Microphone uses "phantom power"

Bruce Trump, Texas Instruments, Tucson, AZ

The electret microphone capsule is similar to those commonly used in telephones, cassette recorders, and computers. The element functions as a capacitor with a fixed trapped charge. Sound pressure moves a diaphragm, producing variations in the capacitance. This action produces an ac-output voltage with an extremely high source impedance. A FET inside the capsule uses an external-resistor drain load (**Figure 1**). R_1 and R_2 provide an appropriate load impedance and voltage from the 10V supply. The basic performance of this simple capsule is excellent, but it requires further signal processing to conform to professional phantom-powered-microphone standards.

The output of a phantom-powered microphone is a low-impedance differential signal. IC_1 is a simple voltage buffer that provides low-impedance drive for one output. IC_2 is a unity-gain inverter that derives its drive from the output of IC_1. Bias for the noninverting input of IC_2 comes from a heavily filtered output of IC_1. We selected the dual op-amp IC_1/IC_2 for its low noise and low distortion properties. R_6 and R_7 provide immunity from long-line capacitance, RF interference, and transients that occur when you "hot-plug" the microphone into a live phantom-power source. The amplifier outputs use ac coupling, C_2 and C_3, to the microphone's output terminals to block the dc phantom-power voltage on the audio lines. Differential-output voltage capability is limited to approximately 2V p-p because of the limited power supply available to drive the op-amp output currents. This level is adequate, because it corresponds to an extraordinary sound level beyond the linear range of the capsule.

Phantom-powered microphones derive power for their active circuitry from the receiving-end circuit through the same leads that transmit the audio signal. The 48V phantom-power supply couples through two 6.8-kΩ resistors, R_{10} and R_{11}, to both signal lines. This coupling allows the microphone's low output impedance to drive a differential ac signal on the relatively "soft" impedance of the phantom supply voltage. In the microphone, power comes from the signal lines through resistors R_8 and R_9. Zener diode D_1 regulates the voltage. These resistors also provide a soft impedance on the balanced line, allowing the outputs of IC_1 and IC_2 to inject their differential ac-output signal. You can locate the microphone hundreds of feet from the receiving-end phantom power and amplifier and still obtain excellent performance.

The receiving-end amplifier, IC_3, is a low-noise instrumentation amplifier with three internal op amps. Its configuration and laser-trimmed resistors provide excellent CMR (common-mode-rejection) properties. The high CMR rejects noise and power-line hum that appear equally in both signal lines. Low noise (1 nV/$\sqrt{\text{Hz}}$), though unnecessary for high-output microphones such as those described here, is necessary in professional-audio equipment to accommodate the use of low-output ribbon and dynamic microphones. These microphone types are strictly passive electromechanical generators and do not require a power source. Phantom power earns its name from the fact that these microphone types "float" at 48V without harm. The electret capsules are available in various sizes and physical configurations. They include both omnidirectional and directional (cardioid) types. Directional capsules have a vent in the rear; you must mount them with free access to both the front and the back to obtain proper characteristics.

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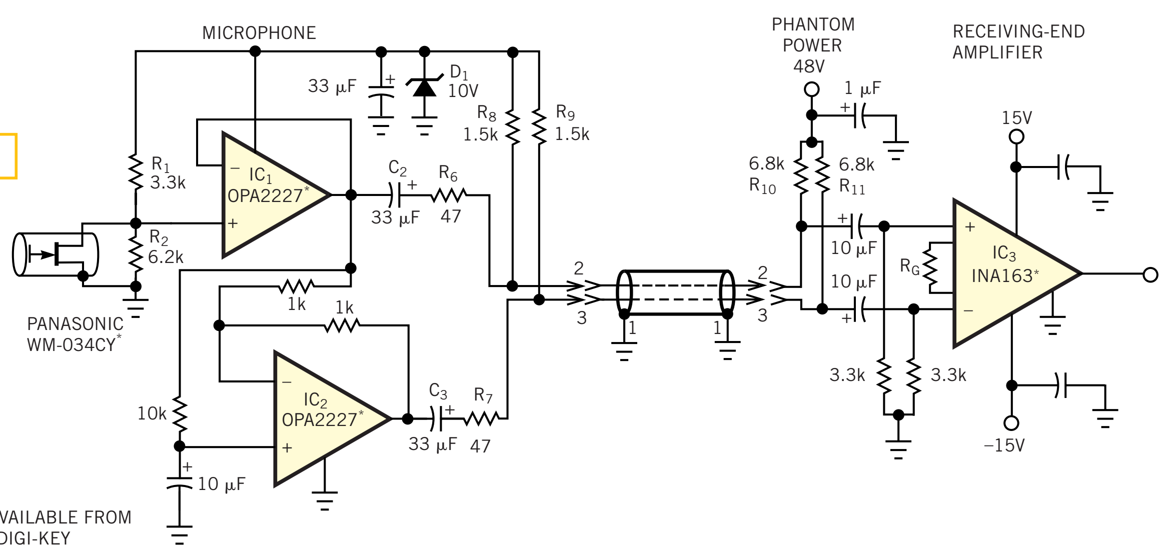
Figure 1



This microphone system derives its power from the receiving-end circuitry through the leads that carry the audio signal.