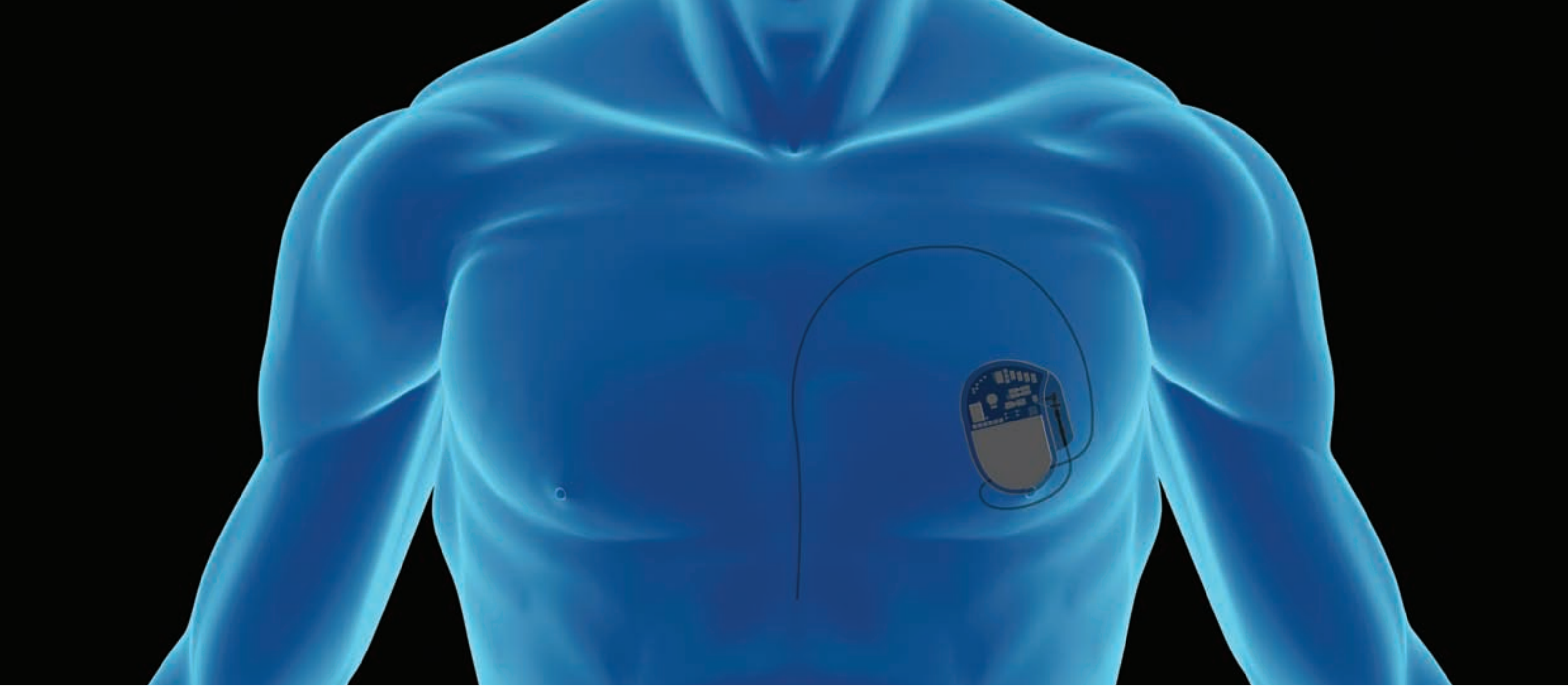

getting the news **out**

Implantable medical devices are rapidly becoming more sophisticated. The days of a 'set-it and forget-it' pacemaker are long gone. Devices which provide real-time continuous monitoring of a variety of physiologic parameters, such as blood pressure, blood glucose levels and cerebrospinal fluid pressure, are just entering the market. All of these devices need to transmit their findings outside the body as efficiently as possible. It takes power to transfer data wirelessly, especially through a medium such as the tissues comprising the human body. Conserving power, however, is extremely important in implants, both to keep the battery, and therefore the device, small and to maximize the lifetime of an implant. While it is easy to focus on the obvious design of low-power circuitry and energy-conserving communication protocols, the not-so-lowly antenna is equally critical to the performance of these implants. Antennas dramatically impact the power consumption, size, and communication quality of implantable devices.

A simple wire dipole antenna radiates equally in all directions when in air. If implanted between the muscle and fat layers near the surface of the body, however, a dipole delivers more power into the muscle (into the body) than into the fat (out of the body) because of the higher permittivity of muscle. Radio Frequency (RF) transmissions are readily absorbed by body tissues. In the case of a device mounted in a traditional pacemaker pocket near the collarbone, when transmitting in the MICS (Medical Implant Communications) spectrum of 402–405 MHz, even at the upper limits of transmission power provided for by current MICS chips, very little signal exits the back of the body due to body tissue absorption. Therefore, to conserve power, it is desirable to design an antenna that radiates preferentially in one direction and to orient that surface of the antenna to face out of the body. If the implantable device calls for continuous monitoring by a base station, it can be more power-efficient to transmit a strong signal out of the front of the body and rely on reflections off walls or ceilings to connect with a receiver that may be behind a patient.

The spectrum of 402–405 MHz was allocated as the MICS band in the US by the Federal Communications Commission (FCC) in 1999. Several chip manufacturers have recently released RF chips in this spectrum, targeted at the implantable device market. It is desirable to use this relatively short wavelength, since higher frequencies are greatly attenuated by tissues such as muscle and fat. Unfortunately, frequency is inversely related to antenna size for most antenna types. For 402 MHz, a standard dipole antenna (two parallel pieces of metal with a transmitter or receiver feeding them from the center) would need to be nearly 40cm long to radiate efficiently. Clearly, an antenna of this size is not appropriate for in-vivo use. With creative use of ground planes, dielectric substrate thicknesses, and metalized layers, antennas can be constructed like PC boards and reduced to the size of a standard pacemaker.

No longer are antennas a simple piece of wire. For many applications, especially in the demanding world of implantable devices, non-traditional antenna designs can reap huge power, size and performance benefits. The right antenna may just make that impossible implant possible!

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