a fresh, 20th century sound that is great for "comping" (rhythmic chording behind a soloist) or texturing orchestral accompaniments. Using a C chord as an example, the root of the triad

in 4th is C, the second note is F (the fourth), and the last note of the triad is B flat (dominant 7th). Perfect fourths allow for a great deal of melodic freedom since you are not encumbered by minor or major scales. The sound is more modal (displaced jazz scale), and is very contemporary.

Use the triadic perfect fourth chord percussively behind a solo performer or solo overdub. Neo-classically, the fourth triad can be used with low strings and horns behind an animated high trumpet or violin line; this adds an earthy ambience to the whole sound. Walking chromatically over a chord progression with the 4th triad gives a unique sound of movement and direction in music. Most melodic executions, within reason, work well with this type of voicing.

4. Polytonal voicing: This involves the use of two different chordal centers played simultaneously. Play a C chord in root position with the left hand, and simultaneously play a D chord in root position with in the right hand. Hear it? That is polytonality, where two unrelated chords are played simultaneously. (The result in this case would be a C 13 omit 7th #11 chord.) This is also known as an Upper Structure Triad (UST). This sound is essential in neo-classical, jazz, fusion, and 20th Century composition; the ear is being pulled and the brain tries to decide which tonal (or key) center is important.

Of course, this UST is not the only polytonal voicing we can use. Playing the root (or I) chord while playing the IV chord also produces a musically useful combination. For example, play an E-flat chord in root position with the left hand, and an A-flat chord in root position with the right hand. What results, besides an interesting chord, is an E-flat 13 omit 7 and 9. Play this with strings and brass at different registrations and listen to the result. This is a complex voicing that may not be applicable to average Top 40 songs, but is great for creating new and unusual experimental sounds. And after all, what is music but new sounds and ideas intended to intrigue and provoke feeling.

Try playing all kinds of combinations of unrelated chords. They need not all be in root position; one chord might be in root position, while the other is not. Or they might both be inversions of both chords. If you find some interesting polytonal chords, try designing a progression or sequence around them. Perhaps you could even write a melody over a progression of unrelated polytonal chords. If you do find an ideal progression, try transposing it into other keys. Remember that the ideas of polytonal voicing were born out of the orchestra, but can now be used for synthetic approximation.

5. Voicing chords with altered basses: This voicing is exciting because it causes tension or "unresolvement". It involves playing the triad or tetrachord (4-note chord) in root position and adding the various single notes of the scale as the bass of the chord.

Playing the ninth in the bass is a widely used jazz and 20th century technique that lends itself to a tension emotion. Take a D chord (triad) and play the E note (the ninth or second) in the bass, then listen to its characteristic sonority. Experiment with playing the ninth in the bass with other chords as well.

Using the fourth degree of the scale as a bass note with the tonic chord produces another interesting sound. Hindemith and Copeland use this treatment quite extensively in their pieces. This suspended 4th sound is rather different in quality compared to the ninth in the bass because of the half-step relationship between the major third of the chord and the fourth interval of the bass note. Play an A triad with two D notes in the bass in octaves to hear this unique voicing.

The dominant seventh (flatted major seventh) in the bass is another voicing that is also used in much 20th century music. To hear one example of this, play a B-flat in the bass with the left hand (in octaves or a single note if you wish) while playing a C chord in root position with the right hand.

Note that inversions of the chord (as well as root positions) will also work well with these voicing concepts. We won't go into using the third and fifth in the bass, since this is a rather common technique in music today (particularly in Top 40 ballads). However, the previously mentioned altered bass chords will lend a new sparkle and tension to your music, as well as make you more aware of their presence in other people's performances.

6. The tenth interval: Please refer to the October 1983 issue of Polyphony for information on this voicing and its dramatic use for synthesis.

7. Common note to chord voicing: This involves using a counterpoint (non-melody) linear passage against a progression of moving chords. Be aware of common notes in a chord progression -- for example, if a chord progression is Bmaj9, Amaj9, F#/G# to F#sus, we need to find a similar note(s) that is included in each chord to suspend over the chord progression. B would work because: 1) it is the root of the Bmaj9; 2) it is the 9th of the Amaj9; 3) it is the fourth of the F#, and 4) it is the suspended fourth of the F#sus chord. Play this note as a high flute, horn, or violin line over the progression and observe that the single note works well over a moving chordal sequence. Another possible note to suspend with this progression would be C#, since C# is 1) the ninth of the Bmaj9; 2) the third of the Amaj9; 3) the fifth of F#; and 4) the fifth of the F#sus chord. This C# note will sound different from the B note because of the tension against the B tonality of the progression. The B note suspended over the progression would sound more tonically oriented because it is the root of the chord.

8. Voicing a simple chord over the entire range of the orchestra: This takes either a few overdubs, an extremely large hand, or many players to do the job! Simply, this enables us to use the low, mid, high, and super high registers of the orchestra (synthesizer) to produce a common chord that sounds thunderous. A simple Csus chord (C,F,G) will sound massive if the root is played in octaves with a cello or low horn sound; it will also sound massive if the fourth is doubled in octaves in the midrange of the keyboard (with, for example, trumpet voicings), and the fifth is played on the top end of the keyboard with a high string sound. What we are doing is arranging the chord over the whole spectrum of the synthesized orchestra and

continued on page 41.....

Center-Channel Reverb: The Electronic Concert Hall

By: Ralph D. Sherman

There's nothing like the naturally reverberant sound of a well-designed concert hall. No matter how loudly or softly an ensemble plays, good concert-hall reverb always enhances the music and never obstructs it. But multi-track recording with separate electronic reverb for each track -- a popular production technique -- just can't match the spatial realism of "live" recording in a good hall. Indeed, it is often the lack of spatial realism that makes synthesists' otherwise fine recordings fall flat.

The concert-hall sound can be imitated quite well, however, with a good, single-channel, spring-type reverb unit (I happen to use a Furman RV-1) and a simple coupler that you can build in an hour for less than $10. The coupler circuit is also applicable to the PAIA "Hot Springs", and similar reverb units which provide "reverb-only" with no provisions for mixing the reverberated and dry sounds.

The concert-hall imitation is rightly called center-channel reverb, and it's really not new. About 20 years ago, center-channel reverb units (such as the Fisher Spacexpander) were bought by hi-fi buffs who wanted to add reverb to their stereos. Unfortunately, units like the Spacexpander -- which you can still find at garage sales -- tend to be too noisy by the standards set by today's noise reduction equipment. But the reverb system described in this article is mostly passive and therefore quiet, and although the incoming signal is attenuated by about 10dB, the attentuation should not be a problem if you design your signal path properly (something I'll discuss later).

The workings of center-channel reverb are simple. With reference to the coupler schematic, when S1 is moved to "expand" (a term borrowed from the Spacexpander), some of the incoming signal from each channel goes to the output jacks (J5 and J6), and some is sent to blend with the other channel's incoming signal, creating a monaural mix at J3. This mix goes to the reverb unit (the Furman, in my system), and the "reverb only" signal -- not a mix of reverb and original signal -- returns from the reverb unit via J4 and is split between the output jacks through resistors R5 and R6.

R1 and R2 maintain stereo separation and keep the incoming signal from overdriving the reverb unit's input circuit. R5 and R6 also maintain stereo separation, and R3 and R4 attenuate the original signal to help balance it with the reverb unit's output.

The output at J5 and J6 thus consists of the original left and right stereo signals attenuated and mixed with a monaural reverb signal. The latter appears in both channels or, in terms of acoustic space, "in the center" -- hence the name, center-channel reverb.

Although the reverb signal is monaural and does not move from the center of the stereo illusion, the listener usually perceives the reverb of a left-channel sound to be on the right, the reverb of a right-channel sound to be on the left, and the reverb of a centered sound to be in the center. All the sounds appear to emanate from the same acoustic space, thus giving an electronic simulation of the stage in a concert hall.

Some equalization of the reverb signal will, of course, enhance the illusion. Using the controls on my Furman, I boost the high bass by 3dB at a center frequency of 300 Hz and the treble by 6dB at its preset center frequency (probably about 4 kHz). As a rule, though, the less equalization you apply to the reverb signal, the more natural it will sound.

In reference again to my Furman, I normally leave the input level control at 10 (maximum) and the reverb level control between 6 and 7. The direct signal level control, which sends unreverberated signal to the unit's output jack, is always left at 0. Thus, reverb is instantly added to the system at a preset level by moving S1 from "bypass" to "expand".

To maximize the signal-to-noise ratio of your system, the center-channel reverb should be inserted at a point as close as possible to the end of the signal path. In my system, for example, the reverb inserts after the mixer and preamp and before the (monitor) equalizer and power amp. The same signal that goes to the last two components goes to the stereo mixdown deck, so that reverb is added to multi-track recordings as they are mixed down to stereo. (My original tracks are recorded dry, although I monitor my work with the reverb switched in.)

Since the coupler is passive, any noise added to your system by the center-channel reverb must originate in the reverb unit. If this article motivates you to buy a reverb unit, choose carefully. Ask for a demonstration and turn the reverb level up with no signal input; then judge whether the published signal-to-noise ratio matches what you hear. Consider that a built-in limiter is necessary on a spring reverb if you're going to send

the strongest possible signal to the spring; without a limiter, percussive sounds will often produce an annoying "boing". Remember too that the reverb must be able to handle the output of your preamp or mixer.

To some extent, the value of R1 and R2 in the schematic was chosen to match the input of my reverb unit to the output of my preamp (a Dynaco PAT-4). Another resistor value may work better in your system, however, dropping the value of any of the six resistors below 47K ohms will noticeably reduce stereo separation in most high-impedance systems.

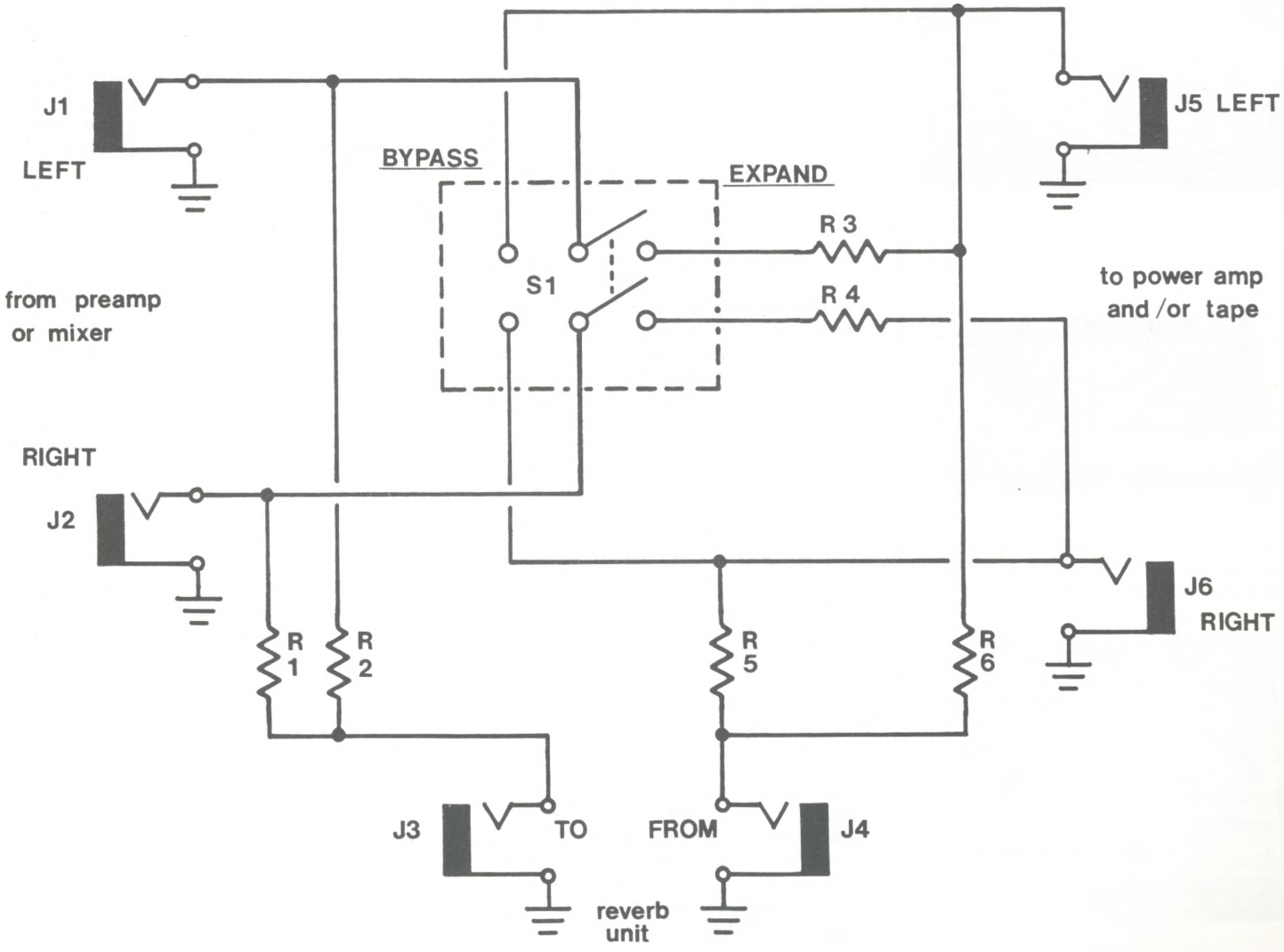
Like the resistor values, the presence of S1 is a reflection of my own needs. If you would rather switch the reverb in and out by adjusting the output level of your reverb unit, and you don't mind the attenuation of the coupler being permanent, eliminate S1 and hard-wire the "expand" connections.

A final note on experimentation: If your studio equipment doubles as your stereo, as my equipment does, you may find the center-channel reverb a pleasant addition to antique recordings (e.g., Fats Waller, circa 1930). After all, it was for use in stereo systems that center-channel reverb was once marketed. Don't hesitate to try it out.

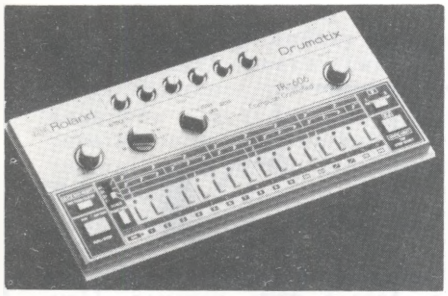
Parts List

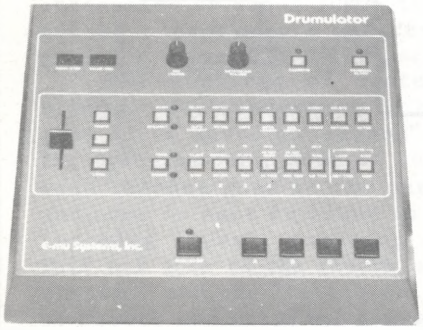
R1, R2	220k, 1/4W, 5% resistor
R3 - R6	47k, 1/4W, 5% resistor
J1 - J6	Phone or phono jacks, depending on your application
S1	DPDT switch
Misc.	Small metal box, wire, solder, etc.

CENTER-CHANNEL REVERB COUPLER



CUSTOMIZE YOUR DRUM MACHINE





Modifications For Roland TR606 Drumatix

By: Perry Cook

When I first considered buying a drum synthesizer, my principle requirements were, in order of importance, drum sound quality; programming features; separate (or at least stereo) drum outputs; sync and run outputs compatible with a variety of synthesizers; and, somewhere in there, price mattered too. The Roland TR-606 "Drumatix" provided adequate sounds and programming features, but lacked discrete audio outputs and provided inadequate sync outputs (trigger outputs are available only on high and low tom attacks).

This article, then, is for Drumatix owners who want more flexibility, or who would like to incorporate some of the features of the more sophisticated TR-808 without paying TR-808 prices. The following designs take advantage of signals already available within the Drumatix, tap these signals at convenient places on the circuit board, and require only minimal modifications to the TR-606's case.

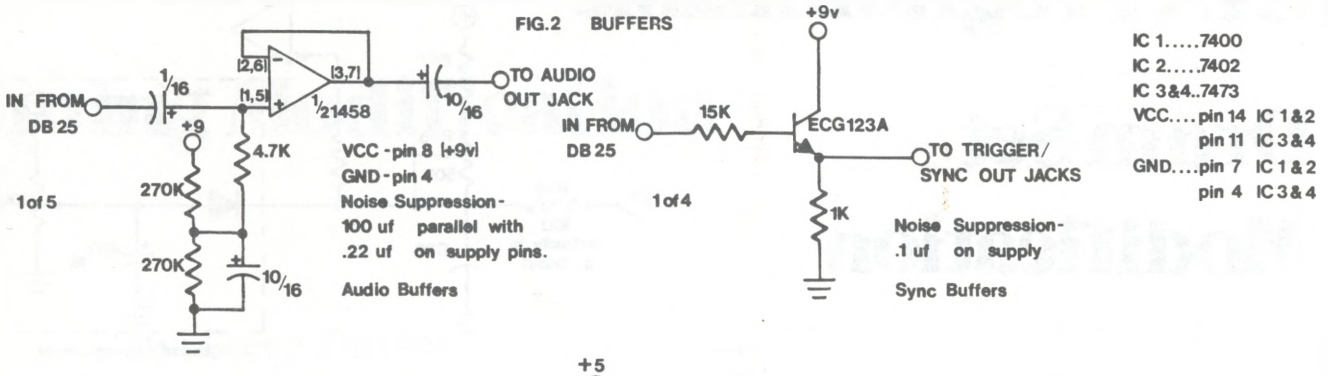
Modifying the machine. The machine modifications are the most frightening (working while visualizing your warranty go up in a $400 CMOS puff of smoke is not fun), so we'll cover these first. I mounted a female DB-25 connector directly in the back of the TR-606 by notching out the top half of the case, and routed taps to it from the five instrument pots (but not the accent pot), the two external trigger jacks (high and low tom), pins 1 and 5 of the DIN connector, and the ground buss connecting the pots. The instrument taps should be taken from the input (hot) side of the pots, since it is assumed that if you need separate outputs, then you already own a mixer to combine these outputs. If you can't figure out which is the input side of the pot, do not undertake this project or you will surely encounter difficulties. Figure 1 shows which taps connect to which terminals of the DB-25 connector. Signals from the DIN connector are pin 1 (run) and pin 3 (clock).

The buffer box. The buffer box plugs into the DB-25 connector you just installed, and buffers all signals so that they can drive low impedance loads. So that I could mount the buffers next to the Drumatix, I built them into a box (with an integral 9V battery supply) that sits right next to the Drumatix on a shelf. If you didn't want to mount the buffers in a box, you could just as easily build the circuitry behind a panel. However, whether constructed as a box or panel, the buffers must be located close to the Drumatix, as line capacitance is critical.

Construct the sync and audio buffers (see figure 2) on separate boards, and bypass them separately to prevent crosstalk. The audio lines are buffered with simple unity gain voltage followers that can drive 600 Ohms (unbalanced). Op amp selection isn't very critical since signal levels are relatively low. The five voltage followers tap off the individual audio pots without interfering with the TR-606's internal mixer.

The sync signals are buffered by common-collector emitter followers. The inputs of these one transistor circuits tap off the high tom, low tom, clock, and run signals. The outputs have 1k output impedances and can drive fairly long lines.

Each output is brought out to a 1/4 " phone jack except clock and run, which are brought out to a single 1/4" stereo phone jack. I recommend using a power switch at the buffer box, and also routing the buffer box power line through the DB-25 connector via pins 15 and 16. Since there is a jumper across these pins on the TR-606's DB-25 connector, either pulling out the DB-25 plug or flicking the power switch in the buffer box will turn off the battery. This "fail-safe" feature helps promote longer battery life.



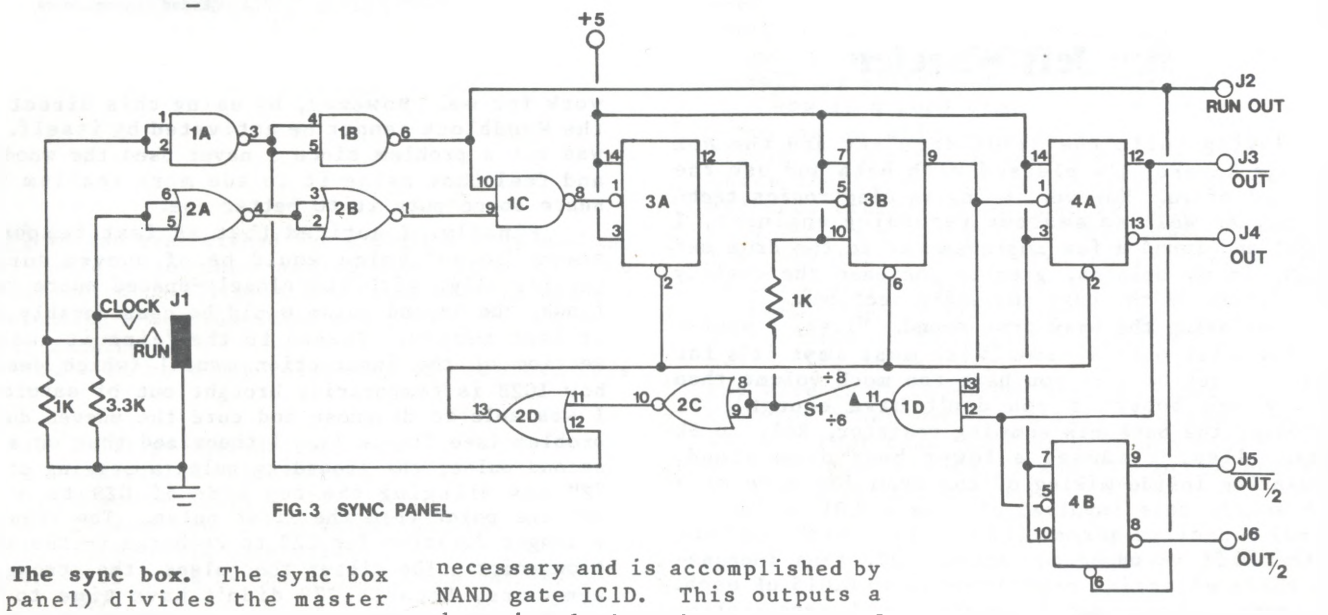


FIG.3 SYNC PANEL

The sync box. The sync box (or panel) divides the master clock into musical sub-divisions (sixteenth notes, etc.), and outputs these as pulses controlled by the run line. (The run line goes high when the TR-606 is running a pattern or track.) Since the sync panel needs a 5 Volt supply, I mounted it in my modular synthesizer cabinet, which already included an existing 5 Volt supply.

A patch cord connects the run and clock signals from the buffer box to stereo jack J1 (see figure 3). The run signal is inverted/-buffered via IC1A, and taken to the clear (reset) NOR gate (IC2D). This resets the counter when the Drumatix stops. The run signal is again inverted, taken out as a run out signal via J2, routed to the reset pin of the last flip-flop (IC4B), and taken to the clock NAND gate (IC1C). This enables the clock signal (which is buffered by IC2A and IC2B) for division only when the run line is high.

JK flip-flops IC3A and IC3B, which are wired for toggle operation, perform the primary division. In four-based meters (Drumatix Function Switch 1 and 2), a divide-by-six function is necessary and is accomplished by NAND gate IC1D. This outputs a low signal when the Q outputs of IC3B and IC4A go high (binary 6). This signal proceeds through switch S1 and inverter IC2C to the reset NOR gate (IC2D). Only the first three flip-flops are subject to this type of reset; however, all flip-flops are subject to run reset. For three-based meters (Functions 3 and 4 on Drumatix), switch S1 is opened and flip-flops IC3A, IC3B, and IC4A act as at a three bit counter, providing the necessary divide-by-eight function.

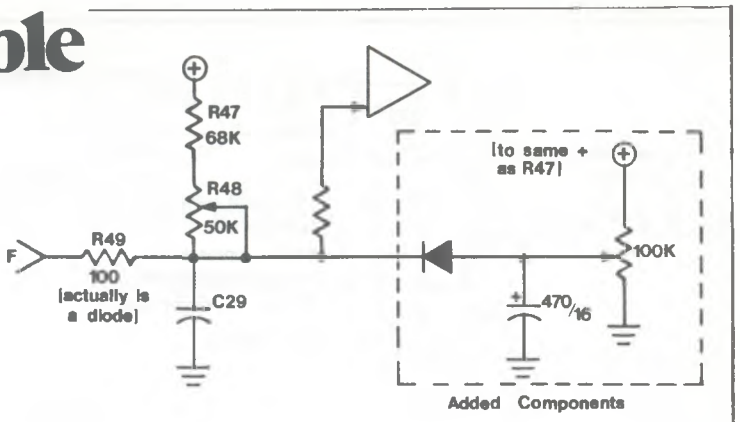
Complementary pulse outputs Out and $\overline{\text{Out}}$ are brought out from flip-flop IC4A via jacks J3 and J4. These outputs function as sixteenth notes in Drumatix Functions 1 and 3, and eighth notes in Functions 2 and 4. The fourth flip-flop (IC4B) divides the output once again to yield complementary Out/2 and $\overline{\text{Out/2}}$ signals.

You can use the sync signals for triggering events, from simple repetitive synchronized tambourine or maracas patches to full scale synchronization with arpeggiator and digital sequencers. The pulses actually lead the Drumatix by two Drumatix clock pulses (one-sixth of a sixteenth note, Function 1), but with the Drumatix tempo knob set at 11 o'clock or faster, this difference is hardly noticeable. Remember, though, that the sync panel doesn't know what the Drumatix is doing (except running or not), and can only do four- or three-based divisions at any one time. A little extra thought and consideration in programming, however, can let you use these sync outputs to maximum advantage.

FIGURE 1
DB-25 CONNECTOR PINOUT

Pin	Function	Pin	Function
1	Bass Dr.	15	Strap
2	n.c.	16	Strap
3	Snare	(pins 15 and 16	
4	n.c.	connect together)	
5	Toms		
6	n.c.	17	n.c.
7	Hat	18	Clock
8	n.c.	19	n.c.
9	Cymb.	20	run
10	n.c.	21	n.c.
11	n.c.	22	H. Trig.
12	n.c.	23	n.c.
13	n.c.	24	L. Trig.
14	GND	25	n.c.

PAIA Programmable Drum Set Modification



By: Jeff Wheeler

Having built the 3750A drum set and the Hot Springs Reverb, I'm pleased with both and use the drum set often. However, being an electronics technician, as well as amateur recording engineer, I sought and found a few improvements to the drum set which, in my opinion, greatly increase the quality and realism of the bass and snare sections.

Improving the bass drum sound. First, I wanted considerably more volume (with most amps it's far easier to cut back if you have too much volume than to try and boost if you don't have enough). I decreased the bass mix summing resistor, R41, to 6k ohms. Also, I wanted a lower bass drum sound, simulating inside-miking of the drum for more of a rock sound; this involved placing a 0.01 uF (micro-Farad) capacitor across (in parallel with) C23 and another 0.01 uF capacitor across C22, thus increasing their effective capacitances to 0.015 uF each. The sound is, at least to my ears, much more realistic.

Incidentally, I noticed when recording that the upper voices were all coming through too stridently compared to the bass. So, in addition to decreasing R41 to 6k, I also changed the other summing resistors as follows, using my ear and some experimentation: Snare mix resistor R53 to 105k; Conga mix resistor R33 to 40k; and Tom mix resistor R25 to 40k.

Modifying the Snare circuit. In my opinion, the snare sounded like someone hitting a large sheet of tin with a hammer, and spitting into a microphone simultaneously. The following mods give a far more realistic effect.

I began by lowering the resonant frequency of the snare section by adding a 0.0068 uF capacitor across C27 and another 0.0068 cap across C28. This increases the overall capacitance of C27 and C28 to 0.0073 uF. After changing the tuning, I was greatly (and still am) pleased with the sound of the drums -- but making two additional changes to the snare really made that voice sound excellent to me. First, I noted that simply combining the Tom sound and Snare white noise didn't quite achieve a good snare sharpness, no matter how I tuned the Tom's trimmer pot. So, I wired in the Woodblock sound as well by running a wire from D1's anode to the junction of R103 and R96. Also, I increased the Woodblock's summing resistor, R9, to 205k. Incidentally, I first tried using a diode (polarized the same as D1) instead of the wire to send the Woodblock into the Snare sound. For some reason, this didn't work for me. However, by using this direct wire, the Woodblock cannot be activated by itself. This was not a problem since I never used the woodblock, and feel that using it to add more realism to the snare sound puts it to better use.

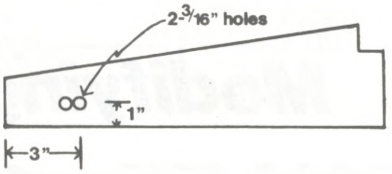
Finally, I noticed that at fast tempos, the snare "noise" voice would be of uneven duration. Specifically, with two closely-spaced snare repetitions, the second pulse would be considerably longer at fast tempos. Thanks to the "circuit analysis" section of the instruction manual (which described how IC2B is temporarily brought out of saturation), I was able to diagnose and cure the uneven duration problem (see figure 1). I theorized that on a quick second pulse, the grounding pulse appearing at point "F" was bringing the top side of C29 to a lower voltage point than the first pulse. The result was a longer duration for C29 to recharge to the saturation point. The closer the pulses, the stronger the symptoms, because C29 didn't have time to fully recharge (or discharge, if you will) to the saturation point; so, it was starting off from a lower point. The solution is a DC biasing circuit, set so that C29 cannot be pulled below a certain positive ("+") level. I noted that when inactive, C29 was at about 1.5V for the snare duration I wanted. I then adjusted the 100k trimmer pot to just below that (actually I used my ears too, since when you have the trimmer set for above a +1.5V output, you'll hear a constant snare noise). By adjusting the trimpot just a bit below that saturation point, now even very fast snare repetitions come out with consistent duration -- no more "dit-dah" effect.

That's all there is to it. One problem with the bias circuit is that the drum set will hiss upon turn-on for a few seconds until the 470 uF cap stabilizes. This is a very minor problem; just turn down the amp until the thing charges, then everything (except the woodblock) sounds just great. As a final note, here are my favorite trimpot settings, should you decide to try any of these suggestions. All trimpots are viewed from the front, with standard rotation descriptions (i.e. 12:00 o'clock means halfway up, 2:00 o'clock means two-thirds of the way up, and so on).

R48	1:00 o'clock
R39	3:30 o'clock
R23	10:00 o'clock
R31	3:00 o'clock
R7	3:00 o'clock
R15	11:00 o'clock

E-Mu Drumulator Tuning Modification

FIG. 1



By: Steve Davies

Have you ever wished for a digital drum machine that would also make analog-type drum machine sounds? With this simple modification, the wonderful sounding E-mu Drumulator can sound like a cheapo analog machine.

You will need the following to complete this mod:

1. Phillips screwdriver
2. Small blade screwdriver
3. X-acto™ knife
4. 25 Watt pencil tip soldering iron
5. 60/40 rosin core solder
6. DPDT slide switch (Radio Shack cat. #275-407)
7. 1/4" drill and two bits (3/16" and 1/16")
8. 1 foot of 22 gauge stranded wire
9. The desire to void your warranty
10. A 12" by 12" piece of foam or carpet
11. Wire strippers

WARNING: Make sure the power cord is not plugged in at any time during this mod!! I mention this because if you were to plug the molex plug back in, and didn't mate things up just right, the resulting smoke and noise would probably cause you to scream so loud that your neighbors would call the police.

Place the foam on your work surface, then turn the Drumulator upside down on top of the foam (this protects the switches from scratches and the like). Remove the eight bottom panel screws, and open the bottom panel up to the left. Unplug the molex connector on the PC board, and the top of the Drumulator should now be able to lay flat on the foam.

At this point, it's time for some Drumulator dentistry. Chuck the 3/16" bit in the drill, and drill two holes as shown in figure 1; then trim the hole with the X-acto knife until it is rectangular, and wide enough for the switch to slide freely. Next, hold the switch up to the outside of the housing, and mark the two switch mounting holes (the tip of the X-acto knife works well for this). Change the drill bit over to 1/16", then drill out the switch mounting holes. When drilling these holes, wiggle the drill around a bit as the holes need to be just a hair larger that 1/16". (If you don't like the looks of the unpainted hole, you can probably find some touch-up paint at hobby shops.) Install the switch with the screws supplied.

Now is a good time to pre-heat the soldering iron, as we will need it shortly. Referring to figure 2, use the X-acto knife to cut the trace where indicated. Be very careful not to cut any adjacent traces. Then, cut two pieces of wire 4" long and one piece 3" long. Strip all of them back 1/8". Solder the 3" wire to the center of the switch and pin 2 of IC 4J. Next, solder the 4" wire to feedthrough #3 (see figure 2) by touching the tip of the iron to the feedthrough. When the solder melts, insert the wire. Add a bit of solder after the wire is in to ensure a good solder joint. Attach the other end of the wire to either end of the switch, then take the last wire and solder one end to DGND (see figure 2) and the other end to the remaining switch terminal.

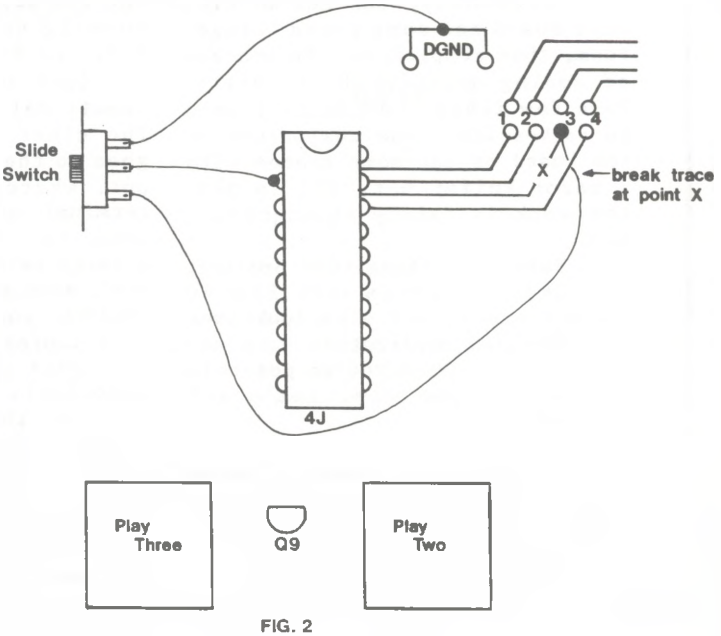


FIG. 2

The mod is now complete; reassemble the Drumulator by reversing the order of disassembly. If anybody out there has any ideas for mods they would like to see, drop me a line: Attn. Steve Davies, E-Mu Systems Inc., 2815 Chanticleer, Santa Cruz, CA 95062. Incidentally, this is the first of several mods I have planned for the Drumulator, so stay tuned for more mods in the future.

Practical Circuitry

Modifying the PAIA EKx-40 VCO

By: Tom Henry

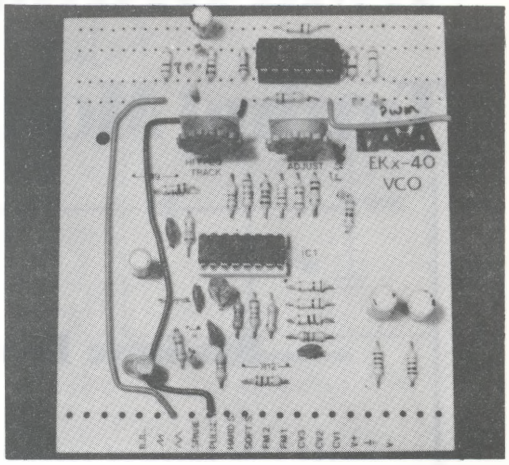


figure 2

The PAIA EKx-40 is a VCO kit configured around the CEM-3340 integrated circuit. It was not intended to be a complete VCO module, but rather a starting point upon which experimenters can expand. In this installment of "Practical Circuitry", we will modify the EKx-40 to give it standard output voltages and impedances. We will also beef up the input controls to include more options, and jazz up the pulse width circuitry.

Fortunately, the EKx-40 circuit board has some extra "kluge" room, thus simplifying the process of adding additional circuitry. In a few instances you will need to tack-solder some components to the board or cut some traces with a razor knife; but, all in all, the work is fairly straightforward.

Before starting this project, be sure to review the EKx-40 owner's manual and also look over the CEM-3340 application note and spec sheet. Once you've got this all out of the way, let's get started!

Modifying the control inputs. We will begin by adding some extra features to the exponential frequency control inputs (labelled CV1, CV2 and CV3 on the circuit board edge connector). CV1 should go to a front panel jack; this jack becomes the 1V/octave input, and is a "wild" input since it has no attenuator associated with it. Next, send CV2 to the wiper of a 100K pot, whose hot side and ground should go to the hot terminal and ground, respectively, of a second jack. Mount both the pot and jack on the front panel; this pair forms an exponential FM input with attenuator. The attenuator is needed since it allows you to dial in the amount of FM required by the application at hand.

CV3 should go directly to the wiper of a 100k pot, where one of the remaining terminals connects to +15V and the other terminal connects to -15V. This pot becomes the coarse tuning control and sweeps the VCO over a range of about 1 Hz to 35 KHz. However, we need a fine tuning control as well. To implement this, solder one end of a 2.7M resistor to the summing node terminated by R17, R18, and R19. (Essentially, you are just adding another control input; call it CV4 if you wish.) The other end of this resistor goes to the wiper of another 100K pot, where again, one remaining terminal connects to +15V and the other to -15V. Since 2.7M is such a large value, the pot will have a much more restricted range, which is what you would expect from a fine tuning control.

This takes care of the four exponential type inputs. Let's examine the linear input next. Start by eliminating R11, since we really only need one linear FM input (labelled FM1). This input should then go the the wiper of yet another 100K potentiometer. The hot side of this pot goes to a jack on the front panel, and the remaining terminal goes to ground. This jack and pot form the linear FM input control duo, and allow you to dial in the required amount of FM.

What about the sync inputs? Well, these are quite easy to fix up as well; consider the hard sync input first. Modify this input by adding a 27K resistor in series with C1 (which leads to pin 6 of the CEM-3340). This resistor restricts the sync input voltage swing, so that a full 10V p-p pulse may be used as the sync signal (10V p-p is our standard signal level). The 27K resistor should terminate at the hot terminal of a closed circuit jack; the switching contact of this jack should be wired to ground so that the sync input is grounded until a plug is inserted into the jack. This guards the sensitive sync input from outside interference.

The soft sync input is modified in almost the same way. Put a 47K resistor in series with C2 (which leads to pin 9 of the CEM-3340). Once again, the other end of this resistor should terminate in a closed circuit jack which has been wired so that the input is grounded if no plug is inserted. (By the way, remove the jumper labelled "*" on the EKx-40 circuit board if it had been installed prior to making these changes.)

So far, our modifications have involved nothing more than adding a resistor here or there, and slapping in a few pots and jacks. To jazz up the pulse width control, we will need to use some slightly more sophisticated circuitry. In particular, we will have to add an op amp and several more resistors. Luckily, the "kluge" area on the circuit board is more than adequate to accommodate our needs.

Refer to figure 1, which shows a schematic for the remaining modifications to be made to the EKx-40. One half of a 4739 dual op amp (or equivalent) beefs up the pulse width circuitry. There are two controls associated with this structure. One is the initial pulse width control, which can manually adjust the pulse width from about 0% to 100%. The

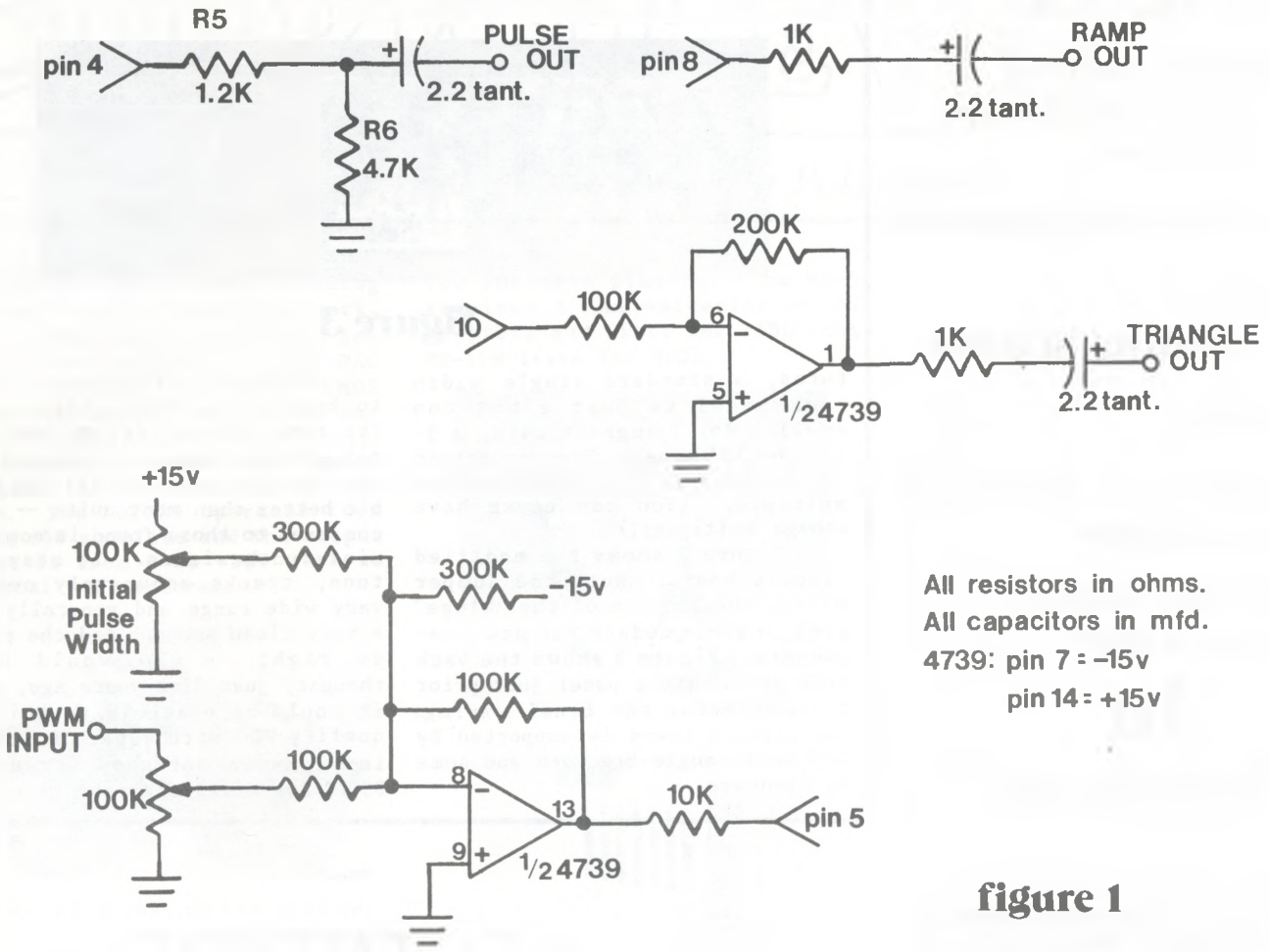


figure 1

other control is an attenuator for the PWM input. This lets you reduce the level of modulating signals.

Use some insulated wire to carry the output of this structure to pin 5 of the CEM-3340. After adding these modifications, I think you will find the pulse width to be much more manageable. Pulse width modulation yields such a neat sound that the extra work needed to give you more control over this parameter is well worth the effort!

Modifying the outputs. Now that we've taken care of the EKx-40 inputs, we want to fix up the outputs so that they meet the standards established in this column over the past couple of years (10V p-p signals with output impedances of 1K).

One standard that we will have to forego is that of direct coupling. To add direct coupling (meaning no capacitors) to the outputs would require quite a bit of extra circuitry, and is hardly worth the effort. This implies that the modified EKx-40 will not be suitable for use as a low frequency control oscillator. However, this in no way detracts from its value as a good tone source. If you really need direct coupled outputs, then try the "VCO Deluxe" previously described in this column (Polyphony, November/December 1981, pp. 28-29, 31).

Consider the pulse wave output first. To bring the signal level in line with our standard, replace R5 with a 1.2K resistor and R6 with a 4.7K resistor. Besides adjusting the signal level down to 10V p-p, this also provides an output impedance of about 1K. To correct for any DC offset, add the 2.2 uF tantalum capacitor shown in figure 1. A good way to install this cap is to find a suitable place on the PC board trace and cut it with a razor knife. You can then drill holes for the capacitor, and solder it in place (or tack-solder it across the cut trace).

The ramp wave is brought up to spec by eliminating R9 altogether and replacing R8 with a 1K resistor. Another 2.2 uF tantalum capacitor blocks DC. Once again, the level will be 10V p-p.

Upgrading the triangle wave output from 5V to 10V requires the other half of the 4739 dual op amp, which amplifies the triangle wave by a factor of two (see figure 1). You can pick up the input triangle wave at pin 10 of the CEM-3340. The output will have a negative DC bias on it; use a 2.2 uF tantalum capacitor to block this. Please note that the polarity of this capacitor is the opposite of the other two used thus far.

Building the modified EKx-40 VCO. Finishing up the project is quite simple, although with the addition of all of these new fea-

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Practical Circuitry

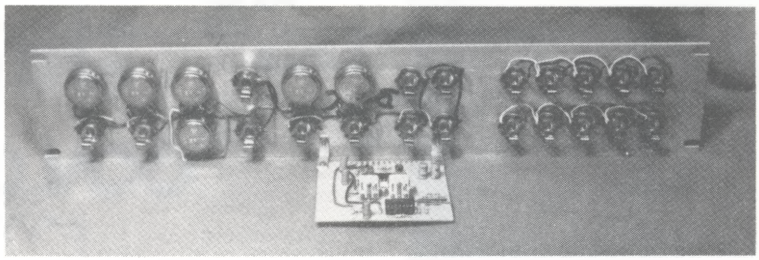

figure 3

tures, a standard single width rack panel is just a bit too small. So, I suggest using a 3-1/2" by 19" panel. You can devote any extra space to a two-by-five multiple. (You can never have enough multiples!)

Figure 2 shows the modified circuit board. Note the jumper wires, and the use of the "kluge" area to accommodate the new components. Figure 3 shows the back side of the front panel just prior to completing the final wiring. The circuit board is supported by two small angle brackets and some #4 hardware.

While this VCO is very easy to build, it doesn't have quite the same versatility as the "VCO Deluxe" (see above). Nonetheless, as VCOs go, it is still quite a bit better than most units -- even compared to those found in commercial synthesizers. It stays in tune, tracks accurately over a very wide range and generally has a very clean sound. And the price is right -- who would have thought, just five years ago, that it would be possible to build a quality VCO with superb features in your own workshop for under $30! How times change!

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CURRENT EVENTS

'Tell Them You Saw It In Polyphony'

QUASH on a chip. Analog Devices (Route 1 Industrial Park, PO Box 280, Norwood, MA) has announced the AD7226, a quad DAC which includes four 8-bit CMOS DACs (with output amplifiers and data latches) on a single chip. The amplifier offsets are laser-trimmed to eliminate offset nulling. The AD7226 operates from +15V, -5V supplies and the output range is from 0 to +10V with an external +10V reference.

Microphone accessories. Shure Brothers (222 Hartrey Avenue, Evanston, IL 60204) is offering a line of microphone accessories including microphone holders, grilles, windscreens, impedance matching transformers, and similar items.

New record source. Euro-Collectibles Enterprises (PO Box 513, DeKalb, IL 60115) stocks a number of rare LPs from the USA and Europe. Write David H. Dellapelle at the above address or call 815/756-7865.

Roland Play Bus. The Boss (7200 Dominion Circle, Los Angeles, CA 90040) HA-5 Play Bus lets two musicians plug in and play together, and also accepts a cassette or drum box signal for accompaniment. It includes an overdrive circuit, stereo chorus/doubling, noise reduction circuit, and bass and treble controls. Adding the RH-11M headphone/mic lets players talk to each other without having to shout or remove their headsets. Several HA-5s can connect together via a single 1/4" phone plug patch cord for ensemble playing. The HA-5 requires 6 AAA batteries or AC adapter, and lists for $180 (the RH-11M lists for $90).

New from Yamaha. Yamaha (PO Box 6600, Buena Park, CA 90622) has introduced the MT44 4-channel cassette recorder ($570 list) and RB30 system rack and patch bay ($175 list). The latter holds the MT44 and Yamaha Producer Series MM30 portable mixer, thus creating a portable 4 track studio package. The MT44 includes a choice of Dolby B or Dolby C noise reduction, full logic transport controls, and independent level controls for each channel.

The R1000 digital reverb provides four different reverb time settings, a three channel equalizer, mix control, bypass switch, and input/output controls. List price is $795. Its bigger brother, the REV1, offers control over such variables as room size, room shape, contents of room, acoustic absorption coefficient, and listening positions. The REV1 can create and control up to 40 early reflections (each with controllable level, relative timing between early reflections, and where they begin), and provide up to 99 seconds of subsequent reverberation. The REV1 also includes 60 user-programmable presets as well as 30 factory presets, high resolution LCD window, LED numeric and level displays, and an RS-232 computer interface. Scheduled introduction is April 1984 (list price to be announced).

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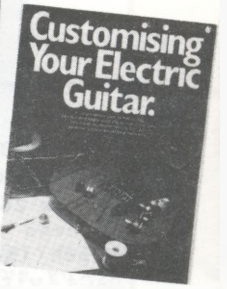

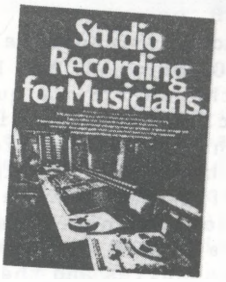

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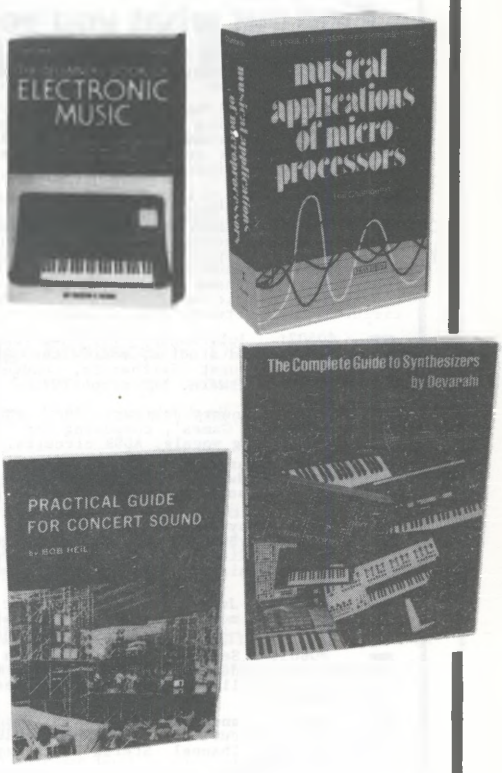

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▬ #0505: January/February 80: Joseph Byrd, Mort Garson, Larry Fast on 'Games', composing for 'live plus tape', using the CA3280, recording vocals, ADSR circuits.

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

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

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

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

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

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

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

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

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

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

▬ #0704 Jan./Feb.'82: Bob Moog interview, Chip Power - STK-050/070, Simple Square Wave Shaper, Tape Timer Ruler, Practical Circuitry: VCAs made simple, Details: Gozinda & Gozouta Revisited, Korg Trident & Casiotone 202 Reviews.

▬ #0705 Mar./Apr.'82: Electronic Music Math, Analog Delay Clock / Modulation; Frequency Domain Modifiers; Screen-Wave for the TRS-80; Touch Switches Revisited; Practical Circuitry: ADSR the Easy Way; Getting the most out of a Cheapo (Guitar).

▬ #0706 May/August '82: Anatomy of a Private record, Don Slepian Interview, Understanding Digital Synthesizers: A Digital Filter, Syn-Bow Review, Optical Audio, Profiles of SSM 2033 & 2044, The PAL Filter, Bill Rhodes Applied synthesis: Bells, Pipe Organ, Harpsichord, Electronic piano; The Realistic MG-1 Reviewed.

▬ #0801 Sept/Oct.'82: Ambience in Electronic Music,Tone Bypass for Fender Amps, 8 Track Reviews, Parametric EQ Tips, Solo/Cut Circuit for TASCAM Model 3, The SSM 2011, Tube Preamp, Snare + Drum Voice Circuit, Triple Pick-up Switcher, Simulated Stereo, When Quality Reocrd Mfg. Counts, Independent Record Mfg. Convention report.

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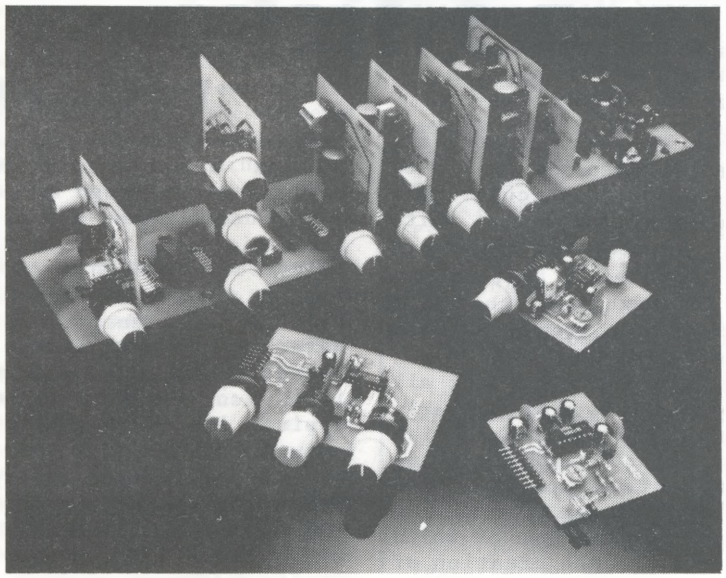

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White Noise is NOT a Cliché

By: Chris Meyer

Would-be electronic music composers are often advised not to use white noise, particularly as wind; the complaint is that white noise is overused, and therefore, clichéd. However, I feel it may be time to resurrect this old effect (after all, aren't new wave bands getting accepted, even though they are bringing back all the gee-whiz sounds from the early Moog age?), particularly if an effort is made towards creating unique variations on the "old standard" white noise effects.

The most common use of white noise used to be the creation of wind: A little filtered noise, automatically or manually swept, and tra la -- wind. Usually the sound was so cleanly synthetic, and so unimaginatively applied, that it sounded like exactly what it was -- a poor imitation of a real event. In a word, boring. However, this need not always be the case. Synthetic wind often sounds unrealistic because it is created by a single sound source; natural wind is a combination of many sources (for example, the sound of many trees rustling). Multi-tracking synthetic wind is the simplest way to add density and interest. I often create three different wind tracks -- one using a lowpass filter, one using a highpass filter, and one using a bandpass filter. Manually sweeping the filters, while listening to the previously recorded tracks, lets you build peaks of tension and mold the windscape as desired. Mixing in natural wind is another way of filling out your wind tracks; you could even try fading from all natural to all synthetic wind, swept with an LFO, to emphasize the surreal nature of the transition. Polyphonic synthesizers can also create good wind effects, since the density and pitch of the wind can be changed rapidly in order to develop and relieve musical tension.

One landmark use of white noise as wind was on David Bowie's "Heroes" album. Brian Eno fed white noise through a radically overloaded flanger, set on a slow automatic sweep. The sharp, spikey result, combined with slow, regular sweeps, gave an excellent blend of high tension and dreaminess. This effect can be easily recreated by abusing a guitar-level flanger with a synthesizer's typical 10V p-p output. If you are not into flogging your effects devices, a similar spikey sound can be created by frequency dividing pink noise (a filtered form of white noise). Also, you can create different timbres of wind by ring modulating white noise with other tones.

That brings us to using white noise for pitched sounds, since white noise is capable of doing melodic voicing as well as sound effects. Listen to Carlos's "The Well Tempered Synthesizer" for a good lesson in the use of pitched white noise. Also, white noise can be used as part of a more complex arrangement. In the song "Footprints in the Snow" from Isao Tomita's first album, "Snowflakes Are Dancing," Tomita uses a patch which sounds like a cross between a struck wood percussion instrument and a flute (or some other type of wind instrument). He apparently used a mixture of oscillator, white noise, resonating filter, and reverb. By the way, Tomita also used the old standby of automatically swept white noise, faded in and out of the piece, to create a comfortable-but-slightly-unreal wind-through-trees effect. This effect contributes to making this piece one of my favorite electronic music pieces of all time.

Back to natural sounds. Besides wind and surf, another naturally occuring white noise-like sound is breath. You may not realize it, but breathing is typically aperiodic -- it does not fall into a precise, repeated

pattern, like a heartbeat. That is why most white noise "breath" sounds, such as those used by Jarre on his album "Oxygene", sound so unrealistic -- thy are too perfect. Tangerine Dream once turned this around on their album "Cyclone"; they inserted real breath sounds between synthetic runs on a Lyricon, to great effect. Another excellent use of breathing appears in Stockhausen's "Hymnen" (Fourth Region), where aperiodic natural breathing totally disarms the listener in preparation for the occurence of a timed event.

What seems to be good general advice in synthesis also seems to apply to the use of white noise: decide whether you want an imitative or synthetic sound. If you want to go the imitative route, study the phenomenon and carefully imitate the most important characteristics -- maybe even mix in a little of the real thing. If you want to try synthetic white noise, have a clear mental vision of what makes your sound unique if you don't want it to sound imitative. Any lack of conviction can make a sound fall short, at which point it becomes just another -- cliché.

Applied Synthesis: Voicing Techniques

continued from page 25

thereby creating a symphonic, layered sound. If you can write music, buy orchestral scoring paper and plot each note on the staff of each instrument played. By doing this you can see how an orchestra becomes "symphonized," or in our case, "synthesized." But once again, be on guard against doubling instruments excessively.

9. "Chord-memory" voicing: Some synthesizers have the ability to memorize chord structures on one note, thus enabling the keyboardist to play up to eight note chords with one finger. This can make for interesting combinations of intervals when the chord memory is used for a melodic treatment. Layered perfect fourths and fifths make novel harmonic combinations and layers. Remember, though, that in most cases the note you choose as "melody" will become the lowest or root note of the chord melody if you build on top of the note. Some of the instruments available today that can memorize chords are the Korg PS-61, PS-6, Monopoly (MP-4), most Roland synths, Oberheim OB-8, Prophet 600, and Rhodes Chroma (to name but a few).

When using chord memory, try using long release times for laying down basic tracks of slow moving chords. If you play highly percussive bell-like or brass sounds using chord memory (perfect 4ths, suspensions, octaves, fifths, etc.) on top, the resulting sound is extremely transparent and fresh.

10. Clusters: Voicing in "clusters" involves the use of close intervallic relationship between tones. A cluster can be as many notes as you want, but usually the half-step and whole step intervals are the most frequent voicings. Clusters are generally played in mid-to-high registration because of their dissonant, and sometimes cacophonic, nature. If played an octave or more below middle C they can sound muddy and dreadful.

Playing percussive clusters in upper registers can take on a "mallet-instrument" quality that is reminiscent of the xylophone or marimba. In some cases clusters serve harmonic purposes, while in other cases they serve as percussive devices. They can be layered over the harmonic structures and melodies of all types of music to good effect, providing that you use care in their execution.

The 20th century music of Charles Ives, Igor Stravinsky, Paul Hindemith, and countless others uses cluster voicing extensively (listen particularly to avant-garde organist/composer Daniel Pinkham for his use of clusters). Remember that clusters can be triadic or contain as many notes as you wish. They are usually effect idioms and percussive elements in most cases, but can be harmonic foundations for compositions of an avant-garde nature.

Here's one example of a cluster (to be played over C minor chord and minor scale): D, E-flat, G, A-flat. Right hand fingering is thumb on D, 2nd finger on E-flat, 4th on G, fifth finger on A-flat. Play this cluster percussively over a C minor chord. Note that the cluster members are included in the C minor scale. Clusters also work well with modal chord applications and jazz modes. For example, the C Lydian mode (F, G, A, B, C, D, E, F) includes flatted 5th and major 7th. Play cluster notes A, B, C (simultaneously) over a Dm9 or Dm11 chord.

11. String voicing using one voice or line at a time: Classical quartet or trio string voicings do not need doublings or multiple oscillator sounds; they sound much purer when a single melody line is played with one oscillator instead of multiple oscillators. In most cases the real violin is playing monophonically as well. If you have enough tracks with which to record, try playing each individual string line on a separate track. If you use a chord chart make sure your voice leadings sound correct, and don't make wild intervallic leaps. Use a separate track for each member or note of the chord called for in your chart. Be aware of registration and the instrument that plays best in that registration. Don't give the violin the cello part, or the low bass the high violin part, etc. You will find using this "separate track/separate voice" technique takes time and patience -- but the rewards are very human sounding when used properly. The multiple oscillator ensemble sound can be used for some applications and the single voiced sound can be used for others. This technique is not limited to strings; also try it on brass, woodwind, flute, and choir timbres.

12. Conclusion: Voicing is a most important factor in orchestral synthesis. If you are mostly interested in imitative synthesis, proper voicing can greatly increase the realism of the final result. As usual, I would like to stress that these voicing techniques are not only limited to synthesizer but work well with piano and other instruments. Be conscious of voicing next time you attend the symphony, listen to Larry Fast, encounter a recording project, or tolerate (sorry!) commercial music.

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SIGNAL DIODE

601-60...1N914 (1N4148) signal diode . 5/.35

TRANSISTORS

2N3904	2N3904 NPN Transistor	.25
2N3906	2N2906 PNP Transistor	.25

POTENTIOMETERS

(3/8 long shaft, 5/16 mounting hole)

854-401	10K Linear taper	1.09
854-501	100K Linear taper	1.09
854-505	500K Linear taper	1.09
855-401	10K Audio taper	1.09
855-501	100K Audio taper	1.09
855-505	500K Audio taper	1.09
856-401	10K Audio taper with on/off switch	1.25

TRIM POTS (vertical mount)

802-251	250 ohm trimmer	.40
802-103	10K trimmer	.40

MINI TOGGLE SWITCHES

403-20	SPDT (on/on) sub-mini (3A)	1.20
403-40	DPDT (on/on) sub-mini (3A)	1.50
405-10	SPST (on/off) bat handle (6A)	1.85

LED's

Please note that the typical DC forward current (I-fwd) of these LED's is less than those offered elsewhere making these LED's ideal for battery circuits or others where current consumption is a factor.

305-201	Red T-1¾ jumbo diffused (20 ma.)	.30
305-202	Green T-1¾ jumbo diffused (30 ma)	.40
305-203	Dual T-1¾ jumbo diffused (50 ma)	.90
305-204	Tri T-1¾ jumbo diffused (20 ma)	1.50

Note: 305-204 is a three lead, tri-color (green, red, yellow) device. It is essentially two separate LED's in one package. (The yellow is obtained by turning on both green and yellow.)

JACKS and PLUGS

1/4 In. PHONE JACKS

901-101	Mono standard phone jack	.45
901-103	Mono with n/closed contact	.52
901-105	Mono encl. jack (open back)	.55
902-211	Stereo standard phone jack	.70
902-213	Stereo encl. jack (open back)	.77

1/8 In. MINI JACKS

903-351	Mono with n/closed contact	.32
903-353	Mono encl. (open back)	.26
903-355	Mono enclosed with contact	.35

RCA JACKS

921-100	RCA jack, chassis mount	.34
921-200	RCA jack on phenolic mount	.25
921-300	Dual RCA on phenolic mount	.43

1/4 In. PHONE PLUGS

911-201	Mono, black phone plug	.48
911-203	Mono, red phone plug	.48
911-205	Mono, chrome (metal) plug	1.20
911-211	Stereo, black phone plug	.65

1/8 In. MINI PLUGS

913-251	Mono, black mini plug	.38
913-253	Mono, red mini plug	.38
913-255	Mono, chrome (metal) plug	.56

SWITCHING JACKS

These are stereo phone jacks that contain an independent switching sywtem that is controlled by the insertion of the plug. Jack 905-301 contains the equivalent of a DPST normally on switch. Jack 905-302 contains the equivent of a DPDT on/on switch making it ideal for switching bi-polar power supplies on and off in effects boxes, etc.

905-301	Stereo jack with SPST switch	.90
905-302	Stereo jack with DPDT sw.	1.00

PGS ELECTRONICS
Route 25 - Box 304
Terre Haute, IN 47802

PAiA STOMP BOX EFFECTS

AT LOWER THAN 1980 PRICES

These new stomp boxes from PAIA are designed to give electronic guitarists the highest quality effect at the lowest possible price. Cases are formed of heavy steel and covered with the most scuff-resistant baked-on finish available. All feature heavy duty switches for long life and electronic effect switching for pop-free punch-in and punch-out. All are high input impedance, low output impedance, non-inverting, low noise devices designed to meet all proposed FX standards. Each provides hour after hour of operation from a single 9 volt battery and provide automatic power switching; you'll never have to worry about forgetting to turn them off.

HOT LYX SUSTAIN

Probably the most used effect by any electronic guitarist, a sustain unit is essentially an amplifier that automatically increases its gain to compensate for a guitar's normal decay characteristics. The result is the ability to hold notes and chords much longer than would otherwise be possible.

Hot Lyx gives you all the control you need, continuously variable sustain from just enough to make your Silvertone sound like a Les Paul to "pedal to the metal" controlled feed-back settings that give rock-guitar its "all-out" quality. Level control allows for either lower or higher volume levels when you're punched into the effect and can also be used as an over-drive control to give you the sweetest fuzz/sustain sounds you've ever heard.

No. 5710 HOT LYX Sustain . . . . . **$39.95 (3 lbs.)**

MOTION FILTER

An envelope follower/filter combination translates the normal dynamic properties of your axe into modulated timbral changes as well, the effect is like a wah-wah pedal being used by someone with magic feet. The first time you get your MOTION FILTER working you won't believe that so much funk and soul can be squeezed into such a tiny box.

Independent Initial Frequency and Sensitivity knobs give you the control you need to realize a wide range of effects and allow the MOTION FILTER to be used with either electric bass or guitar. **No. 5720 MOTION Filter Kit . . $34.95 (3 lbs.)**

GATOR™ Noise Gate/Envelope Controller

The almost un-noticeable "hiss or swish" that each unit in a multiple-effects system adds to your music can sum to annoyingly noticeable background noise just when things are supposed to be quiet. GATOR listens while you play, and when you stop, electronically isolates your effects from your amplifier, zapping noise completely.

And despite its low cost, GATOR has added features that let you do more than just make other effects sound good. It's an important effect in its own right.

The ATTACK control lets you re-shape the normal percussive envelope of your guitar for bowed string and organ effects with attack times up to 1.5 sec. and an AUXILIARY TRIGGER SIGNAL INPUT allows the dynamics of one instrument to be gated by another (drums, for example) to impart unique "synchro sonic" rhythmic characteristics to your sound.

Other features include High Impedance In/Low Impedance Out, Electronic Footswitch for quiet punch in/out, wide range Threshold Control, Single 9v. battery supply (not included).

GATOR (tm) Cat. No. 5730 . . . . . **$39.95** . . . . . **3 lbs.**

MIDRANGER™ Midrange Equalizer

Sure, your amp has bass and treble controls — but what about the all important midrange?

When you need more sound from your axe than most amps can give, but don't have the bucks for a fancy equalizer, the MID-RANGER is for you. Featured in Craig Anderton's June 1982 Guitar Player column, this special purpose equalizer gives more presence and "punch" by providing continuously variable boosts of up to 12 db. at switch selectable frequencies of 90, 200, 1000, 2000 or 4000 Hz.

Designed for guitars, voice, rhythm boxes and keyboards, the MIDRANGER features High Input/Low Output Impedance, quiet electronic switching and single 9v. battery supply (not included).

MIDRANGER (tm) Cat. No. 5740 . . . . . **$37.95** . . . . . **3 lbs.**

5750 — AXE GRINDER(tm)

A classic fuzz to FX standards.

The AXE GRINDER might be a pretty routine fuzz if it weren't for a couple of subtle but significant features. Like a Distortion Intensity Knob that provides smooth control of clipping from just a hint when you really get it on to pure square waves when you even think of picking.

And the Distortion Tone, Distortion Level, and Clean Level controls are like having a built in mixer and E.Q., letting you precisely set the amount of distortion and its tone as well as the mix of clean and distorted signal. You probably never realized you could get so many sounds from a "simple" fuzz.

The AXE-GRINDER also features totally pop-free electronic switching and adherence to uniform FX standards that allow any Effect to work with any other without concern for mismatch noises or phase incoherence. 9 volt battery power (not supplied). **5750 Axe Grinder(tm) Kit . . . $34.95 . . . . . 3 lbs.**

5760 ROCKTAVE DIVIDER(tm)

Whereas most effects that alter the harmonic content of a signal can only produce or accentuate frequencies higher than the fundamental frequency produced by the instrument, the ROCKTAVE DIVIDER fills out your sound by adding in waveforms that are sub-harmonics of those produced by your axe.

Compandor stages are used to stabilize input for reliable triggering of the divider circuitry and to impress the original dynamics of your playing onto the newly created subharmonics.

Independent level controls on the extracted fundamental and first and second sub-octaves allow you to produce just the mix you're after and master tone control lets you round the square wave sub-octaves off to near-sinusoidal purity.

The ROCKTAVE DIVIDER also features automatic power switching when in use, pop-free electronic cancel function and single 9 volt battery power source (battery not supplied).

5760 Rocktave Divider(tm) . . . . . **$44.95** . . . . . **3 lbs.**

ORDER TOLL FREE WITH VISA OR MASTERCARD

1-800-654-8657

DIRECT MAIL ORDERS & INQUIRIES TO:

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