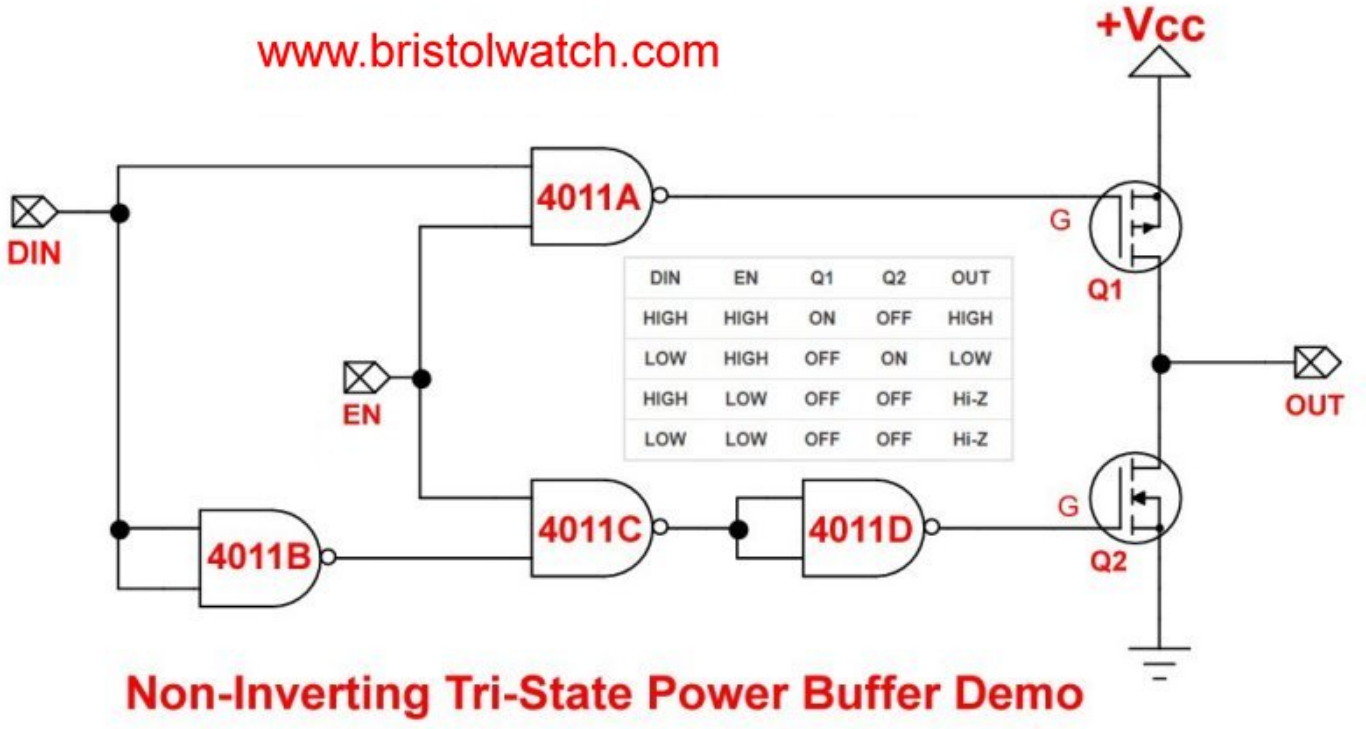

Fig. 1 Tri-state buffer schematic.

Non-Inverting Tri-State Buffer-Switch Demo Circuit

by **Lewis Loflin**

This page demonstrates using a single integrated circuit with 2 MOSFET output transistors.

To better understand the operations of this circuit as far as MOSFET output see **High Current Tri-State MOSFET Driver Circuit**. This was not a tri-state circuit with the output either HIGH-LOW.

This has three output levels: HIGH (Vcc), LOW (GND), and Hi-Z.

The ultimate goal is the H-Bridge shown as **hb_big2.jpg**

Also, the **original tri-state circuit** required three separate integrated circuits. This uses a single integrated circuit to do the same thing.

Fig. 1 illustrates using a single CD4011 integrated circuit with quad (4), 2-input NAND gates. A CD4011 operates from 3-15 volts.

CD4011B and CD4011D operate is inverters - HIGH in = LOW out and vice-versa.

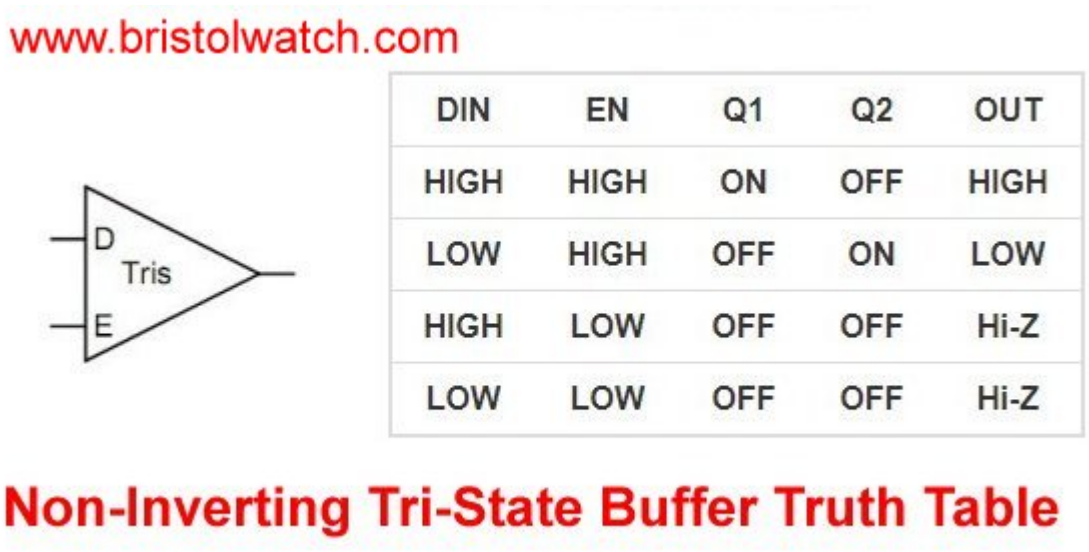

Fig. 2 Tri-state MOSFET output buffer truth table.

Fig. 2 is the truth table for the circuit in Fig. 1. What is not shown in Fig. 1 is the voltage connections for the CD4011 and +Vcc.

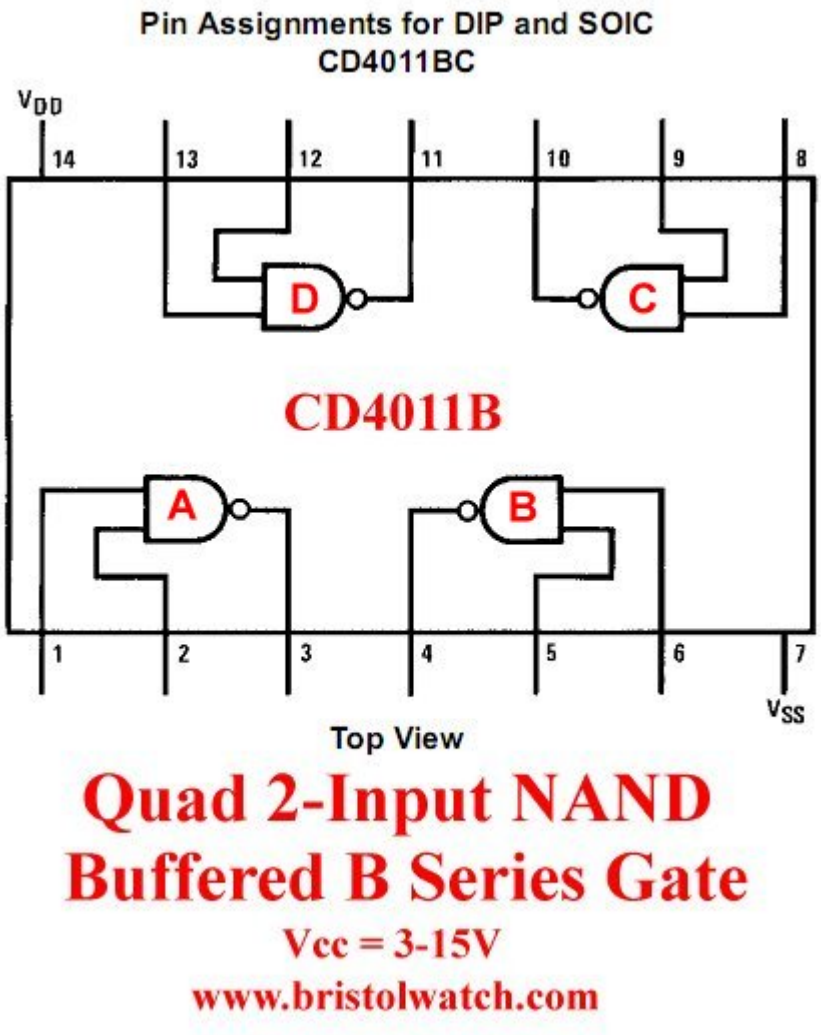

Fig. 3 CD4011 Pin Connections

If this circuit is connected to 5-volts then direct connection to a microcontroller such as PICAXE, Arduino, and PIC are simple direct connections.

When the gate to Q1 LOW, Q1 will turn on. When the gate of Q2 is HIGH, Q2 will turn on.

Both Q1 and Q2 must never be turned on at the same time!

If we use a 12-volt motor, etc. then the CD4011 voltage must also be 12-volts. The problem is direct connection to a 5-volt microcontroller won't work.

That requires a separate interface circuit. Q2 can remain as it is, it's the Q1 circuit that is the problem. I'll assume a 5-volt supply for the digital circuits.

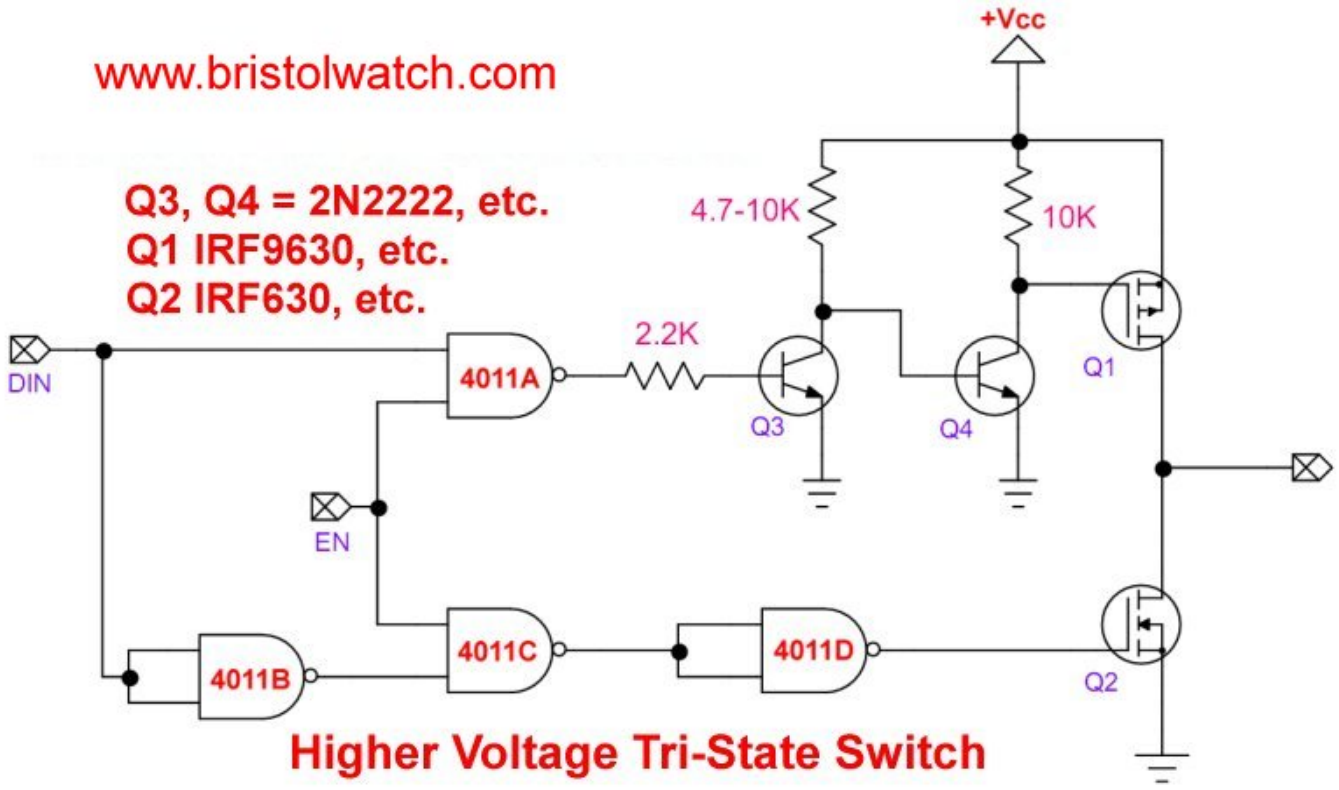

Fig. 4 Tri-State switch with NPN transistors for higher voltage output.

Fig. 3 illustrates the use of 2 NPN bipolar transistors and 3 resistors for higher voltage output. Remember +Vcc is NOT the 5-volt supply for the digital circuit. This is the output voltage that can't exceed Vgs of the P-channel MOSFET.

The truth is identical to Fig. 2.

For more on power MOSFET switches see the following:

- **N-Channel Power MOSFET Switching Tutorial**
- **P-Channel Power MOSFET Switch Tutorial**

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- H-Bridge Schematic with Darlington-MOSFET Transistor Outputs
- H-Bridge schematic with Darlington-IGBT Transistor Outputs
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