

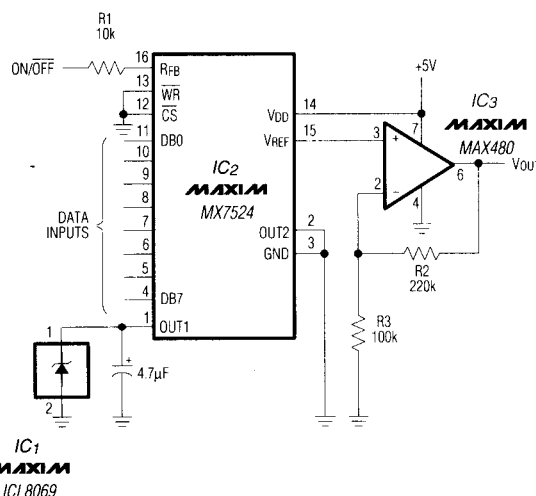
## DESIGN SHOWCASE

### Voltage-Output D/A Converter Offers Low-Power Operation and Shutdown

In Figure 1, the 8-bit D/A converter (IC<sub>2</sub>) consumes only 1mW during normal operation, when the control input ON/OFF is high. During shutdown mode (ON/OFF low) the circuit draws only 10μA of supply current.

The converter operates in the "backward" voltage-output mode: its OUT1 terminal (normally an output) is driven with the 1.23V output of voltage reference IC<sub>1</sub>, producing a digitally scaled voltage output at V<sub>REF</sub> (normally an input). The high-impedance V<sub>REF</sub> signal is then buffered by the noninverting input of op amp IC<sub>3</sub>. R<sub>2</sub> and R<sub>3</sub> determine the output range:  $V_{OUT} = 0V \text{ to } 1.23V(255/256)(1+R_2/R_3)$ . As shown, the range is approximately 0 to 3.920V.

To minimize power consumption, you should take care to drive the D/A converter's digital inputs to the supply rails.



IC<sub>1</sub>  
MAXIM  
ICL8069

Figure 1. This low-power, voltage-output D/A converter draws 200μA when operating (ON/OFF high), and 10μA when shut down (ON/OFF low).

(Circle 9)

### Increase Regulator Input Voltage

By adding a JFET in cascode with a linear regulator, the regulator's input-voltage range can be extended. A MAX666 is suitable for battery-powered applications because its CMOS circuitry draws only 12μA maximum, regardless of the output-current level. However, the chip's V<sub>IN</sub> limit of 16.5V excludes it from certain applications.

Connecting the external JFET to the regulator extends the circuit's input-voltage limit to the JFET's gate-source breakdown voltage. A J106 device, for example, extends the limit to 25V. The J106 has a 6Ω on-resistance, and the regulator has a minimum V<sub>IN</sub>/V<sub>OUT</sub> differential of 0.6 to 0.8V.

For low load currents, combining the two parts supplies a 5V output with chip inputs as low as 5.6V. The circuit can deliver 40mA at 5V with a 6.5V V<sub>IN</sub>.

Replacing the J106 with a 2N4391 JFET increases the allowable input voltage to 40V. The on-resistance of the 2N4391 is 30Ω, so it delivers a current of 40mA with a 2V in/out differential or 10mA with a 1V differential.

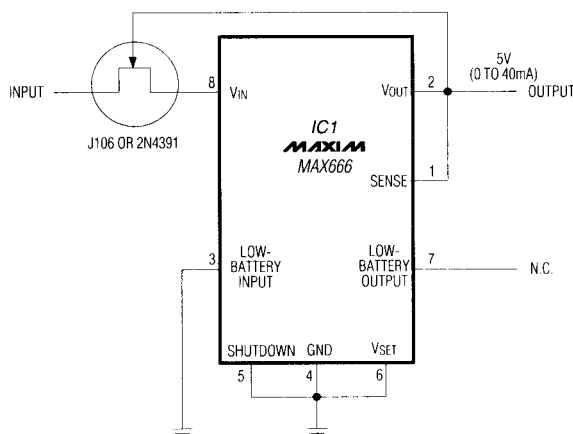


Figure 1. Adding a JFET in cascode with a linear-regulator IC stretches the allowable input voltage to 25 or 40V, depending on the JFET device used.

(Circle 10)