PAiA
POLYPHONY

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Editorial

Welcome to the first issue of "POLYPHONY", the PAIA people's newsletter and User's Group journal ; an information exchange primarily for owners of PAIA equipment. Although personal response to each of the many letters received was an impossible task, we would like to thank you for your overwhelming response to the mention of this publication. The most requested areas of coverage were many of the same ideas which were discussed here at PAIA during preliminary development of this project.

With electronic music synthesis at a critical point in its development, there is a multitude of literature dealing with electronic theory and circuit design on one hand and the related fields of music theory, accoustics and recording techniques on the other for the serious synthesist to delve into. But, with the tremendous growth in popularity of electronic music the time has come to combine this wealth of information into a usable format for electronic music applications.

The avocations and interests of the people owning synthesizer systems are varied; from hobbyists and amateur musicians to recording artists and physics laboratories. Communication between those who are working with similar equipment, combining capabilities and creativity, could produce more applications than any one individual could realize in a lifetime of work. Many times others will have accomplished things that you are specifically searching for.

"POLYPHONY" is being published in response to a need expressed by you. It is intended to be an information exchange. You are the one who will ultimately mold this publication into what you want and need. We intend to rely heavily on reader contributions with PAIA serving as "Organizer". If you have modifications to recommend, favorite patches, editorial type comments, new product ideas or anything else that might be of interest to the masses, please share them with us.

Our goal is quarterly publication in 1976 but bi-monthly publication is a possibility if enough interest is generated. Remember, we are depending on you for editorial material so spread the word, "Keep those cards and letters coming in" (original, eh ?), and above all – Keep on Synthesizin'!!!

— Marvin Jones

contents

E-Z-Way

A sharing of miscellaneous hints which might prove helpful in an electronic music studio but are not directly concerned with the Synthesis equipment.

STANDARD RING BINDERS STORE INSTRUCTION MANUALS

The small 9 X 6 inch ring binders available in most dime stores and office supply houses conveniently holds PAIA instruction and User's manuals in an easy to use book format which can be expanded as you add to your system.

Plastic index tabs, labeling individual manuals, give quick access to the desired information. Kept near your synthesizer it provides for easy reference while developing patches and tuning or servicing the equipment.

LOGIC TEMPLATES USED FOR PATCH CHARTS

If you are one of those systhesists that keep records of every patch you devise you've probably been looking for a quick and easy method for drawing them and still have them turn out neat and uniform.

School Bookstores and art supply houses carry plastic drawing templates. Computer logic symbol templates lend themselves quite well to drawing synthesizer patch charts.

EASY TO BUILD PATCH CORD HOLDERS

As synthesizer systems grow, the number and lengths of patch cords increase proportionally. Eventually, the problem of organization and storage of these cords becomes a problem that warrants special attention. The simplest patch cord rack shown in figure A consists of a rectangular piece of plywood which has a number of saw cuts along one edge. Patch cords can be slipped into the slots and arranged according to length.

FIG. A

If you'd like something with a little more class, try this idea submitted by Greg Leslie of Ponca City, Oklahoma. The basic idea is the same but the end product is more attractive. (see figure B)

A rectangular piece of wood is used as a back plate with a number of wooden dowels protruding from the panel. Bear in mind when selecting and mounting the dowels the amount of space that you will need to allow to keep the plugs from slipping through the dowels and still providing ample access to the patch cord plug.

FIG. B

The dowels can be mounted using glue and nails, screws from behind the panel or by drilling holes in the panel to allow the dowels to be tapped into place with a hammer. Pegging the dowels into the panel seems to be the sturdiest construction.
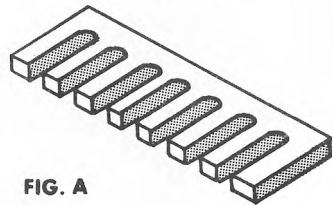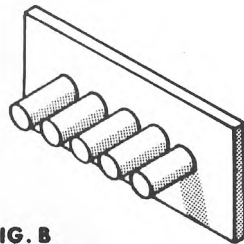
Adding Permanent Triggering

AN ENVELOPE GENERATOR MODIFICATION By: Gary Fisher
Allendale, Michigan

   The internal trigger pushbutton caused difficulty when tuning the sequencers as it required re-patching to bypass the unit, biasing it on or an extra hand to hold the trigger button. My solution was to replace the trigger button with an ALCO # MST-1054 miniature toggle switch. This is a SPDT switch which "holds" in one direction and spring-returns from the other. By installing the switch with the fixed contacts tied together, the direction of travel being vertical and the momentary position downward, I can now test the sound of the note through the normal action of the ADSR by simply pushing the switch down and releasing it. Testing and setting pitch can be accomplished by pushing the switch up and leaving it. This, for my use, is a definite improvement.

TRIGGER

++ Ⓜ ——————→   Ⓚ R4

STOCK 4740

HOLDING

++ Ⓜ ——— OFF   Ⓚ R4

MOMENTARY
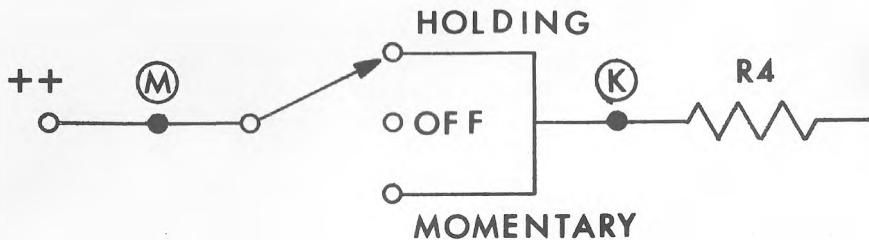
MODIFIED 4740

Editors note: Although this modification was made to a 4740 Envelope Generator, this idea will work equally as well in the 2720-4 Function Generator.

Modifying Time Constants

IN SYNTHESIZER MODULES

By: Marvin Jones
Director of Technical Service, PAIA

Changing time constants in synthesizer modules and audio processing equipment seems to be the first place that most people begin in customizing their equipment. Modifying the time varying circuitry can change the speed of the 2720-9 Glide module, vary the range on Envelope Generators, change clock speeds in Sequencers and Synthespin units.

Generally, in any time varying circuit there will be an R-C (resistance and capacitance) network whose time constant is used for timing the operation of the overall circuit. For our purposes, it will suffice to say that a smaller resistance and/or capacitance will make a smaller time constant. This will result in faster changes or higher frequencies. Logically, a larger resistance and/or capacitance will make a longer time constant, slower changes or lower frequencies.

A circuit design analysis is published in PAIA instruction manuals and along with information for studying or repairing the circuit, timing circuits are usually pointed out. Once the timing elements are found a decision will need to be made as to how the circuit is to be changed.

Let's take a look at a fairly complex situation as an example. In the 4740 Envelope Generator there are three time varying parameters: Attack, Decay and Release. Studying the schematic shows that there is a common timing capacitance (C3) for all of these functions. Each parameter uses a separate resistance which is comprised of a variable resistance (to change the timing for that function) and a fixed resistor which is used as a current limiter to "set" the minimum time constant when the variable resistance is 0 ohms. In the 4740, the Attack resistance is R22 and R13, Decay is R23 and R19 and Release is R25 and R7.

Now comes the decision of how the timing is to be changed. If you want all parameters changed proportionally, the easiest way would be to change the timing capacitor (C3) which is common to all three timing circuits. To make the times longer increase the value of C3 and vice versa. This change will not only change the the maximum settings but the minimum settings as well. If, on the other hand, only one function needs to be changed, it would be best to change only the resistance for that function. If you want the capability of a longer final release, replacing the release potentiometer (R25) with a larger value will do the trick. Changing the potentiometer value for this function will allow the same "minimum" timing which you had before because the current limiter (R7) remains the same. Only the maximum resistance has been changed making longer release times available. Likewise, the attack or Decay potentiometers can be changed for longer timing.

Keep in mind, whenever you want to change a circuit's design, that you should always start with correctly operating original circuitry. Also, be prepared for something to go wrong. Many times, parts in a circuit will serve several different purposes. When making extreme part value changes there is a chance that there will be a limit to the amount of change which can be made. For example; in the previously discussed 4740 modifications, if one of the timing potentiometers is replaced with a large value (2.2 meg or 5 meg) there is a chance that leakage current paths may overide the timing circuit and render the 4740 permanently on or off, or make the entire circuit operate in an erratic manner. If this happens, try a less drastic change in value until the circuit resumes normal operation. In timing circuitry it is generally a better choice to vary the timing capacitance rather than the resistances.
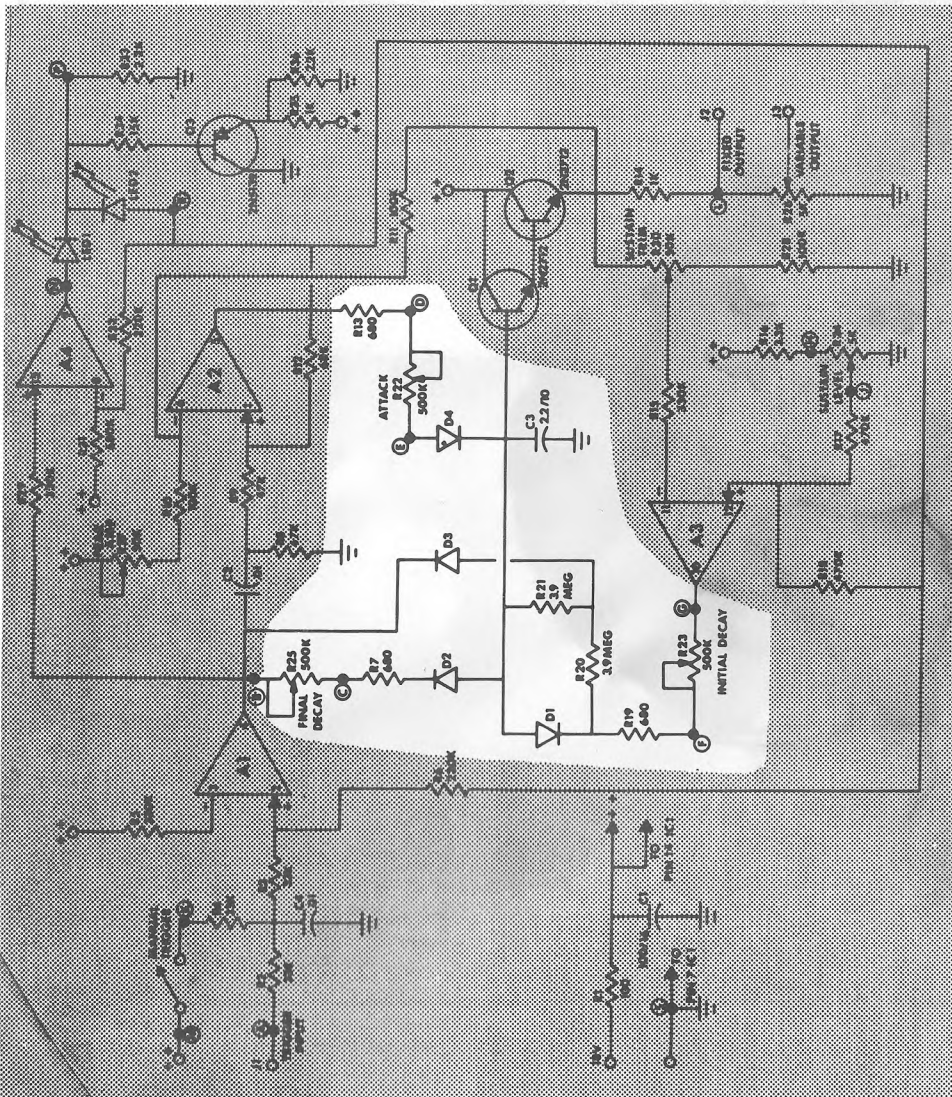
Changing Glide Rate

Another commonly requested timing change is the glide rate of the 2720-9 Glide circuit. Changing the timing in this circuit is much simpler than in the Envelope Generator and is easily changed to suit individual tastes.

In this particular circuit it is best not to increase the resistance (R3 and R4) of the timing circuit for two reasons. First, a potentiometer is more expensive than a capacitor and secondly, an increase in the value of R4 can, in conjunction with the input impedance of the op-amp IC-1, cause a voltage divider which would cause the keyboard tuning to lower as the glide rate control is advanced. Lower glide times can be most easily obtained by increasing the value of timing capacitor C3. Values above 1 mfd. will require that you use an electrolytic capacitor so be sure that these polarized capacitors are installed with the negative lead to ground and the positive lead at the conductor which leads to point (H) on the circuit board.
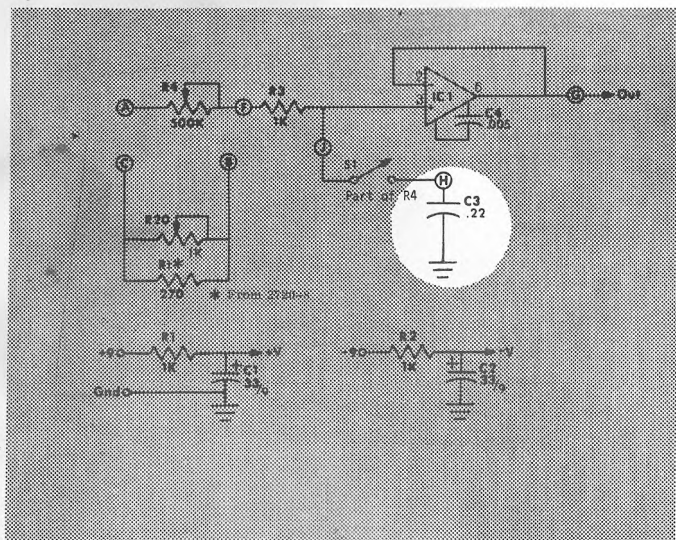
NEXT ISSUE - More modifications and a Footswitch control for the Glide circuit.

Dear Sir;

While your PAIA Gnome Micro-Synthesizer is nothing to sneeze at, I was wondering if you knew that it can very realistically synthesize such a sound. That's right, the Gnome can sneeze.

I must admit that when I organized a patch that would sneeze, I immediately cracked up. When I let a few of my friends hear it they also rolled. I don't know, I guess that the thought of a synthesizer sneezing was too much for them.

I am writing to let you in on this seemingly strange patch just in case you didn't already know about it. It is very simple and an easily synthesized sound. Enclosed is a drawing of how to arrange the controls and instructions for playing the patch.

Yours truly,
Sammy Greene
Synthesist, STONE ASH
Jay, Florida
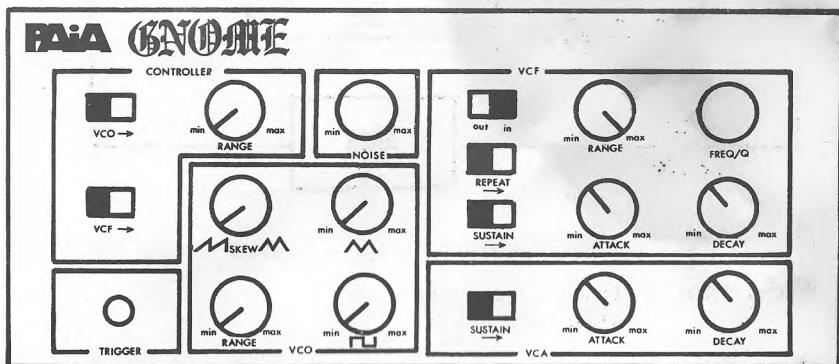
COMMENTS:

Noise control should be set to the proper volume of the sneeze.

VCF Range control should start at max then be backed off to synthesist desire.

The controller and the VCO are not used in this voice so switches - left, knobs set to min.

VCA sustain is not used so leave the switch in the out position. Attack and Decay controls should be set as shown.

The VCF in-out switch is set to the "in" position. The VCF "Q" control is set to the desired position for the type of sneeze wanted.

ALTERATIONS

The function generator controls can be changed, but both Attack controls should point in the same direction and vice-versa for the Decay controls. The VCF "Q" control can be rotated while the patch is being played to change the sound during the sneeze like more natural sneezes are.

more • • •

••• patches

A popular synthesizer sound is Pulse Width Modulation with a touch of Glide. This has been used in several popular recordings but was most recently spotlighted in the theme for ROCKFORD FILES by Mike Post.

The basic patch, shown below, can be expanded in several ways. If more VCO's are available, add another narrow pulse an octave higher. This will help give more of the actual ROCKFORD FILES sound. Also try various sweep times for the Pulse Width Modulator.
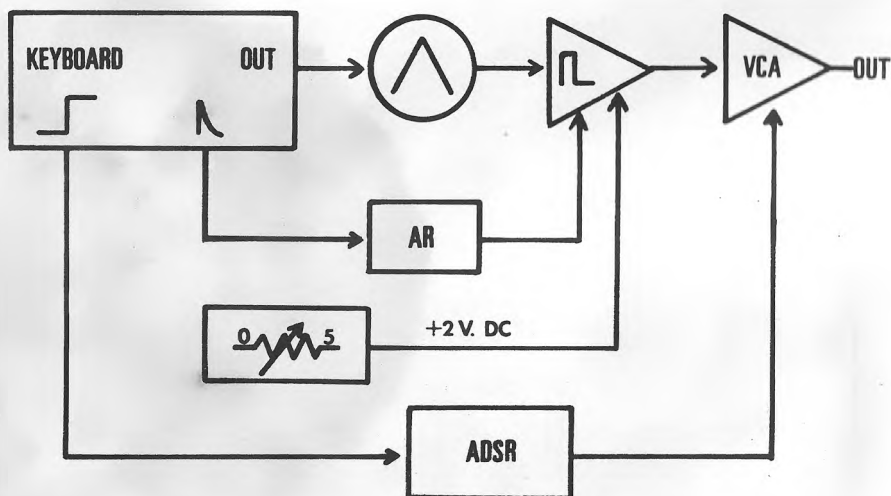
Tuned to
Glide -

KEYBOARD: Tuned to high range
             Glide - 10% to 20%

AR: Expand on
             A- 20%
             R- 30%
             Output- 60%

ADSR: A- 20%
             D- 50%
             S- 60%
             R- 50%
             Full output

Variations: Add another VCO tuned one octave higher
            with a fixed 20% pulse.

more •••

••• patches

"FROM THE BEGINNING"

```
KBD          OUT                4781              /\         4711

                                               |_|

                          _/                VCA            OUT

                    -vWv-  +2V.DC

                    ADSR
```
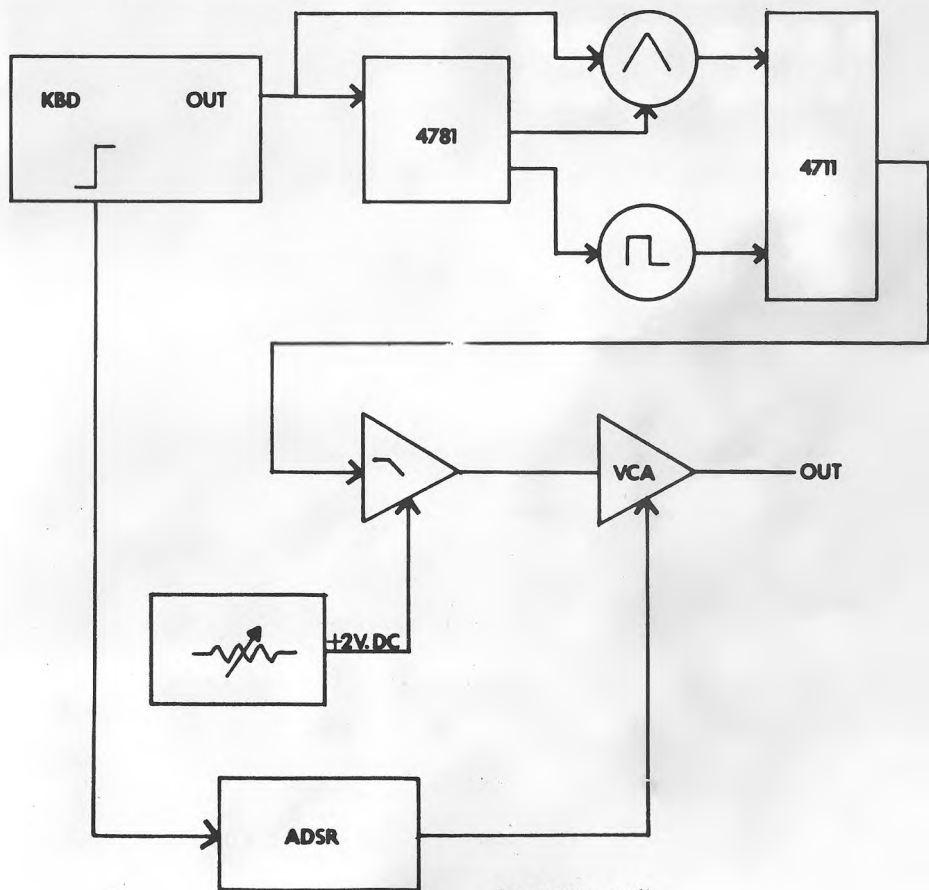
ATTACK: 20%
DECAY: 50%
SUSTAIN: 70%
RELEASE: 30%

    Keith Emerson has done a lot for the advancement of Music Synthesis. One
of his songs which is popular with many bands is "From the Beginning" on the
TRILOGY album. The synthesizer solo is a pleasant, mellow type of sound and
may be useful in other songs also. The basic patch is shown above. The
Triangle oscillator should be tuned 3 or 4 octaves above the pulse VCO. The
pulse wave should have about a 30% duty cycle. A low pass filter allows the
harshness of the pulse wave to be eliminated while retaining the uneven harmonic
series for the nasal quality. The pulse wave should be mixed at about one half
of the triangle level. This patch seems to sound the best when the keyboard is at
its upper octave setting. As always, experiment with variations of the given
settings.

MORE NEXT ISSUE ● ● ●

11

2 NEW MODULES

4720 VOLTAGE CONTROLLED OSCILLATOR (Shown above - right)

We've been working on and off for about 2 years on up-grading VCO designs. After taking a short time out to incorporate some of what we'd learned in the 2720-2A we're now ready to introduce the 4720 VCO. This oscillator offers Range, Linearity and features that place it at the high end of the performance scale while still being low in cost.

4720 Voltage Controlled Oscillator - Preliminary Specifications

Power Req.:	±9v. @ 20 ma.
Range:	16 Hz. to 16 kHz.
Outputs:	Ramp
	Triangle
	Pulse/Square
	Sine
C.V./Freq. response:	Linear
Features:	Front panel control sets initial pitch of oscillator. Internal Pulse Width Modulator. Wide Range – Exceptionally linear.

When this oscillator appears in out 1976 catalog the selling price will be $34.95. But for a limited time we will be offering it to past customers for $29.95. This offer applies to pre-release sales only and will expire on the anticipated shipping date of the first units, Dec. 1, 1975.

4730 MULTI-MODAL VOLTAGE CONTROLLED FILTER
(shown preceding page – left)

The biggest single weak point in the 2720 series modules was the filters. The 2720-3L and -3B weren't bad for the price but we certainly couldn't have sold them for any more than we did. Now we have the 4730 Multi-Modal Bi-Quad (transfer function quadratic in both numerator and denominator) Voltage Controlled Filter. Like the 4720 VCO, this unit is high in performance and low in cost.

4730 Multi-Modal VCF – Preliminary Specifications

Filter Type:	Voltage Controlled bi-quad; state variable	Max Q:	150
		Power Requirements:	± 9v.
Outputs:	band-pass low-pass high-pass simultaneously available	Features:	front panel init. freq. control front panel Q adjust extremely linear keyboard tracking
Range:	16 Hz. – 16 kHz.		

1976 catalog price will be $37.95 but on pre-release orders we are offering a special price of $32.95. Offer expires on anticipated first shipping date of December 1, 1975.

... and 2 for the ROAD!

The Pygmy Amp taught us how to build vinyl covered cases, so now we introduce the 4761 Wing Cabinet and 4762 Keyboard Case.

The 4762 Keyboard case features slip hinges on the keyboard cover and a hinged top for tuning access. Includes instructions for retro-fitting your 2720-8 innards and a new power supply for these electronics. All necessary hardware included.

The 4761 Wing Cabinets have space for 13 single width modules and includes power buss rods, special single width interface panel for power distribution and all hardware. Buy two and we throw in hinges, latch and carrying handles (NOTE: two cabinets shown above.)

| #4761 | Wing Cabinet | $16.95 | $2.50 shipping |
| #4762 | Keyboard case | $34.95 | $3.00 shipping |

Sorry – no packages available with these cases at this time. But if you have special requirements write and let us quote.

Dear PAIA,

A column devoted to answering your questions about PAIA, electronic music or any area which might be of interest to our readers. We've started out here with a few composite type questions which are typical of what is most often asked. We've opened the forum now so let us hear from you. If we don't know the answers to your questions we'll find out

DEAR PAIA, I would like to contact other people to arrange some discussion groups or Synthesizer Ensembles. Could you give me the names of people in my area who have purchased PAIA equipment?   John Q. Synthesist

Dear Mr. Synthesist,   It would be highly unethical to indiscriminately distribute our customer lists; however, if you're game for such a thing and have a den, practice hall, recording studio or even a tree house and would like to host a few fellow synthesists we will give you a listing in our "Local Happenings" column in the next issue. We'll print your name, address and phone number so that other synthesists in your area can contact you to arrange times and meeting places. Once you've established a group be sure to let us know what you're up to so that we can let everyone in on various activities occuring across the country. (In point of fact, our mailing lists are completely confidential and are never sold, leased or loaned to any other organization - though we may from time to time forward offers that would appear to be of interest to our customers. - J. S.)

DEAR PAIA, Why is your equipment so inexpensive? Budget Minded Customer
Dear Budget;   There are a lot of reasons. Probably the biggest is that it's sold directly to the end user without a middle man taking a big chunk. A typical music store works on what they call a 50% mark-up. To them this means that of the price they receive for a piece of equipment, 50% is gross profit. Normal people would call it a 100% mark up since it doubles the price that a customer pays for the merchandise. This isn't a rip-off. A merchant in a normal in-house sales environment has a lot of over-head cost to contend with. He's got sales personnel to pay, insurance, building costs, interest on loans, taxes and all the other costs that any business has to pay. In many cases he has losses through theft and someone has to pay these - it's sad that it has to be the honest customer but that's the only way the system will work. The point is that you've got a lot of people making money from that one piece of equipment: the manufacturer, the wholesaler, the distributor and so on. With us, only one organization has to show a profit; PAIA Electronics, Inc.
        The second biggest savings is that the equipment is user assembled and in many cases that's a time consuming, though hopefully pleasant, operation.

DEAR PAIA, Last summer a very nice lady named Rhonda helped me get an order re-shipped that had been lost by UPS. When I called to order a new module last week I was informed that she was no longer with you. What's the deal?   a friend
Dear Friend; On October 17th Mrs. Rhonda Fleming our former customer service clerk, gave birth to a 7 lb. 10 oz. son. She's currently at home getting John Michael off to a good start in life but she hopes to rejoin our staff sometime in the future.

Marvin has gone to great pains, in the rest of this book, to explain what specific sections are and are going to be and what they are going to contain. I'm not going to explain anything here and I'm certainly not going to try to predict what (if anything) will appear in this space in future issues. I'm just goint to write about whatever happens to be on my mind at the moment and if that's nothing then the column will be nothing. (It's doing a pretty good job of starting out as nothing already)

By way of introduction, I'm John Simonton and my title is President by virtue of the fact that PAIA started in my garage.

That was a little more than 5 years ago and we're not in a garage anymore, we're in a little over 10,000 sq. ft. situated on about an acre and a quarter of land on the North side of Oklahoma City. In the old days there was just me but now there's me and about 25 to 30 others. We're a pretty decent bunch trying to 1) turn out interesting and useful new products 2) have a good time and 3) make enough money to add to the facilities to enable us to do more of 1) and 2). Sometimes it works that way and sometimes it doesn't.

We do a lot of things here at PAIA, including our own sheet metal work, printed circuit board manufacture, woodworking and case assembly, printing, design, recording of demo's and associated production work, instruction set preparation and associated art, screen printing --- it's a longer list than that but you probably get the idea. Most people that come through the shop are surprised that we do as many different things as we do. It's a hassle being that diversified but there's a reason and the reason is:

"IT'S LESS HASSLE THAN THE ALTERNATIVES"

When you're small and go to a contract manufacturer your requirements must come in a poor second to other larger organizations. If you do it yourself you can assign priorities that are in line with your needs. (as I write this we are trying to find a lost shipment of steel - but we can't do everything). Also, if you do it yourself you can keep the prices of the goodies down because there aren't three or four companies trying to make a profit from (for example) a single switch bracket. There are lots of other reasons too, but there's no need to get too boring.

It's a bigger job than most people would imagine just trying to shake the "garage shop" philosophy and in all honesty there are some areas where we have a way yet to go - but being fair about it, we've come a long way too.

So, that's where we were and are. Now where are we going? As I write this, our biggest current problem is shipping. Bob Pierce, who was running our shipping department, has left to begin a venture of his own and while we certainly wish him well it has left something of a gap in getting the kits and things out of the back door. The solution (our current red-hot project) is in programming our data processing gear to take over the management of shipping. So far, so good. When this operating system finally runs - which it should be by the time you read this - it should increase the efficiency of our shipping department by conservatively 200%. Isn't that fascinating?

You don't really want to know about that. You want to know what we're doing to give you neat new stuff to work (play) with. The most immediate things are the 4720 VCO and 4730 VCF. We've been promising them to you for over a year now and we haven't been sloughing off - we've been working on them that long. We believe that these two new modules will be for sale

around the first of December - preliminary specs appear in another section of this book. At the same time the vinyl covered road cases will be ready and we will begin offering complete 4700 series synthesizer packages. There's no need to go into hysterics or get too carried away but I will say that this is really nice stuff and we'll match it with anybody elses equipment no matter what the price.

Long term, there are some awfully exciting things going on. Our Fairchild F8 Micro-processor evaluation unit came in a short time ago and I expect that within the next 6 to 9 months we'll have some synthesis equipment that is digitally based probably using this processor. Don't look for any PAIA computers - we're not going to get into that game but certainly you will see some kits that have a processor doing some specific something that only a processor can reasonably do.

If you're into digital electronics in a big way you can expect to see some PAIA things to go along with your computer - some really far out (and useful) peripherals. I don't want to go into this too much but you'll like them.

— John S. Simonton, Jr., President, PAIA Electronics, Inc.

NEXT ISSUE:
The Design of an analog output, Polytonic digital keyboard!

Special Notice

Over the last year and a half we've accumulated about 25 assembled 2720-2's. Some of these came from our own demo studio, some were linearity rejects from customers. They all oscillate over the originally specified frequency range but that's all they're guaranteed to do. We'll sell one or all on a first come first serve basis for $7.50 each. For the most part these oscillators are non-linear but they are still useful for sweeping oscillator effects, local oscillator inputs to balanced modulators, etc. Order these oscillators directly from:

PAIA Electronics, Inc.
Attention: Tech Services
1020 W. Wilshire Blvd.
Oklahoma City, OK 73116

THE ROAD CASES ARE READY!   See page 13

PAiA POLYPHONY
P. O. Box 14359
Oklahoma City, OK 73114

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