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ADI ADVANCES TILT/MOTION SENSING AND SYSTEM HARDWARE MONITORING.

10/01/00

Sensor Business Digest

Full Text

In June, Analog Devices, Inc. (headquartered in Norwood, MA) (NYSE:ADI) (www.analog.com) the ADXL202E--described as the world's smallest and least expensive micromachined tilt/motion sensor. Compared to the ADXL202, the original version of the product, the ADXL202E's footprint is decreased by 75% and its height is reduced by 50%.

Utilizing the integrated microelectromechanical systems (MEMS) technology and design of the ADXL202, the ADXL202E measures a diminutive five millimeters by five millimeters by two millimeters in chip scale packaging (CSP). The new package and lower cost offered by the ADXL202E will enable enhanced capabilities in consumer products--including wearable computing devices, personal digital assistance (PDAs), cellular phones, laptop computers, toys, and navigation systems--where space and cost are vital issues. The ADXL202E,

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which allows for integrating motion-sensing features to create innovative products, is priced starting at \$4.99 in quantities of 100,000. Volume production of the device began in August.

"Motion sensing technology will become an important feature in many types of emerging consumer products," stated James Doscher, director of consumer/industrial business for ADI's Micromachined Products Division (Cambridge, MA, 800-262-5643). "The new size and cost reduction of our sophisticated micromachined technology will make this possible, and enable new and emerging uses of motion sensing that will allow people to do things that are not possible or even thought of today."

For example, the ADXL202E enables the user to communicate with a cellular phone, PDA, or handheld computer via gestures or motion. When combined with voice recognition, the sensor will further streamline the user interface and enhance the convenience and versatility of these products. Moreover, the ADXL202E enables location and movement awareness, since acceleration data can be used to derive position data. The sensor's location awareness capability can serve to facilitate and support personal navigation.

Christophe Lemaire, marketing manager for consumer and industrial markets at ADI's Micromachined Products Division, pointed out that the ADXL202E's sensing capabilities can enhance the functionality of a wide variety of consumer products, including: smart pens (that can be used, for example, for user authentication based on recognition of a signature profile, and for remote data input devices); game controllers; and portable computer peripherals (e.g., pointing devices, remote controls).

The ADXL202E can also enhance the performance of computer disk drives. Vibration affects the disk drive's head position and

accuracy. Using methods similar to those involved in noise cancellation, the accelerometer can measure and correct for vibration interference, allowing more data to be stored on the disk drive. In addition, the ADXL202E is being aimed at cutting-edge security applications (i.e., data and physical security systems built into laptop computers, flat panel displays, and PC data projectors).

Lemaire noted that--in addition to the aforementioned consumer product (including game controllers) and computing/computer security areas--target markets for the ADXL202E include vehicle security systems (car alarms), automobile event and accident recorders, emergency braking warning systems (that would alert the driver when the brakes are suddenly applied in car in front of him/her), and sporting goods and health products (including calorie counters, pedometers), and toys.

In August, ADI reported an agreement with **Caveo** Technology, LLC (Cambridge, MA) whereby the ADXL202E will be used in conjunction with Caveo's proprietary software to develop advanced security products for laptops and other applications. The resulting product, **Caveo** Anti-Theft (TM), will incorporate the ADXL202E tilt-motion sensor, which provides location/movement awareness.

Caveo and ADI are working with a number of Japanese and U.S. manufacturers of notebook PCs to integrate the AntoTheft solution into their PC designs. **Caveo** Anti-Theft, designed for laptop computers, is expected to be on the market in spring 2001. The initial Anti-Theft product is focused on an OEM motherboard application.

Laptop computer theft is becoming key problem in the workplace. According to the Computer Security Institute (San Francisco, CA), 57% of companies suffered losses from laptop theft in 1999, a security problem eclipsed only by virus infections. The ADXL202E will enable the Anti-Theft security product to provide performance

and cost benefits to laptop manufacturers, and augment current security measures.

Caveo Anti-Theft sets up a security perimeter for the laptop. Moving the laptop beyond the perimeter sets off an alarm, locks keys to the encrypted files, and disables the computer at the BIOS (basic input-output system) level, rendering it useless to unauthorized users. Caveo's proprietary algorithm processes the motion signals from the ADXL202E to determine when the computer has been moved beyond a certain perimeter.

ADI's tilt-motion sensor technology combined with Caveo's proprietary motion algorithms allow for a security system that protects software and hardware in the event of a threat but remains transparent during normal operation. **Caveo** Anti-Theft is compatible and augments complementary security products, such as biometric user authentication systems.

"**Caveo** Technology has recognized the potential for applying Analog's advanced motion sensing technology to a range of critically important security applications," Doscher stated. "We are confident that our partnership will lead to products that address a critical need in the laptop computer marketplace and in other situations in which valuable products are susceptible to theft or unauthorized use."

"We are excited about the partnership with Analog Devices and the great potential for the products we are developing together," commented W. David Lee, **Caveo** Technology's CEO. "The ADXL202E is an extremely powerful and sensitive motion sensor which is uniquely suited to the highly sophisticated functionality that our products must provide."

Lemaire noted that additional applications where Caveo's proprietary software in conjunction with the ADXL202E can provide security include flat panel displays and PC projectors. Moreover, the ADXL202E can be

used in data projectors to measure inclination in order to compensate for the keystone effect (distorted image), resulting from the tilting of the projector.

Based on iMEMS(r) (integrated MEMS) technology that combines moving minute silicon parts and signal conditioning on a single chip, the ADXL202E offers a low-power, economical, and accurate technique for measuring tilt, shock, and vibration. The ADXL202E--a two-axis accelerometer with a digital output on a single IC chip--offers low power (250 [micro sign]A per axis), and operation down to 2.7V. It is designed to interface with low-cost microcontrollers that have a counter-port I/O or an A/D converter.

Moreover, Lemaire noted that packaging of MEMS devices is more difficult than packaging standard integrated circuits, which typically use low-cost plastic packages. The MEMS sensing device needs to be hermetically encapsulated in a manner that does not cause undue stress on the sensing element. The new 8-pin ceramic leadless chip carrier (LCC) package for the ADXL202 provides the benefits of lower cost, higher quality, and smaller size.

Having produced what is described as the first fully integrated, single-chip iMEMS accelerometer in 1991, ADI is the premier producer of high-volume, single-chip iMEMS accelerometers/motion sensors. ADI is, purportedly, the major supplier of automotive airbag sensors, having shipped over 50 million units to date. Their micromachined accelerometers/motion sensors are used in a variety of applications, including automotive car alarms; PC and console game controllers; earthquake sensors; industrial applications requiring the ability to measure tilt, motion, and vibration; global positioning systems (GPS); military requirements; and virtual reality.

Worldwide shipments of PCs (mobile and desktop) totaled 114,894,000 units in 1999 and are expected to reach 180,355,000 units in

2002, representing a compound annual growth rate of about 16.2%, according to Dataquest (San Jose, CA, 408-468-8000).

Civilian, open, global demand for acceleration sensors totaled \$703.2 million in 1998 and is forecasted to reach about \$1.3 billion in 2008, representing about a 6% average annual growth rate, according to Intechno Consulting's Sensor Markets 2008 report. The distribution of the acceleration sensor market in 1998 by measurement principle was: piezoelectric--45%; piezoresistive--25%; capacitive--27%; strain gauge--2%; and others--1%.

The civilian, free world market for acceleration sensors in the household appliances and consumer electronics sector totaled \$19.3 million in 1998 and is projected to reach \$31.3 million in 2008, representing an average annual growth rate of about 5%.

Revenues for the overall U.S. MEMS-based sensor market totaled about \$538.4 million in 1998 and are expected to expand at a 12% compound annual rate to exceed \$1.16 billion in 2005, according to Frost & Sullivan's U.S. MEMS-Based Sensors Market report (5999-32). Revenues for 2000 are projected at \$696.01 million.

In 2000, the U.S. automotive MEMS-based sensor market is projected to reach about \$444.8 million, and the U.S. defense/aerospace MEMS-based sensor market is expected to reach about \$96.5 million. In 2000, the U.S. MEMS-based industrial sensor market is expected to exceed \$93.2 million, while the U.S. MEMS-based medical sensor market is projected to reach \$61.5 million.

In addition, Analog Devices unveiled in August the ADM1026--a highly integrated PC thermal and systems management device that includes 19 analog and eight fan-speed measurement channels, 13 general-purpose I/O pins, remote and on-chip temperature sensing, on-chip firmware, and an I2C-compatible system

management bus (SMBus). The unique, comprehensive system hardware monitor ASIC integrates linear and pulse width modulation (PWM) fan controllers, thereby reducing cost.

The ADM1026, which is compatible with the Intel HH5 server standard, is designed for higher-end server platforms and high-reliability systems, such as Web servers and cellular base stations that require remote monitoring. The system hardware monitor for microprocessor-based systems addresses the thriving server market. According to Dataquest, worldwide server shipments totaled 3,177,467 units in 1999 and are expected to reach 5,280,517 units in 2002, representing a compound annual growth rate of about 18.4%.

"In today's microprocessor-based server systems, maintaining stringent voltage levels and effective thermal management are critical to system reliability and continuous high performance," noted Paul Errico, marketing manager for thermal and systems monitoring products at ADI. "The ADM1026 offers all the functionality needed to monitor multiple system voltages, as well as to monitor on-chip and remote temperatures, while controlling system fan speeds. Although the device has default limits built in, designers can easily set different limit values to tailor the ADM1026 to their specific system requirements, providing a high degree of flexibility to server design."

The ADM1026, priced at \$4.95 in quantities of 1,000, was developed in conjunction with Intel and can be used with an Intel processor or any NPN/PNP diode connected transistor. The device meets the requirements for the Intelligent Platform Management Interface (IPMI), Desktop Management Interface (DMI), and the Wired for Management (WfM) initiative. Errico explained that these initiatives standardize on a set of hardware and software management parameters that allow a manufacturer to provide such information in a format which can be understood, interpreted, and acted upon by another manufacturer.

Errico noted that Analog Devices continues to add functionality to their system monitoring chips, which are finding burgeoning opportunities in the high-end server market. He added that the ADM1026 is targeted at all server platforms, from appliance servers to high-end servers.

The ADM1026 incorporates an Analog Devices AD7416 digital temperature sensor that is capable of measuring the temperature of a remote transistor configured as a diode. The AD7416--a 10-bit temperature monitoring device than can serve as a replacement for National Semiconductor's LM75 temperature sensor---is supplied in an 8-lead SOIC or [micro sign]SOIC package. The temperature can be calculated by reading the device's data register. Additional registers allow for programming high and low temperature limits; and an over-temperature indicator (which becomes active when a programmed limit is exceeded) is provided.

The AD7416, which uses an I2C-compatible serial interface, has a selectable serial bus address that allows up to 8 devices to be connected to a serial bus. In quantities of 100-499, the 7416AR (in a standard SOIC package) and the 7416ARM (in a micro SOIC package) are both priced at \$1.66. Applications for the AD7416 include data acquisition with ambient temperature monitoring, industrial process control, automotive, battery charging, and personal computers.

Revenues for the U.S. and European markets for silicon/IC temperature sensors totaled about \$62.1 million in 1999, according to SBD.

For the first nine months of FY 2000 ended July 29, 2000, ADI had net sales of \$1,771,930,000, net income of \$407,260,000, and diluted earning per share of \$1.07.

Analog Devices' latest approach to integrating MEMS and semiconductor technology, [micro

sign]mIntegration, builds MEMS structures on top of standard semiconductor wafers that are processed at a separate fab. Complementing the iMEMS technology used for ADI's accelerometers, [micro sign]mIntegration provides interconnects between the MEMS superstructure and underlying semiconductor devices, which allows for realizing high-density, cost-effective products (e.g., digital isolation channels, micro-miniature electromechanical relays) incorporating electrical/mechanical features and functions.

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