MEMS-Based Systems

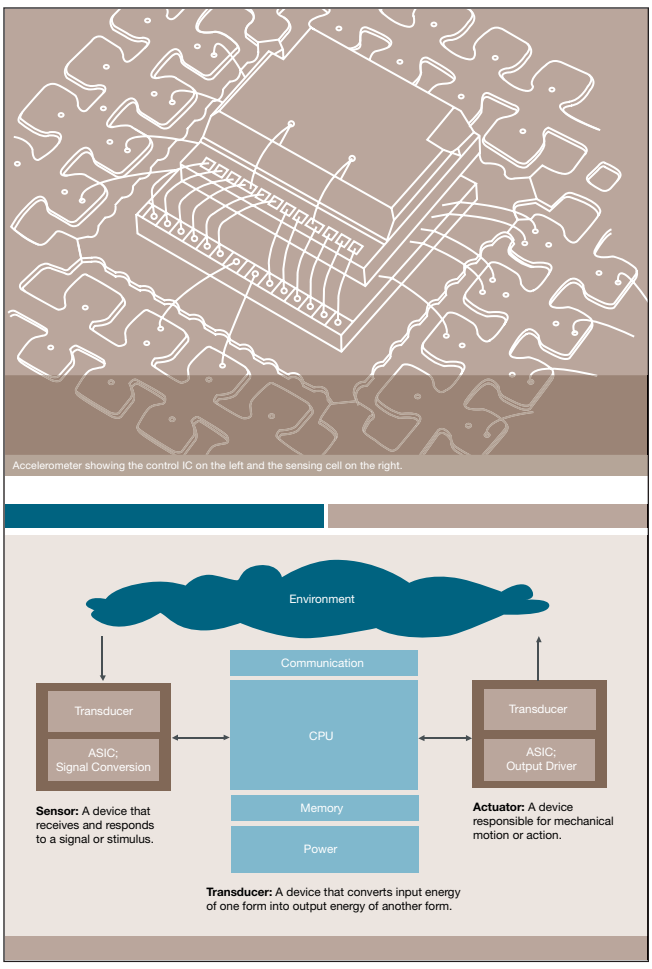
MAKE A LOT OF SENSE

Bigger is better in most cases, but not when looking for cost-effective sensing upgrades in such industries as industrial automation, power transmission and motion control, among others. Companies in a number of manufacturing sectors—automotive and transportation, product testing, medical device, energy and power systems, e.g., are augmenting or completely retrofitting their older-generation electro-mechanical sensing capabilities with MEMS—micro-electro mechanical systems. In fact, industry figures state that the MEMS device market is expected this year to reach $7 billion in U.S. sales. (MEMS are sensor- and actuator-based systems with performance derived from mechanical features measured in microns.)

As you might discern, the key word here is "micro," as in a-heck-of-a-lot-smaller than the mature-technology sensors still widely used in industrial and other applications. MEMS' downsized scalability is enabled by the use of micro-mechanical, device-encoded, silicon semi-conductor chips, which allow for the creation of the miniaturized devices and systems now being used in a number of manufacturing settings and applications. (*Editors' Note—You might want to check out our story on MEMS-enabled desktop factories—"This is About as Lean as it Gets"— in the June 2007 issue of* Gear Technology.)

Peter Adrian is a principal analyst and research manager in the Tech Insights division of the Frost & Sullivan market research and consulting firm in Palo Alto, CA. He explains how MEMS technology—sensors coupled with electronics that can range in size from a millimeter down to a micrometer—can make an appreciable difference in a manufacturer's process and bottom line, and in a variety of applications.

"What MEMS technology allows for is the creation of miniaturized devices on a chip," he says, "so some of the key features of MEMS are small size (miniaturization), lower power consumption, and integration of electronics with sensors. So rather than having bulky external electronics, you can integrate the amplification and signal conditioning with the sensor element."



Indeed, MEMS technology provides users with highly developed integration capabilities. Further, according to Tempe, AZ-based Freescale Semiconductor Inc., MEMS functionality can be integrated on the same silicon chip or in the same package, thus reducing dramatically the number of components needed. There are essentially two types of MEMS systems—monolithic integration systems, and a totally self-contained system-in-a-package. The similarity with a distinction between the two is that monolithic integration is a one-die solution using the same silicon, or chip, in which the MEMS device and integrated circuit are packaged together. The system-in-a-package differs in that it utilizes two dies—one for a MEMS device and one for an integrated circuit, both packaged together.

"In an industrial environment, MEMS facilitates using more sensors to monitor different sections of a machine, or to monitor different processes," says Adrian. "MEMS is conducive to electronically distributed controls, where you can have sensors at many points and they send signals to monitor various parameters and processes."

In further distinguishing MEMS from the older technology, Adrian explains that older-type sensors are without integrated electronics, require more real estate, use more energy and that "Their electronic signals can be more difficult to configure," as well. And, he says, the older sensors are "more expensive."

And Michelle Kelsey, inertial sensor marketing manager for Freescale, points out that MEMS is also suitable for portable and remote applications, has higher mechanical bandwidths, and

continued