Single bipolar transistor inverts pulses on command

By Dale Hileman
Sphygmetrics Inc., Woodland Hills, Calif.

An ordinary bipolar transistor can be made to function as a command inverter—that is, it will pass a pulse signal without modifying the pulse, but it can invert the signal upon command. The command is a simple reversal of the polarity of the supply voltage.

To do this usually requires several gates, involving perhaps dozens of parts and interconnections. The command inverter shown here, however, requires only three parts: a single bipolar transistor and two ordinary resistors.

The key to this circuit's operation is that the role of a transistor's emitter and collector can be interchanged if the supply polarity is reversed. When the polarity of the invert control signal is normal, the transistor operates as an emitter-follower, so that the polarity of the output
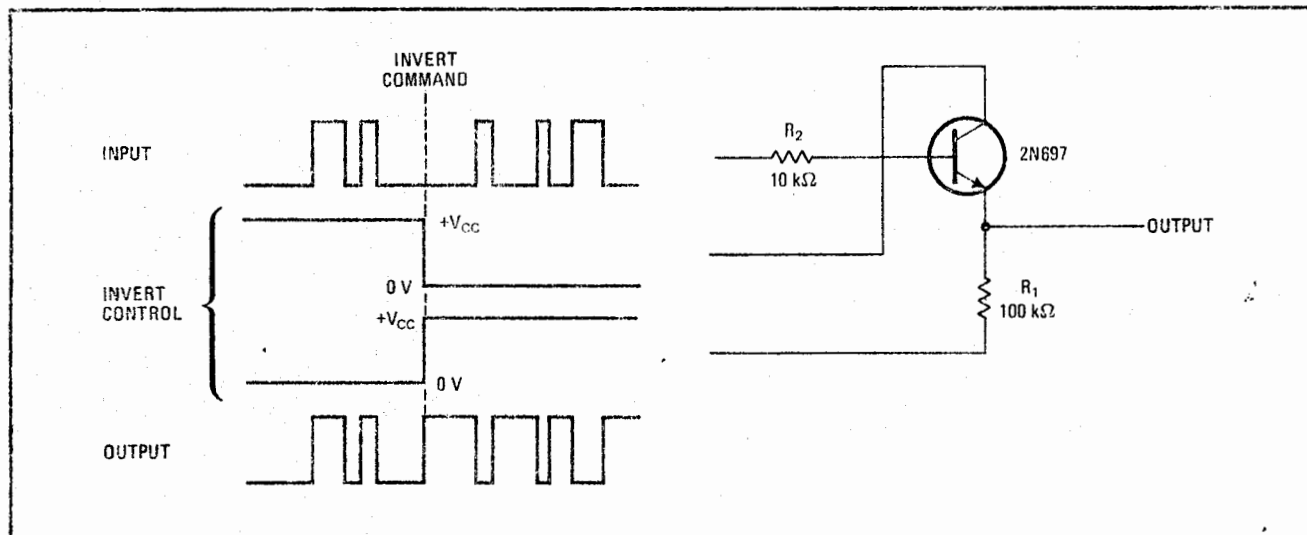
Command inverter. With normal supply polarity, this bipolar transistor operates as an emitter-follower, passing the input pulse train to the output without modifying it. But when the supply polarity is reversed, the transistor's emitter acts as its collector, and the transistor's collector acts as its emitter. Now the polarity of the input pulse train will be inverted at the transistor's output.

pulse train is the same as the polarity of the input pulse train.

The invert command reverses the polarity of the supply voltage, making the transistor's collector act as an emitter and its emitter act as a collector. Now the circuit becomes an inverting amplifier, with resistor R_1 serving as the collector load resistor. Under this condition, resistor R_2 simply limits the transistor base current to a safe value.

Any general-purpose npn or pnp bipolar transistor may be used in the circuit, and the precision of neither resistor R_1 nor resistor R_2 is critical. This command inverter will work with virtually any value of supply voltage and any input pulse level that the transistor will tolerate. □

Here's to fuss-free inversion

A spare inverter gate can be a handy item to have around when you're trying to debug your logic design. But finding one on the board and then having to connect or disconnect it whenever you want to switch between the normal and invert modes can be bothersome. Instead, says Robert A. Dougherty of Dunedin, Fla., **build an easy-to-use inverter from an exclusive-OR gate and a subminiature single-pole double-throw slide switch.**

First, break the line to be inverted, bridging the gap with one input of the gate and its output. Then tie the other gate input to the switch's center contact, ground one outer contact (the normal position), and wire the other outer contact (invert) to the power supply through a resistor.

With the switch in its normal position, the switched gate input is pulled low and the gate's output follows the circuit input. With the switch in the invert position, the switched gate input is high and the output is the complement of the input. If the exclusive-OR gate is the quad 7486 package, then use a 5.1-kΩ power-supply resistor, adds Dougherty.