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Simultaneous power transfer and bidirectional serial communication for implantable electronics

K. de Jager [1], M. Mentink [1,2], H. Lancashire [3], S. Taylor [1], A. Vanhoestenberghe [1]

[1] Aspire CREATe, University College London, Stanmore, HA7 4LP. [2] UREST Ltd., Basingstoke, RG24 8WP.
[3] Depart. of Medical Physics and Biomedical Engineering, University College London, London, WC1E 6BT.

Introduction

Al-Ajam et al. [1] investigated the use of a bone-anchored device as a hard-wired conduit for transmitting electromyography (EMG) signals from implanted epimysial electrodes towards realising EMG control of smart upper limb prostheses attached to the bone-anchor. The complexity of the implant-prosthesis connection could be further reduced by implanting the EMG recording device. A system to both power the implant and to facilitate bidirectional serial communications through the conduit is presented.

Methods

The system (figures 1a & 1b) incorporates an external power supply and two transmitter-receiver (TX-RX) modules (an external master & an internal implant module). The 1-wire signal line and a ground line are passed through the bone-anchor conduit. The 1-wire signal is a modified RS-232 communication protocol, modulated between 6-9 V. The TX module actively transfers a 0-3 V digital signal onto the 1-wire signal line, while the RX module passively monitors the 1-wire and converts all modulated signals back to the 0-3V level. Power is obtained by passing the 1-wire signal via a 22 μF smoothing capacitor to the voltage regulators on the implant.

Results & Discussion

Fig. 1c shows power (80 mW) and bidirectional serial data transmission (baudrate 38400 bps) between the master and the implant. Collision avoidance must be incorporated in the communication protocol as may occur if both TX modules are active simultaneously. During transmission RX interrupts within the sender should be ignored as the RX module detects both incoming and outgoing transmissions.

Conclusion

Bidirectional communication allows in vivo changes to electrode configurations [2] and data streaming.

Acknowledgments

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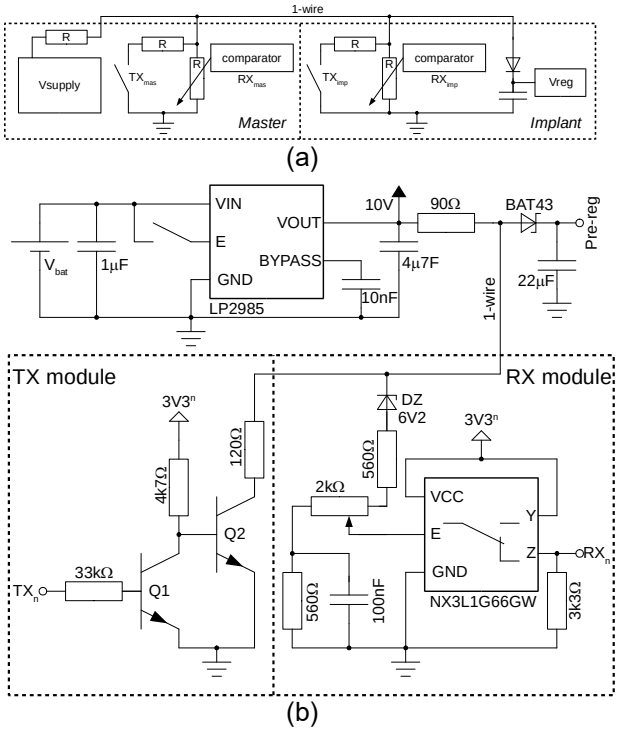
References

1. Al-Ajam Y et al. *IEEE T Bio-Med Eng*, 2013; 60(6):1654-1659.
2. de Jager K. et al. In: *BioMedEng18*; 2018.



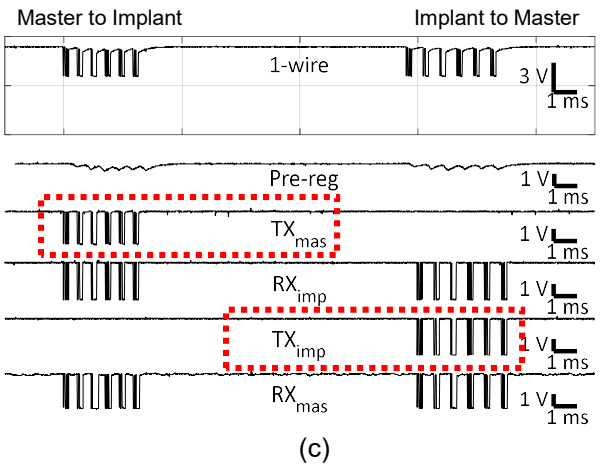


Fig 1: (a) Schematic representation of the system used to transfer power and data between the master and implant. (b) Circuit diagram of the master battery supply and a single 1-wire TX-RX module. (c) Master-implant communication (2 data packets; 6 bytes each). Communication drivers (TX_{mas} and TX_{imp}) are highlighted.