High-voltage amplifier uses simplified circuit

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Many scientific instruments and sensors need ac high-voltage drive. High-voltage drive is useful for driving electrodes in many applications. The challenge is to boost the output of a conventional op amp to high voltages. Available ac high-voltage amplifier modules are limited to approximately 1200V p-p. This Design Idea presents a simplified ac high-voltage amplifier that uses complementary, cascaded NMOS and PMOS transistors (**Figure 1**). The OP07 op amp has low input-offset voltage, low input-bias current, and high open-loop gain. These attributes make this op amp useful for high-gain instrumentation applications. In addition, the OP07 features excellent stability of offsets and gain over time and temperature. The ac gain of the LM356 stage, which R_3, R_4, R_7, and R_9 determine, is approximately 100.

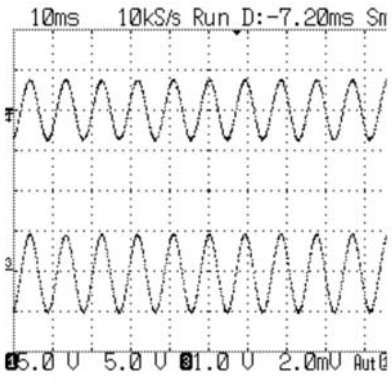

Figure 2 The sinusoidal input is 8V p-p (top trace), and output is 1800V p-p (bottom trace).

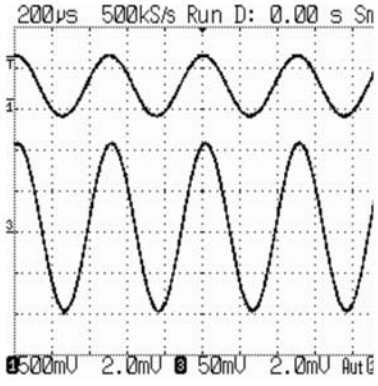

Figure 3 The input is 750 mV (top trace), and the output is 200V p-p (bottom trace).

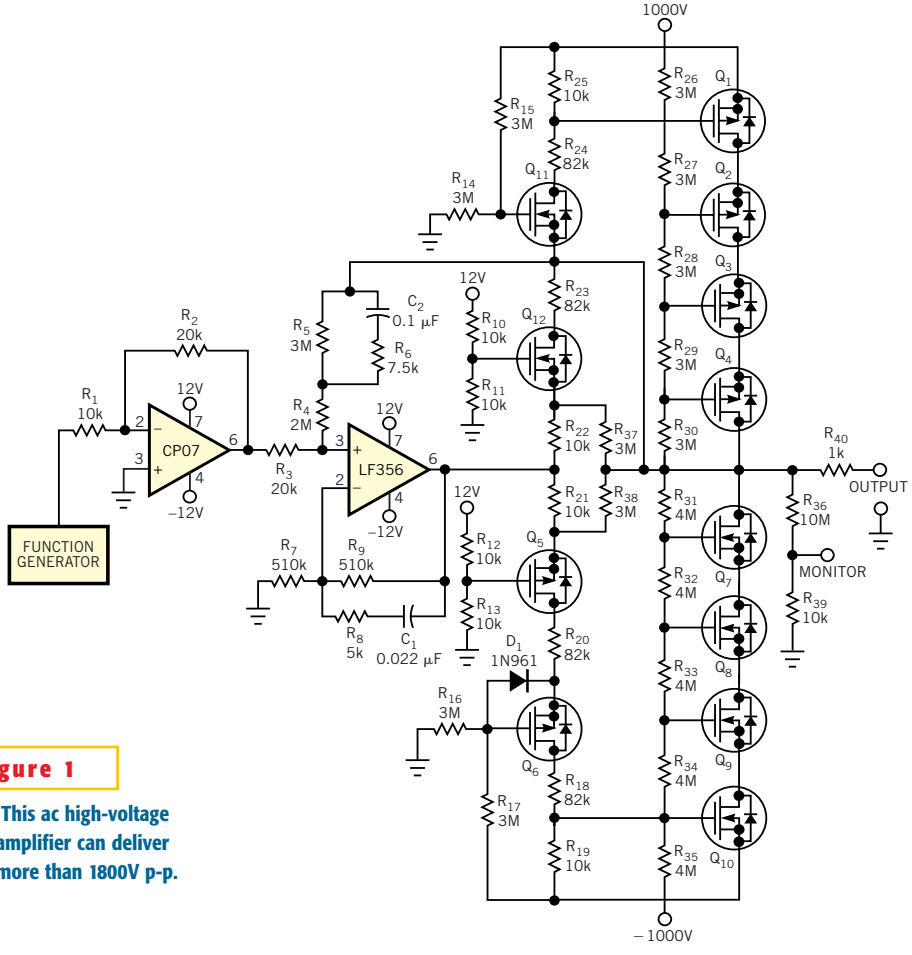

Figure 1 This ac high-voltage amplifier can deliver more than 1800V p-p.

The high-voltage MTP2P50E p-channel MOSFET has maximum drain-to-source- and gate-to-drain-voltage ratings of 500V. The high-voltage BUK456800B n-channel MOSFET has maximum drain-to-source- and gate-to-drain-voltage ratings of 800V. Q_1 through Q_6 are PMOS transistors, and Q_7 through Q_{12} are NMOS devices. These FETs are well-suited for high-voltage cascade circuits. They connect symmetrically in series to increase their overall breakdown voltage for power applications. The bias-voltage circuits comprise separate biasing-resistor pairs R_{10} to R_{13} and R_{14} to R_{17}; the result is a symmetrical output of the high-voltage amplifier. **Figure 2** shows a sinusoidal input of 8V p-p at 100 Hz and an output of 1800V p-p. **Figure 3** shows a sinusoidal input of 750 mV p-p at 2 kHz and an output of 200V p-p. The total power bandwidth of the circuit is approximately 200 kHz.□