ASK R-E

FLASHING LED's

I've been trying to build a sequential LED flasher using 4017's, but I haven't had much luck. Could you show me how to cascade two more of those devices? Any help would be appreciated.—K. Gordon Knoxville, TN.

The CMOS 4017 is a one-of-ten decoder that's a perfect choice any time you want to build something using sequencing logic. If you only need ten outputs, all you have to do to use the IC is pay attention to the pins, plug in the peripherals, and power up the part. Things get a bit more complicated when you want to increase the count beyond ten because the 4017 wasn't designed with that application in mind. That doesn't mean that you *can't* do it. It just means you have to think about *how* to do it.

There are two ways to cascade the 4017. You can use them as decade counters (the job they were intended for), or you can have them do sequential counting (a job they weren't intended for). For decade counting, all you have to do is use the CARRY output (pin 12) of one 4017 as the clock input of the following 4017—that's what CARRY is designed for. A simple implementation of that is shown in Fig. 1, and the same idea can be used to extend the count as far as you need. The first 4017 counts the units, the second the tens, the third the hundreds...but I think you get the idea.

Sequential counting with the 4017 is completely different and it's complicated by the fact that there's no way to turn off all the outputs. The basic idea is to drive all the
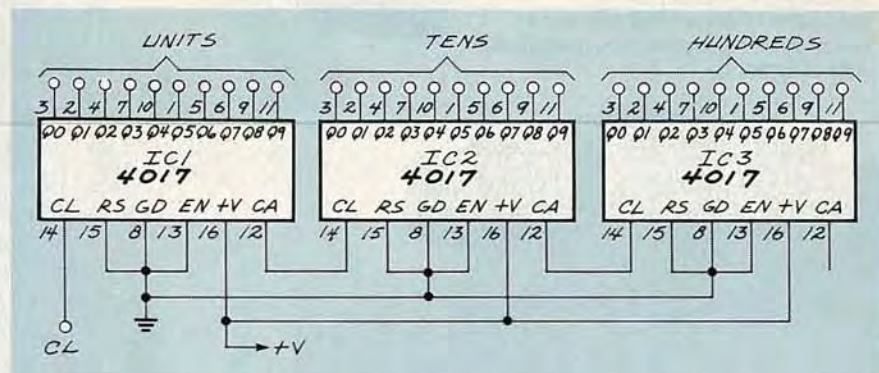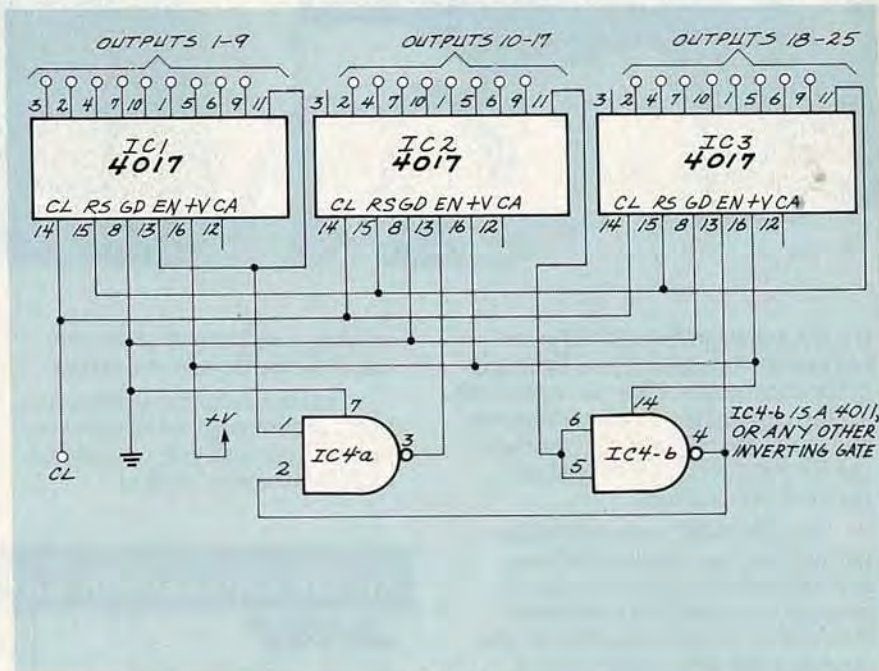

FIG. 1

FIG. 2

4017's with a common clock and then have their outputs go high one after the other. In the ideal circuit, the first 4017 would respond to the first ten clock pulses, the second would handle the second ten, and so on. The seventeenth clock pulse, for example, would light the seventh LED on the second 4017.

The only two control pins on the 4017 are RESET and ENABLE, and even though they're the major players in designing the circuit, you can't

get around the fact that no amount of logical glue is going to turn *off* all of the 4017 outputs. The only way to make that happen is to cut the power to the IC. That isn't as silly as it sounds, because the 4017, being a CMOS part, draws so little power that its +V input (pin 16) can be driven by a transistor. The transistor switch, in turn, can be toggled by the logic controlling the 4017's.

A simpler way to handle the problem is shown in Fig. 2. Three 4017's are used to provide 25 sequential outputs. There isn't room here to go through all the logic but you should draw up a truth table on your own to make sure that you understand how it works. Notice that the lack of a way to turn off the LED's has caused the loss of one output on the first 4017 and two outputs on the others.

If you use that circuit, be sure to pulse the RESET line when you power up, because the 4017 usually has an illegal (and silly) state at its outputs when you first turn it on. If you want to work out some way to use all the outputs, try the transistor-switch approach I mentioned earlier.

TOUCH SWITCH

I'm building a touch switch and I need a way to build a bistable using two op-amps in an LM324. Have you got a simple circuit that I can use?—A. Askey, St. College, PA

Just so that we all know what we're talking about here, I'm assuming that when you say "bistable" you mean an RS flip-flop. If that's the case, the easiest way to do the job would be to use a digital flip-flop and be done with it. The circuit would be a lot simpler, much more immune to noise, and you'd be using an IC that's specifically designed with that in mind.

But I suspect that you're using half of the 324 for the touch-switch oscillator and you want to keep the parts-count down by using the rest of the IC for the flip-flop. If that's the case you're on the right track, since minimizing the parts count is a good thing. If, on the other hand, that's the only job you want to do with the 324, it makes a lot more sense to use a TTL or CMOS flip-flop—believe it.
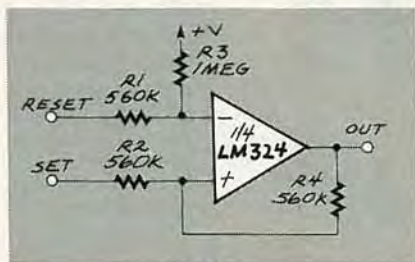

FIG. 3

Now that we understand each other, the answer is: Yes, it's not hard to build an astable around a 324. You may have two op-amps available in the IC, but if you take a look at Fig. 3, you'll see that you only need one to get the job done. A high pulse on the set input will drive the output high and it will stay that way because the resistor in the feedback loop, R4, causes the op-amp to latch up. If you put a positive pulse on the reset input, the output will drop very close to ground. How close to ground depends on the characteristics of the particular op-amp, but it will easily be within a couple of millivolts of ground level.   **R-E**