Comparator-Based Circuits Easily Shift Voltage Level, Flip Polarity

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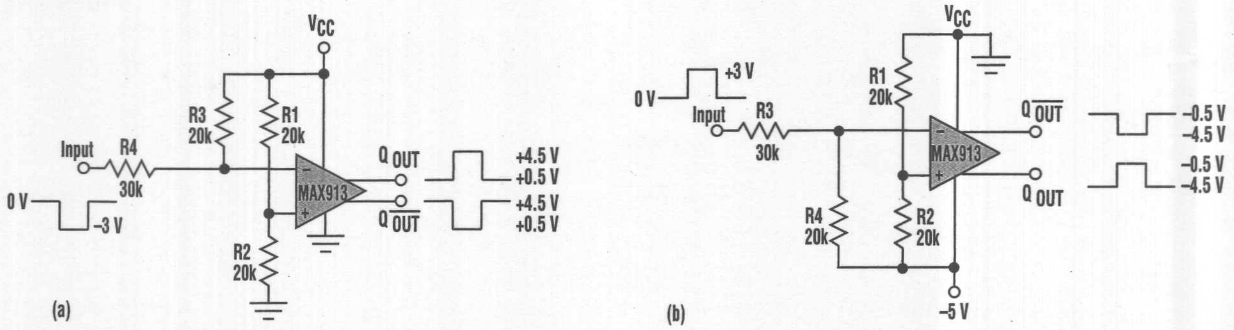


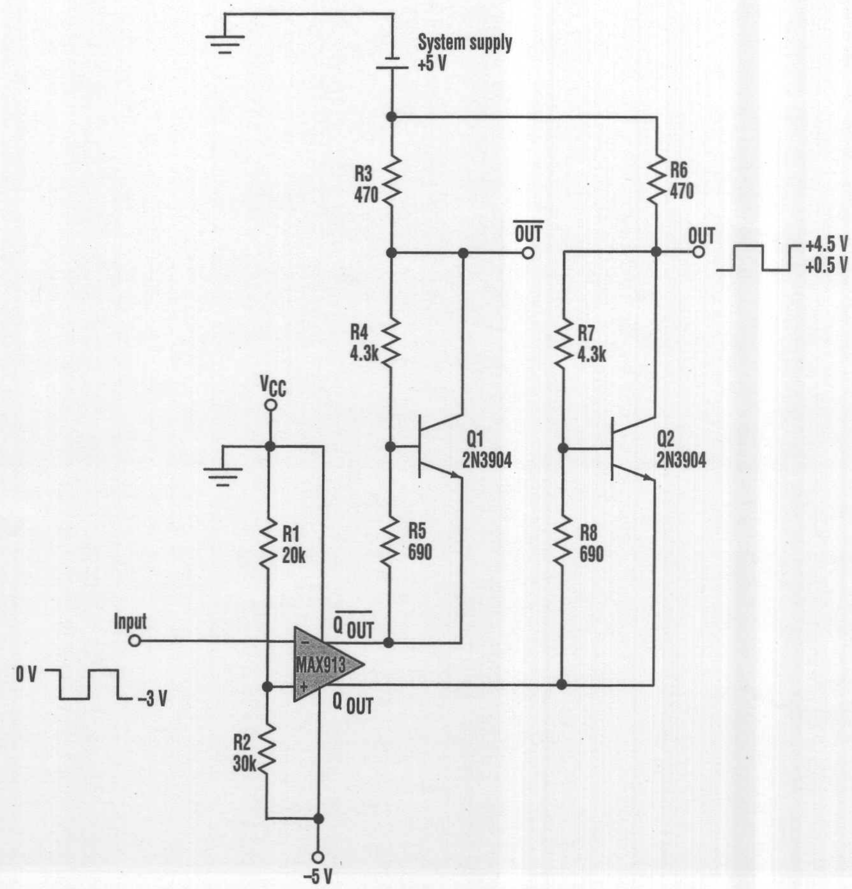
1. Operating from a positive supply, the circuit in (a) takes in negative input pulses and puts out complementary bipolar outputs. The circuit in (b) does just the opposite: It works off a negative supply and accepts positive input pulses to produce its complementary bipolar outputs.

Because digital systems often have only a single-polarity power supply, a common problem becomes translating an opposite-polarity pulse train into a positive- or negative-pulse output. Here are some simple circuits that can do the job easily and reliably.

For positive-supply systems, the circuit of Figure 1a transforms a negative pulse train into positive-going output pulses. The dual-output comparator provides both in-phase and out-of-phase outputs. (If the system requires only one output phase, you can substitute an alternative single-output comparator.) Voltage at the comparator's inverting input swings between 1.8 and 3.0 V. Also, making R1 = R2 sets the noninverting input voltage to 2.5 V. As configured here, the complementary comparator outputs produce positive pulse trains.

For negative-supply systems, the circuit of Figure 1b (which is very similar to that of Figure 1a) transforms a positive pulse train into negative-going output pulses. Voltage at the comparator's inverting input ranges between −1.8 and −3.0 V, and setting R1 = R2 makes the noninverting input voltage equal to −[illegible] V. In this instance, the complementary comparator outputs generate negative pulse trains.

In the circuits of Figure 2 and Figure 3, the comparator serves as a buffer, there-



2. The circuit here translates negative-going pulses to positive-going ones, while operating with a negative comparator supply and a positive system supply.

by providing an interface configuration for systems whose input signal and system supply voltage are of opposite polarity. The Figure 2 circuit enables a system with positive supply voltage to accept negative pulses. Similarly, the Figure 3 circuit lets a system with negative supply voltage handle positive input signals. Both circuits use npn transistors to level-shift the comparator's outputs by:

$$[V_{BE}(R5 + R4)]/R5 \approx 4.5\ V$$

For single-phase outputs, you can choose a suitable single-output comparator.

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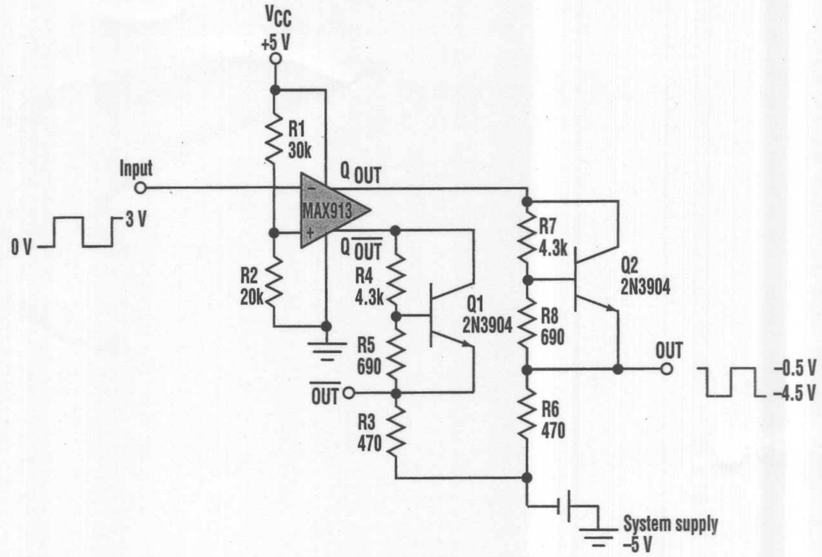

3. This circuit changes positive-going pulses to negative-going ones, while operating with a positive comparator supply and a negative system supply.

PWM-To-RS-232 Translator Boasts Over 11-Bit Accuracy

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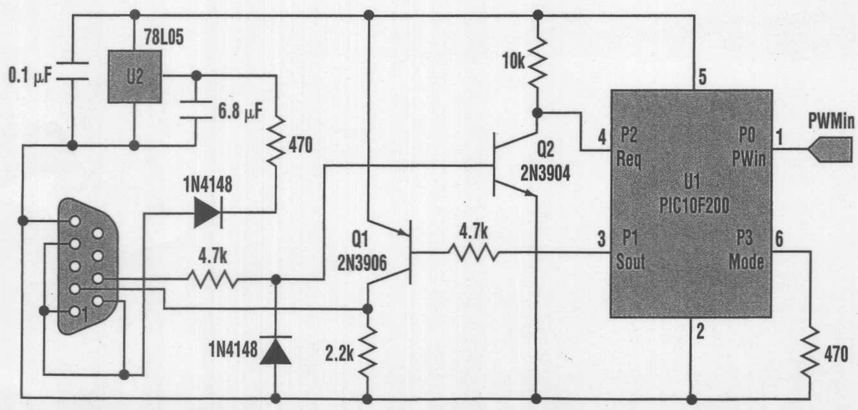
Over the years, many sensor monitor designs would have benefited by being able to have their encoded pulse-width modulation (PWM) data forwarded to and post-processed by a PC-based host. However you encode the PWM information, the PWM-to-RS-232 translator described here has a small footprint and a total cost under a few dollars.

Several relatively small and inexpensive controllers are available (in addition to several techniques) to perform this function. This application uses the Microchip 10F20x-series, four-I/O controller. It was selected because of its predictable execution time and small (SOT23) package. Portable into multiple compatible controller footprints, this translator should give new life to dozens of old ideas and serve as a bridge circuit for new designs. The circuit includes the controller (U1), transistor translators (Q1 and Q2), and the 78L05 regulator (U2) *(Fig. 1)*.

Assembly-language-based processes in the controller equalize the branch paths to constant-length loops. Both high and low input states are evaluated by totalizing the number of these 8-µs loops in each state, using 16-bit "totalized-count" registers. An 8-bit "loop-index" register allows up to 255 periods to be accumulated. When all periods are processed, the totalized-count registers are copied and zeroed, the loop-index register is reloaded, and the request line is qualified.

The request input is asserted as a high to low transition on U1's P2 (pin 4). When the request is asserted, the saved results are scheduled to an RS-232 serial link. As a result, the period between serial updates depends on the number



1. This PWM-to-RS-232 translator, which features a small footprint, costs under a few dollars.

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