INTERFACING ELECTRONIC FOR MEASUREMENT, SIGNAL PROCESSING AND WIRELESS COMMUNICATION

Edited by

Sheroz Khan, International Islamic University Malaysia

AHM Zahirul Alam, International Islamic University Malaysia

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Taman Perindustrian Batu Caves
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68100 Batu Caves
Selangor Darul Ehsan
Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

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Chapter 5

WIRELESS TRANSFER OF LOW-POWER TO IMPLANTED BIOMEDICAL DEVICES: RECTIFIER DESIGN

IMRAN M. KHAN, SHEROZ KHAN, OTHMAN O. KHALIFA

Power can only be transmitted to implants wirelessly through non-contact means using an AC or square wave signal from an external source. However, implanted sensor electronics such as sensors require DC voltage to operate. Some challenges that that must be overcome include the wireless power supply of sensors, accurate and steady DC reference, load matching of circuitry, linearity of the measurements and the modulation of data. This chapter investigates two types of rectification for power transfer in implanted sensor applications and the use of rectifier for phase and level modulation via Load-Shift Keying (LSK).

5.1. INTRODUCTION

The precise rectification of AC signals is a requirement for several types of devices that derive their energy from constant DC voltage supplies, or that use steady DC as a voltage reference (Daniele, Emilio, Mauro & Andrea, 2008). Traditionally, AC signal rectification is carried out using diode full wave rectifiers. However, diode rectifiers often produce unsteady DC voltage with high ripple factor that cannot be used as a constant power supply, or as a steady reference source. This chapter analyzes two techniques that can be used in low voltage power transfer for implanted biomedical devices. One technique employs transistor switching to rectify a square and sine wave input (Sauer, Stanac', Cauwenberghs & Thakor, 2005). The other design is a novel AC rectifier design that produces a DC supply and reference through the Pythagorean identity (Sahu, Singh, & Baishya, 2010).

5.2. IMPLANTED DEVICES AND LOAD-SHIFT KEYING

Although power is transferred as an AC signal, implanted devices need a constant DC source. Rectification is difficult due to non-linear effects in small-sized coupled coils, source-load mismatch and the effect of the skin interface [4, 5]. Thus, a very precise and robust rectifier must be used to ensure that the sensitive electronics are provided with a safe supply to avoid it being damaged. Moreover, as this DC source may act as a level or threshold sensing reference in some applications, its level is required to be as ripple free as possible.