Design Project: Stepper motor driver

Your project is to design and build a stepper motor drive circuit based on a shift register. The basic principle will be to use a shift register to load the binary number `0001` in parallel mode once at power-up, then continually shift that number around in serial mode to the beat of a clock pulse signal. The output lines of the shift register will then drive the four respective coils of the stepper motor:

. . . to the stepper motor . . .
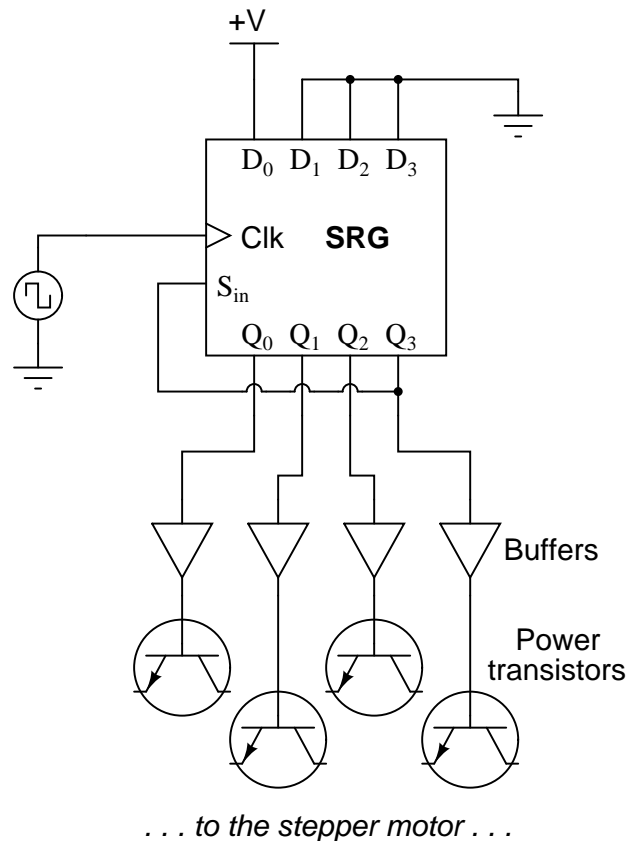
Many details have been omitted from this schematic, but it should be enough to give you the general idea of how a stepper motor can be driven by a shift register IC. For extra challenge, design your circuit to be able to move the stepper motor either direction.

Deadlines (set by instructor):

- Project design completed:
- Components purchased:
- Working prototype:
- Finished system:
- Full documentation:

Question 1

At first it may seem pointless to have the four buffer gates following the shift register output lines, since the power transistors should be able to drive adequate current to the stepper motor windings without any help. However, the buffers are not in place for the benefit of the transistors, but rather for the benefit of the shift register.

If the buffers were not there, and the shift register had to drive 100% of the transistors' base current, there may be a problem with the output lines' logic levels if any other digital device needed to read their "high" states. At minimum, this will be a problem at output line Q_3, which is sensed by the serial data input line of the shift register to recycle the "1" bit (transitioning from binary `1000` to `0001`.

Explain how the buffers help avoid this problem, and formulate a general rule for avoiding this sort of problem in any digital circuit.

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Answer 1

The buffers boost the shift register's output line currents, so that a "high" state at any one of the Q output lines will be nice and strong, rather than weakened by the burden of driving its respective transistor base.

As a general rule, digital circuit outputs used to drive loads need to be buffered if those same output lines also must send digital logic signals to other digital device inputs!

Notes 1

This is a very important design tip, easily overlooked. I have fallen prey to this problem more than once in designing and building digital circuits of my own!