PATIENT MONITORING BOOSTS CONFIDENCE

Chip companies are developing MICS (Medical Implant Communications Service) devices that free patients from monitoring systems in the hospital, open up reliable self-diagnosis and even profile personal drug therapies. By CAROLINE HAYES

The US FCC (Federal Communications Commission) established the MICS (Medical Implant Communications Service) in 1999 that came into effect in January 2000. The ultra-low power, unlicensed mobile radio service is used for transmitting data using implanted medical devices, such as pacemakers and defibrillators, without interference to other equipment in the electromagnetic radio spectrum.

Before MICS, medical implant devices had to be magnetically coupled to external programmers or readers. Without this, the patient is freed from being close to the monitoring or control equipment, as there is no longer the need to be either close, or physically in contact with the machine. The data rate was also slower, so MICS speeds up the data transfer rate over a short range, approximately 2m, via wireless links.

Wireless devices

Devices such as AMI Semiconductor's (www.amis.com/wireless/) AMIS-53000 can be used in these robust, low power wireless communications and wireless telemetry systems. The ASTRIC (Application Specific Transmit and Receive IC) can be used in low to moderate data rate systems. It provides an integral MICS instruction set with clear-channel-assessment, or listen before transmit, and transmit-on-medical event mode. The device has a Quick Start oscillator design with a 15µsec turn-on time that allows the on-board receiver to power up quickly to check for an RF signal. The devices Sniff Mode operating mode is programmable to optimise power and system performance in battery-powered products.

An 8bit ADC eliminates some of the conventional external components used in wireless sensing applications, saving space and reducing the bill of materials. Packetisation and cyclic redundancy checks ensure robust transmission and data shaping narrows the occupied bandwidth to increase device efficiency. It is tuneable for 300 to 928MHz frequencies and supports ASK, FSK and GFSK modulations.

By reducing patient contact with equipment, as well as allowing a degree of mobility while the patient is being monitored, MICS not only reduces the risk of infection in particularly vulnerable patients but also improves their quality of life. Another benefit that has been reported is that medical staff working with the equipment can also be more mobile.

AMIS-53000 provides an MICS instruction set

Radio architecture

Cambridge Consultants (www.cambridgeconsultants.com) has developed SubQore, a radio architecture for implant devices that extends the device's battery life. For example, it extends the lithium cell life in a typical pacemaker by a reported ten years. The implantable transceiver uses the company's ultra-low power radio IP, and its XAP, RISC processor core and can also be used in devices that can be swallowed, such as video imaging devices, where high volumes of data are required over the short term.

The architecture is designed for SoC solutions, as the devices have to be not only small but with minimal power requirements. The architecture consumes an average current of less than 1mA and less than 1.7mA peak for a 0.05 per cent duty cycle, with 400kbit/sec bi-directional communications. Richard Traherne, head of the wireless business unit, Cambridge Consultants, identifies the three trends in implantable applications as ultra low power consumption, intelligent radio performance

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and extreme miniaturisation. 'We see great demand for an optimised single-chip, wireless platform that delivers the economy required for mass-volume medical applications,' he says. The radio operates in the MICS frequency band, which is 402 to 405MHz.

Sensor technology

Bio-Nano Sensium Technologies was created to develop bio-nano sensors that can be implanted into a patient's body to diagnose and treat various medical conditions. As a result, the first board-level demonstrator of the Bio-Nano Sensium system is available. The system, based on CMOS technology and designed for low-cost production, combines a disposable sensor interface chip, the Sensium, developed by Toumaz Technology (www.toumaz.com) with the low-power, wireless monitoring system, developed in the joint venture with Advance Nanotech (www.advancenanotech.com). The sensor interface chip can be worn or implanted and can be configured to detect vital signs, such as ECG, blood oxygen and glucose, body temperature and even motion and mobility. Events can be transmitted to network nodes to monitor and treat chronic conditions. Trials are due to begin mid-2006.

Monitoring the changes

Aside from the double-digit growth of implantable medical devices, other areas of medical equipment development are also looking healthy. Analog Devices (www.analog.com) for example has shrunk the size of an instrumentation amplifier with its AD8220 JFET (junction field effect transistor)-input amplifier. The eight-lead, plastic MSOP (mini small outline package) is claimed to be half the size of competing devices. The resulting savings in board space can be used to increase patient monitoring systems, such as ECG (electrocardiograms), EEG (electroencephalograms) and channel density. Smaller monitoring equipment with a high channel density allows for more measurement points for small signals, like heart pulses and brain activity, while protecting the patient from electrical interference.

The AD8220 operates on a single, low-voltage power supply that only draws 700mA. The input bias current is also low at 4pA, claimed to be less than half the level of competing devices. It also reduces the source of signal error in the end-product precision instruments. The IC achieves an 80dB CMRR (common mode rejection ratio) up to 10kHz. Competing in-Amps guarantee only 72dB to 200Hz. The low input bias current can open up previously undetectable levels of heart pulses, electrical brain waves and other patent vital signs. The high rejection ratio means that electrical noise from other parts of the body can be rejected, shielding the signals from outside interference.

Test results

The advances in test and calibration have also led to the use of PXI-based instrumentation replacing GPIB-based instrumentation. This is the case, for example, with Sanmina-SCI, which has chosen National Instruments' PXI modular instruments and its TestStand test management software (www.ni.com), instead of the traditional GPIB-based rack and stack instrumentation, to develop its production tester to test and calibrate medical devices that measure blood glucose levels.

The NI test platform was used to build a compact test system, testing 83,000 devices/week while maintaining a cycle time of 30sec/device. The PXI-based system uses test sequencing of LabWindows/CVI and C.NET modules, native parallel testing support and a custom software interface to measure the current and impedance characteristics produced from an electromechanical reaction. The system calibrates the DC amplifier circuits of the measurement engine and verifies other critical support circuits within the device. The system also switches various loads into the measurement engine to emulate simulating the blood response.

Innovation is driving the fortunes of the medical device industry, according to the organisers of this month's Medical Device Technology Exhibition (www.mdtevents.com). R&D spend has increased, with 20 per cent of medical device manufacturers surveyed reporting at least £1million spent on R&D and nearly half plan to increase R&D spend again this year. EPD