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SpineRepair RTD 2013

FNSNF

Ultra low-power implantable telemetry and customized stimulator for spinal cord neuroprosthesis

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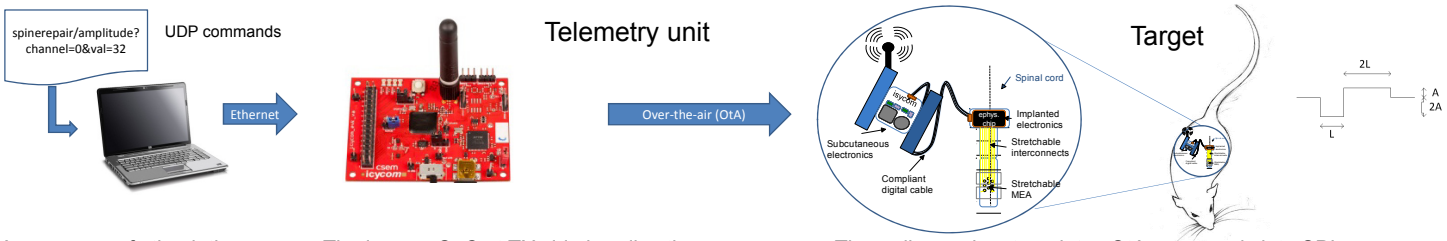
The SpineRepair project aims at developing an electrical stimulation neuroprosthetic system based on ultra-compliant microelectrode arrays, embedded low power analog electronics and efficient telemetry unit, thereby paving the way towards fully implanted miniature devices for motor rehabilitation.

System overview



A sequence of stimulation patterns to induce movements is generated on the host

The icycom SoC at TX side handles the communication with the implanted receiver (also containing an icycom SoC)

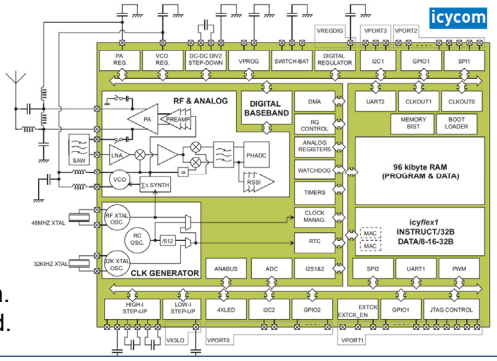
The radio receiver translates OtA commands into SPI commands. The stimulator generates biphasic pulses on the stretchable electrodes connected to the spinal chord

Telemetry unit

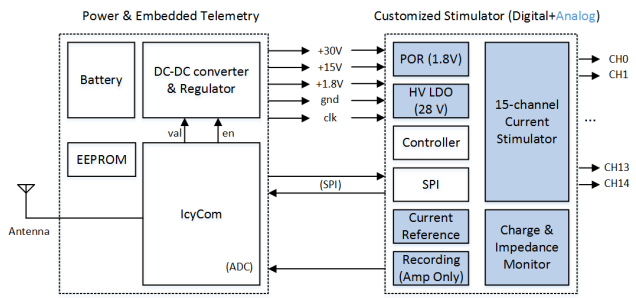
A miniature wireless telemetry RX module enables the system to be fully implanted, without the obtrusive burden of wires running through the skin towards external electronics. The unit is based on the icycom System-on-Chip with 900 MHz ultra-low-power radio and icyflex1 CPU.
The transmitter is not power limited / no particular optimization is required.

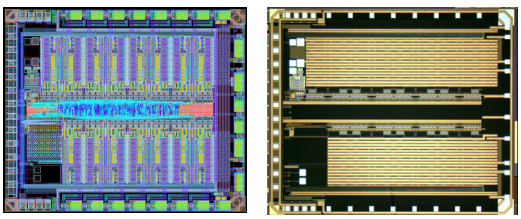
Implantable receiver features:

- Power consumption: 3.5 mA (continuous RX)
- Supplied from a single 3 V battery
  (+6V/+12 V supply for the stimulator is generated with COTS step-up)
- Radio protocol: custom, non-connected, continuous RX
- SPI connection to the stimulation unit
- Inductive recharge: 125 kHz frequency; same antenna as for 900 MHz communication.
- Watchdog: stops the simulation in case no command is received after a defined period.



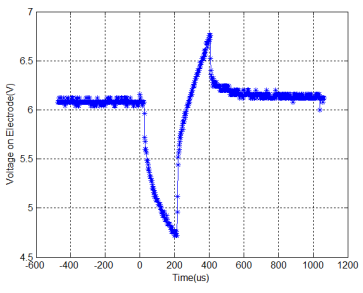
Implantable neural stimulator



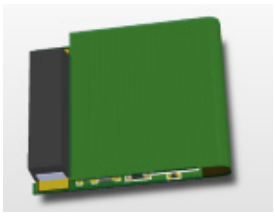


Size: 3.3mm x 2.8mm

Results



Sample waveform from the initial *in-vivo* test in rat; performance compared to that of desktop equipment.



Preliminary miniaturization experiments of the receiver with ceramic antenna.

Conclusion and outlook

The in-vivo validation of the stimulation unit being successful and its connection to the telemetry unit having been validated, the system size will now be reduced to an implantable size, typically 2 x 2 x 0.5 cm