

# DESIGN SHOWCASE

## Proximity Detector Features Ultrasonic Transducers

Combining micropower op amps with a pair of matched piezo-ceramic transducers (one optimized for 40kHz transmission and the other for 40kHz reception) yields an ultrasonic proximity detector that operates on a 9V battery (**Figure 1**). The detector employs the radar principle, in which nearby people or objects reflect the transmitter's steady tone back to the receiver.

The transmitting transducer is a resonant circuit that can draw spikes of current from its signal source (in this case, the low-power CMOS timer IC<sub>1</sub>). To prevent damage from these undesirable spikes, the timer is buffered by a push-pull driver composed of Q<sub>1</sub> and Q<sub>2</sub>. You should adjust the potentiometer R<sub>1</sub> for a transmit frequency of 40kHz.

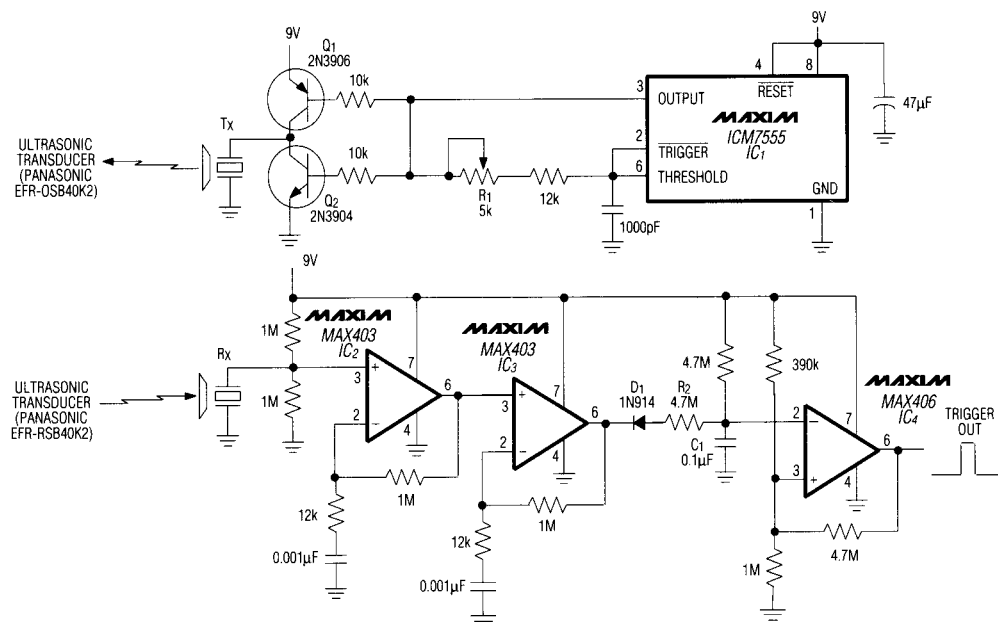
The receiver (bottom circuit) must offer high gain at ultrasonic frequencies while operating from the same 9V battery as the transmitter. Op amps IC<sub>2</sub> and IC<sub>3</sub> provide the necessary wide bandwidth and low supply current (7MHz min at unity gain, and 375µA max). Op

amp IC<sub>4</sub>, offering a rail-to-rail output swing and extremely low quiescent current (1.2µA max when low, 30µA max when high), is also well suited to its role as the output-signal comparator. Supply current for the complete circuit is slightly more than 2mA. (You can halve this consumption by replacing the transistors with a CMOS inverter.)

The receiver is stable with the component values shown. If you change the gain, however, note that you must also adjust the pole/zero locations associated with op amps IC<sub>2</sub> and IC<sub>3</sub> to maintain stability.

In a typical store-display application, the proximity detector triggers a prerecorded video message on the arrival of an interested customer. A pause to look signifies interest; the detector shouldn't respond to someone just walking by. Therefore, the transducer signal is filtered by R<sub>2</sub>C<sub>1</sub> after rectification by D<sub>1</sub>. The filter also prevents false triggering as a response to brief bursts of ambient noise in the ultrasonic range.

(Circle 4)



**Figure 1.** Comprising an independent transmitter and receiver, this battery-powered, ultrasonic proximity detector features two 40kHz piezo-ceramic transducers.