Build a Quad Sequential Switch by Tim Fluharty

Electronic switches have great potential for control elements, once you create support circuitry that can control them in sophisticated ways. This module, designed for compatibility with PAiA equipment, closes four electronic switches sequentially in response to trigger inputs. This may not sound too earth-shattering, but read on - there are many uses for this deceptively simple module.

ABOUT THE CIRCUIT. The heart of this circuit is a 4017 CMOS decade counter (see figure 1a for pinout), which is an extremely useful chip for electronic music applications. At any given time, only one of its ten outputs (numbered 0 - 9) is in a logical 1, or "high", state. Sending clock pulses to the trigger input steps this logical 1 through each stage, one stage at a time. Refering to figure 1b, the first trigger makes output 0 go high (all other outputs are low). The next trigger turns on output 1, the next trigger turns on output 2, and so on until output 9. At that point, the sequence starts all over again. Returning different outputs allows for counting different numbers of events.

DESIGN NOTES. Refering to figure 2, IC2 and IC3 are CMOS parts running off a split (bipolar) supply. Since CMOS parts can't accept more than a 15V supply, zener diodes D1 and D2, along with resistors R1 and R2, drop the ± 9V supply to ± 6V. IC1 is a 748 or equivalent op amp, configured as a Schmitt trigger. This converts standard 0 to +5V triggers to the ± 5V level required by IC2's trigger input.

IC2 is turned into a 4 stage counter by connecting pin 10 (output 4) back to the RESET input. Each of the four counter outputs drives one 4066 electronic switch control input (IC3 contains four such switches), as well as four LED drivers that show which switch is closed at any given moment.

CONSTRUCTION. The quad switch is just the right size for a double-width module. This is a

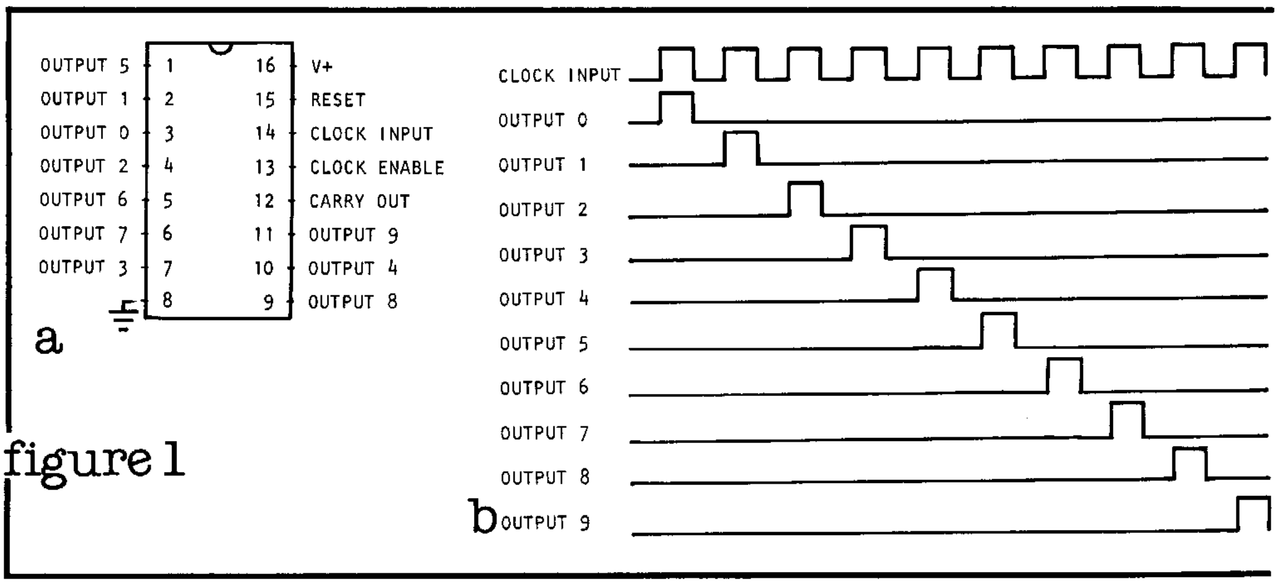


figure 1

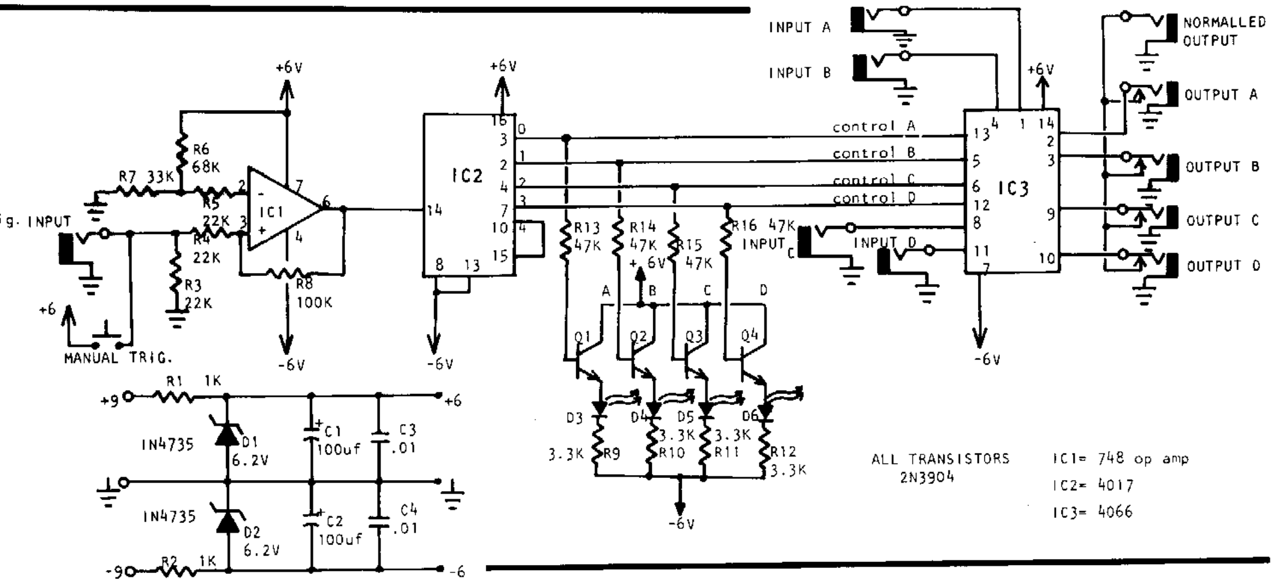
In addition to the inputs and outputs, there are CLOCK ENABLE, CARRY OUT, and RESET pins. With the clock enable pin low (grounded), the counter will advance with each positive going clock edge. Taking clock enable high (connected to V+) inhibits the counter, so that even if you feed in trigger pulses the outputs don't change.

The carry out pin doesn't concern us, since its function is to signal other circuitry that the counter has counted ten clock pulses.

My favorite feature of the 4017 is the reset pin - taking this pin high resets the counter so that output 0 is high and all other outputs are low. Therefore, by returning a particular output to the RESET input, we can create any counting sequence from two to nine events long. For example, by returning output 4 to the RESET input, the 4017 will count normally from 0 to 3. However, the instant that output 4 goes high, it resets the counter so that we're back to output 0 non-critical circuit; I built my prototype of perf board, with a smaller piece of perf board supporting the LEDs. Each LED inserts in a rubber grommet mounted in the front panel. Use sockets for all ICs.

I used mini phone jacks for the inputs and outputs, with closed circuit jacks on the four outputs. The shorting connections of each output jack buss together, with the buss terminating at the "normalled output" jack. This is very useful for multiplexing-type applications, where you can switch the 4 inputs into a common output. Note also that this circuit is bidirectional, so a signal plugged into the normalled output jack may be distributed sequentially to the 4 input jacks, which when used in this fashion become output jacks.

In PAiA synthesizers, audio and control voltage signals use different connectors. However, this module is equally suited to either audio or control voltage processing. In my system the fine line



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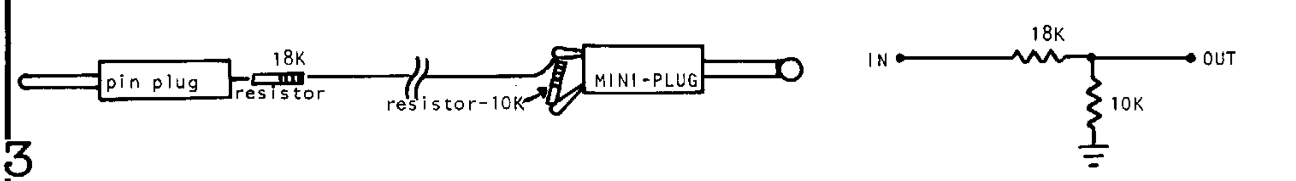
between audio and control was erased years ago, so I suggest that you do as I do and have a number of adapter cords lying around.

There is a problem, though, in switching the gate pulses that come out of the PAiA 4780 sequencer, since this is the only module in the PAiA line that has a non-standard voltage output (typically +13 to +15 Volts). This is higher than the maximum allowable input of IC3, which is +6 V. I solved this problem by making some attenuating patch cords (see figure 3). These lower the gate voltage to a nice, safe level for IC3. If you do use these special purpose patch cords,

signals with an audio frequency trigger pulse creates amplitude modulation "klang" textures.

2. PRESET PROGRAM BOX. This application involves the use of the manual trigger button. By setting up four different voices, or a four channel variable in a patch, you could select "preset" voices by stepping manually to the desired switch positions. This same principle can also work with control voltages.

3. AUTOMATIC PROGRAM BOX. By triggering the input from your keyboard trigger instead of the manual trigger button, you can step through each output every time you hit a note. This can provide, for example,



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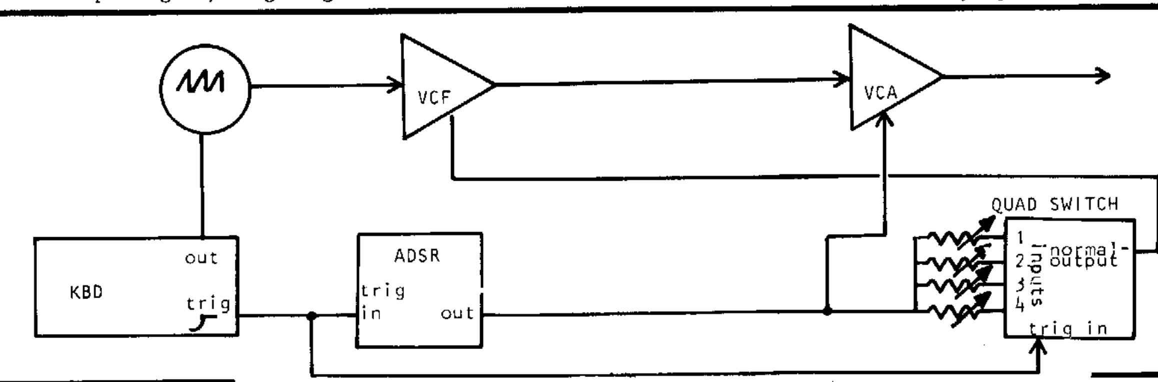
use a different colored wire (bright green, for example) so that they will be easily distinguishable from your normal patch cords.

USING THE CIRCUIT. Here are some examples to get you started in sequenced switching.

1. KLANG SOUND. The frequency response of the circuit is quite good, so gating one or more audio

alternation of four note voices (or four waveforms from an oscillator) as you play on the keyboard.

4. AUTOMATIC ENVELOPE CONTROL VARIATIONS. Figure 4 shows how to provide automatic variations in the envelope level going to a VCF. This creates a more animated and interesting sound than having a constant envelope level at all times. This same technique could switch different amounts of LFO modulation to a VCO for varying vibrato.



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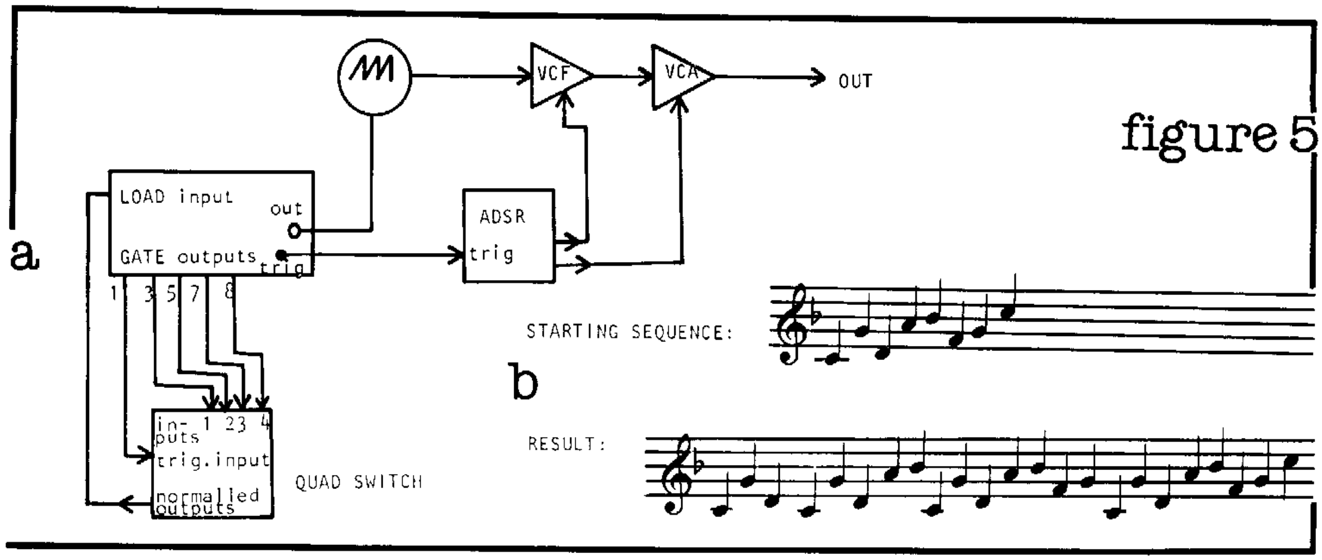

5. EXPANDING THE 4780 SEQUENCER. A sequential switch can greatly expand the possibilities of the 4780 sequencer to "improvise" on a basic sequence. Figure 5b shows a sample sequence, and the resultant 23 note mutation produced by the patch.

Putting the switches in the audio path of a sequencer patch also presents interesting possibilities. Figure 6a shows one possible patch, while figure 6b shows a starting sequence and the 44 note sequence that results from using these switches. Using two switch modules to combine the technique of the patches in figures 5a and 6a can produce a sequence of 96 or more notes before repeating. Remember, these are only basic patches - using multiple switch modules can produce gigantic sequences. Mark Styles has covered patches of this nature in a previous issue of Polyphony.

FINAL NOTE. If this switch circuit interests you, I strongly suggest that you check out the level-sensitive switch presented in Gary Bannister's Experimenter's Circuits column on bar graph ICs (July/August 1979 Polyphony). I use one in my system, and it has lots of uses. You can split your keyboard up into 10 different voices (if you have that much hardware), create random alterations of predetermined sequences of notes, and obtain timing triggers from absolutely ANY varying control voltage.

Another switch circuit that has been useful to me is a clockable toggle switch. This is basically the same as the circuit in figure 2, except that output 2 of 4017 connects back to the RESET pin, essentially turning the circuit into a "two channel sequential switch".

By themselves, switching devices may not appear all that useful. But using them intelligently as information routing devices in a patch multiplies your control possibilities. I hope that you will give this circuit a try, as it offers much ground for experimentation at little cost. *f*

References

Mark Styles; The Synthesizer as a Medium; Polyphony Sept/Oct 1979

Ken Perrin; Aries 300 system owner's manual; Sequencer/Switches supplement

Gary Bannister; Experimenter's Circuits: Bar Graph ICs; Polyphony July/Aug 1979