Wireless, Ultra-Low-Power Implantable Sensor for Chronic Bladder Pressure Monitoring

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The wireless implantable/intracavity micromanometer (WIMM) system was designed to fulfill the unmet need for a chronic bladder pressure sensing device in urological fields such as urodynamics for diagnosis and neuromodulation for bladder control. Neuromodulation in particular would benefit from a wireless bladder pressure sensor which could provide real-time pressure feedback to an implanted stimulator, resulting in greater bladder capacity while using less power. The WIMM uses custom integrated circuitry, a MEMS transducer, and a wireless antenna to transmit pressure telemetry at a rate of 10 Hz. Aggressive power management techniques yield an average current draw of 9 μA from a 3.6-Volt micro-battery, which minimizes the implant size. Automatic pressure offset cancellation circuits maximize the sensing dynamic range to account for drifting pressure offset due to environmental factors, and a custom telemetry protocol allows transmission with minimum overhead. Wireless operation of the WIMM has demonstrated that the external receiver can receive the telemetry packets, and the low power consumption allows for at least 24 hours of operation with a 4-hour wireless recharge session.

Categories and Subject Descriptors: B.7.1 [**Integrated Circuits**]: Types and Design Styles

General Terms: Design, Measurement

Additional Key Words and Phrases: ASIC, implant, low-power, wireless sensor, bladder pressure, neuromodulation, urodynamics, ULP, offset cancellation, FSK transmitter, wireless recharge

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1. INTRODUCTION

In the urology field, catheters are the current state of the art sensor for many bladder pressure measurements. Although catheters have vastly improved thanks to MEMS technology, the shortcomings of catheterization still exist. Catheterization is

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