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Strobing Displays is Cool

Well, I'd managed to build my own home brew frequency meter, mostly from the K5DUS article in the March, 1973 issue of *73*, only to discover that the most lightly covered subject, the regulated power supply, was insufficient to power *my* version of the instrument. I not only had ac hum on the Vcc line, but I had little samples of everything that was going on inside the timing circuits also appearing on the +5 volt "regulated" Vcc line. As everybody knows (but doesn't take into account), transistor devices are current eating little monsters and must be fed properly or else! Something in there was using up mils like mad.

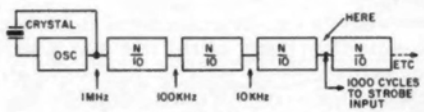

Fig. 1. All n/10 = 7490.

I checked the Vcc line with my voltmeter and sure enough, the regulated Vcc lines were down to about 4.6 volts and "hairy," even though I had split up the loads between two LM309 IC voltage regulators (which should each have handled a full Amp). In fact, the LMs were so hot you could fry eggs on the heat sink. The thing was drawing upwards of three Amps and the LEDs were doing the worst drawing.

Having recently been involved in trying to solve a problem with an IC digital clock, I remembered the unique way that the clock displays were strobed to decode the numerals into only seven lines. Strobing is just another way of saying that the power was being applied to first one segment and then another, so fast that the eye couldn't detect the flicker. This also resulted in power being applied to only one segment at a time, and the power supply was never "seeing" more than about a 20 mA load at any time. Wonderful!

Before I could work it all out (I'm a slow thinker), W5NPD's article appeared in the July, 1975 *Ham Radio* about multiplexing (strobing) LED surplus calculator displays for ham use. These multi-digit, one piece LED displays are out of those little hand held calculators which have become so plentiful and are absolutely useless unless they *are* strobed.

Anyway, this saved me a lot of trouble trying to design something new. I would strobe the display anodes and reduce the amount of power they used to about a sixth and still have adequate brightness. It would also save me from re-engineering the whole power supply, which I had neatly tucked into the leftover space at the back of the cabinet.

We start with 1000 Hz borrowed from the timing chain. If you are using a 1 MHz crystal for your standard, the takeoff point would be at the output of the third 7490 IC from the 1 MHz oscillator. See Fig. 1. From this point the 1 kHz goes into the strobe circuit and into the 7492 divide-by-twelve countdown IC. In W5NPD's schematic he used a 7490 divide-by-ten IC, which gives a scan frequency of 100 Hz, but I figured that by going to the 7492 I would get about 83.3 Hz scan (which gives a longer duty cycle with consequent brighter display). The binary output of the 7492 is then presented to a 7441 IC, which converts it to a one-in-ten output. The 7441 was designed to drive numeral elements in a Nixie tube by grounding whichever element it wanted to light up. Very nice! Since the IC couldn't handle the current being used by the LED displays, we use a cheap pass transistor to do the dirty work. All that is needed is a 5600 Ohm "pull up" resistor on each of the ten output leads and a 470 Ohm resistor to limit base current. Ha! Now we're getting somewhere! See Fig. 2.

In order to get the highest brightness to the displays, I hooked the pass transistor Vcc line to the power supply right where the rectified dc goes into the first filter capacitor. There's a high 120 Hz ripple there (as might be expected), but there are also about 8 volts pulsating dc (and the LEDs aren't bothered a bit by that).

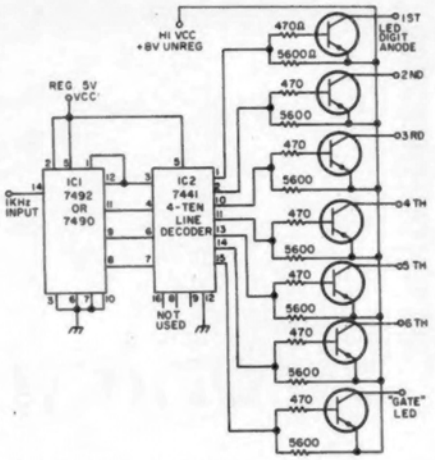

Fig. 2. All transistors are 2N3904 PNP. All resistors are ¼ Watt.

I built the strobe circuitry on a plug-in card and eased it into a spare slot which I had provided to cover Murphy's Law on homebuilt equipment.

I then removed the jumper wire which connected all the display anodes and brought a wire from each anode in turn to one of the pass transistor leads. I included a separate wire for the little LED that shows the gate is "open". This used up seven of the possible ten outputs and left three "spares" in case something else turned up.

Back into the socket went the old line cord and again I checked the Vcc lines. This time the Vcc lines were pure. I was getting a good solid 5 volts on each of the VRs and the strobe circuitry was drawing only about 90 mils. The power supply assembly fit nicely back into the rear of the case with the heat sink only mildly warm to the touch.

At 83.3 Hz/sec the display appears solidly lit to the eye and the count is not a bit affected by what is being used to power the displays.

I've since wondered whether I couldn't have put the whole thing, more or less, on a synchronized strobe and reduced the power consumption even more, but that would mean more brain work – and everybody knows that hams like to do things the easy way. Any ideas, anyone?

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