

SIMPLE FREQUENCY DOUBLER

I recently got involved in a project that required a frequency doubler without a lower frequency limit and was unable to locate one in any reference books or magazine articles. Left to my own ingenuity, Fig. 1 is a design that I came up with. It works quite well, and I thought that it might be of some use to your readers.

The circuit is really quite simple. The 74LS393 (dual counter) is used to keep down the parts count, but any counter with a reset input should work equally well. The 74LS393 is designed to advance one count on the positive to negative transition of the pulse at the clock input (pins 1 and 13). An inverter in front of the B section of the counter causes the B section to advance one count on the negative to positive transition of the input pulse.

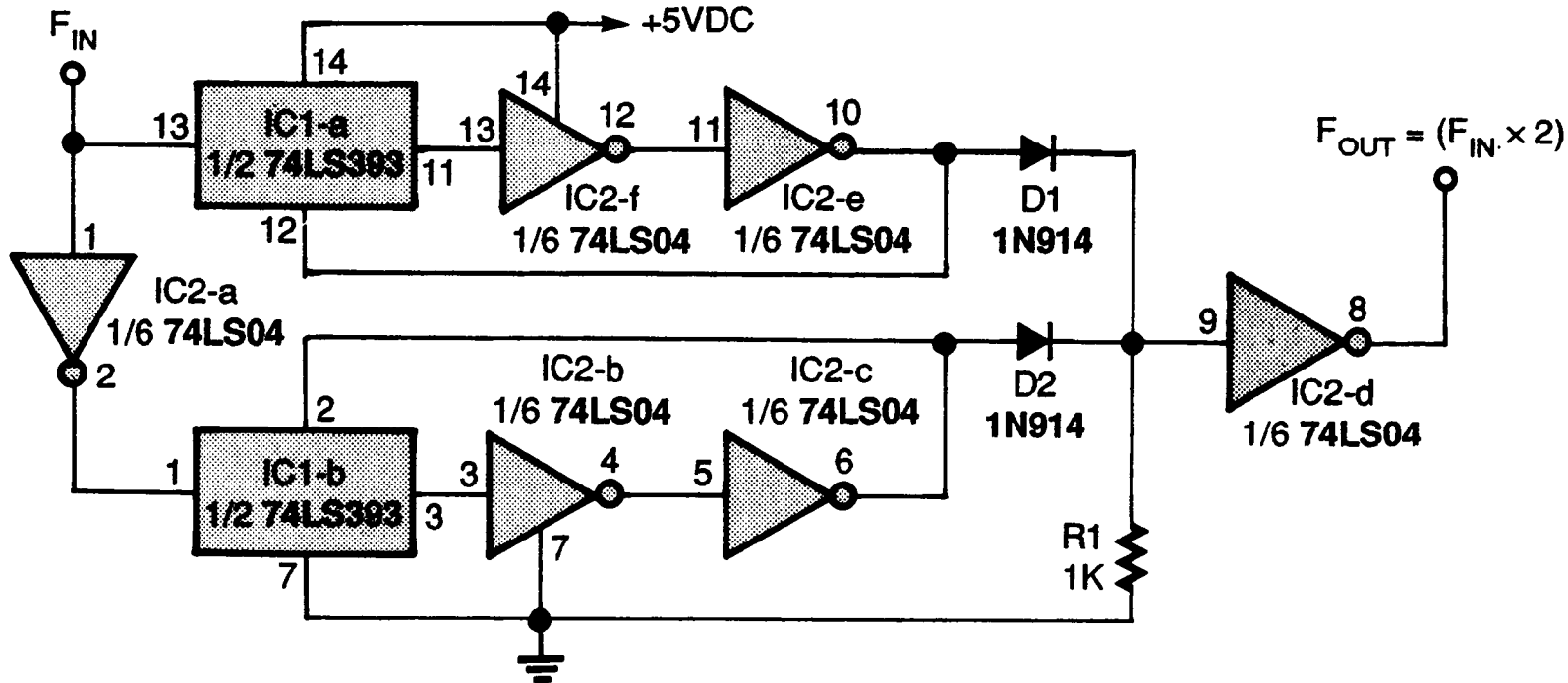


FIG. 1—A SIMPLE FREQUENCY DOUBLER. IC1 is a 74LS393 dual counter; IC2 is a 74LS04 hex inverter.

Each section of the counter is cleared with a positive-going pulse on the master reset input (pins 2 and **12**). By connecting the QO output of each counter (pins 3 and **11**) to its respective master clear pin, through two inverter sections, we end up with positive-going output pulses from pins 6 and **10 of IC2, which resets the** respective counters.

The duration of the pulses depends upon the propagation delay of the inverters. With the 74LS04 hex inverter, that delay will probably be in the vicinity of 20 to 25 nanoseconds. The output pulses are also connected to the remaining inverter gate through switching diodes and a pull-down resistor, which configures the

remaining inverter as a NOR gate. The output at pin 8 of IC2 represents the input frequency multiplied by two.

Because the output pulse lengths are about 2.5 nanoseconds, they are difficult to see on the typical hobby oscilloscope. But if you have a logic probe with a pulse mode, you can put in an input frequency of just a few hertz and see it quite well. If you would like to experiment, you can connect the output of the doubler to a divide-by-two circuit. That will allow you to confirm that the circuit is working because the frequency at the output of the divide-by-two circuit will be the same as the input frequency to the frequency doubler. If you have a dual-trace scope to connect to those two points, you will notice that the waveforms are identical. Keep in mind that the only way to get evenly spaced output pulses from the doubler is to feed it with a 50% duty-cycle squarewave.

There you have it. I hope others can find a good use for this circuit. Keep up the good work. I always look forward to the next issue of **Electronics Now.**

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