# Microcontroller drives piezoelectric buzzer at high voltage through one pin

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A previous Design Idea demonstrates how you can use a microcontroller to drive a piezoelectric buzzer at a high alternating voltage through a four-MOSFET circuit that interfaces to two of its I/O pins (**Reference 1**). This expanded Design Idea provides a modification of the previous circuit to save one of the I/O pins of the microcontroller. $Q_4$'s gate connects to $Q_2$'s drain rather than a second I/O pin (**Figure 1**). The microcontroller turns on $Q_2$ by applying a high logic level to the I/O pin, pulling Node A down to a low logic level. This action turns on $Q_3$ and turns off $Q_4$. The voltage on Node B becomes 15V, and $Q_1$ turns off. The voltage across the piezoelectric element is now 15V.

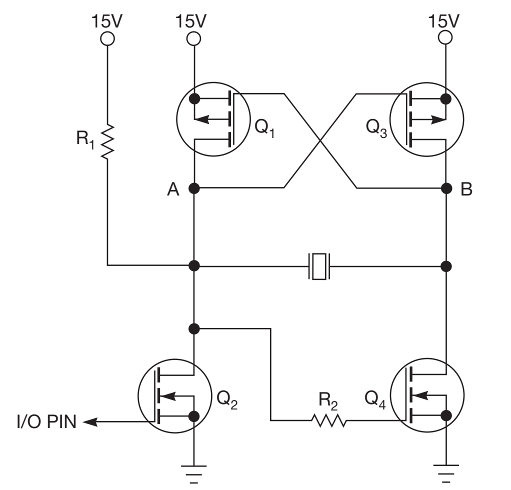


Figure 1 One microprocessor I/O pin drives this circuit to generate an alternating voltage across the piezoelectric buzzer.

The microcontroller then toggles the I/O pin low, turning off $Q_2$. $Q_1$ is also off, so Node A slowly rises to a high logic level through pullup resistor $R_1$. When the voltage on Node A reaches the switching threshold of the inverter comprising the $Q_3$ and $Q_4$ pair, $Q_3$ quickly turns off and $Q_4$ quickly turns on. The consequently low logic level on Node B turns on $Q_1$ and speeds the increase of Node A's voltage. The 15V across the piezoelectric buzzer is now of the opposite polarity.

$R_2$ weakens the coupling between the output and the input of $Q_4$ due to the presence of the piezoelectric element. A value of 330Ω for $R_2$ is usually sufficient to suppress high-frequency oscillations that the feedback causes. The drained power from the supply increases if you use low values for $R_1$. Using excessively large values for $R_1$ also increases power dissipation by prolonging the switching of the transistors and associated shoot-through currents. The optimum value for $R_1$ is approximately 1 kΩ.

Saving an I/O pin with this design involves the trade-off of increased power consumption. The circuit's power consumption is thus one order of magnitude greater than the circuit described in the previous Design Idea. EDN

## REFERENCE

1 Ozbek, Mehmet Efe, "Microcontroller drives piezoelectric buzzer at high voltage," *EDN*, March 1, 2012, pg 44, http://bit.ly/JyzLpz.