How one-chip Akustica mic does it

R Colin Johnson - February 27, 2006

The standard way to add a microphone to a digital appliance such as a notebook PC, Bluetooth headset or PDA is through a combination of four components: a miniature electret condenser microphone, a discrete field-effect transistor (FET), a separate operational preamplifier chip and an analog-to-digital converter chip. Akustica's digital-output CMOS microphone chip concentrates all four functions in a single device.

An electret microphone uses a metallic diaphragm with an air gap between it and a fixed metallic backplate, which acts as the plates of a capacitor. The gate of the FET is attached to this capacitor, and as sound waves move the diaphragm, they change the capacitance between the diaphragm and the backplate. This invokes a change in voltage output from the FET that is fed to the external preamplifier, which in turn feeds an analog-to-digital converter.

Akustica's design, too, is based on a metallic diaphragm inducing a change in capacitance, but eliminates the high-impedance input to the FET by directly connecting the diaphragm to an impedance-matched preamplifier that is on the same chip as the diaphragm. Likewise, the A/D converter is also integrated on-chip. Because of the short distance between the diaphragm and the preamplifier, the single-chip MEMS microphone has better isolation from the power supply and output stage as well as being virtually immune to stray RF, electromagnetic and power supply fluctuations. Moreover, its output is digital, making it a perfect fit for digital appliances.

The short trace lengths eliminate antenna effects and make reliable, repeatable impedance matching possible for the on-chip preamp. Also, the diaphragm can be less than 0.5 mm in diameter, compared with 4 to 6 mm for the diaphragm of an electret mic. The MEMS microphone can be surface-mounted, eliminating the need for a mechanical socket to isolate the mic from the high temperatures required to surface-mount components. Pick-and-place equipment can solder down the single-chip microphone along with all the other surface-mounted components.

**Placement anywhere**

And unlike electrets, which need to be on the motherboard of a design or be connected to it by expensive shielded coaxial cables, the Akustica mic can be placed almost anywhere. For instance, the MEMS microphone could be mounted atop a laptop PC's display bezel, with its digital output just adding a single line to the ribbon cable that already attaches the display to the motherboard. Placing the mic there not only isolates it from the mechanical noise of the spinning disk drive, but also puts it closer to the user's mouth.