An Energy Harvesting System for In-tire TPMS

Thomas Herndl [1], Jakob Jongsma [1], Franz Darrer [1], Terje Kvisterøy [2], Christian Hambeck [3], Stefan Mahlknecht [3], Eskild Westby [4], Svein Husa [4], Einar Halvorsen [4], Andreas Vogl [5], Niels P. Østbø [5]

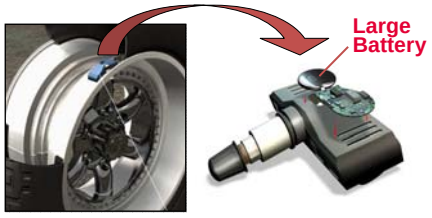
(1) Infineon Austria, (2) Infineon Norway, (3) TU Vienna, (4) Vestfold University College, (5) SINTEF
Contact: Thomas.Herndl@infineon.com

Main Objective

Development of a highly miniaturized Tire Pressure Monitoring System for in-tire assembly with V < 1cm^3 and m < 5g.

Today's rim-mounted TPMS:

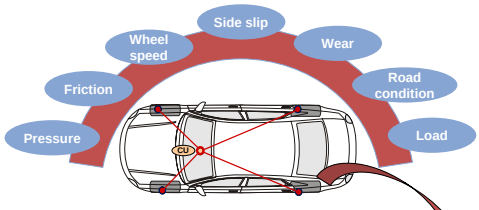
60 cm^3



Future self-sufficient tire-mounted TPMS:

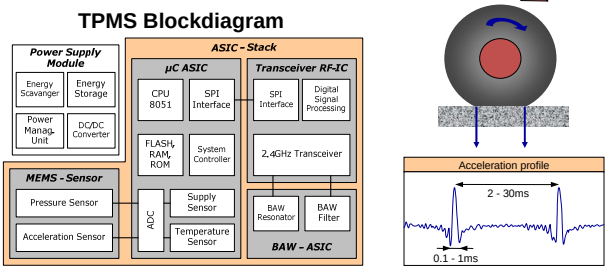
< 1 cm^3

Application Background



Tire monitored parameters – Information for comfort and safety

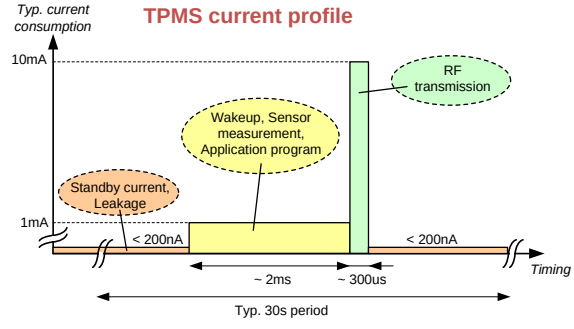
TPMS Blockdiagram



TPMS Supply Requirements

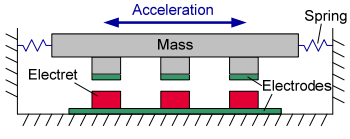
- Mechanical reliability to shocks and vibration up to 2000g
- Operating temperature range from -40°C to 125°C
- Life time > 10 Years
- High efficiency of Energy Scavenger even at low vehicle speed
- Low-leakage energy storage device
- Competitive costs to rim-mounted supply unit

TPMS current profile

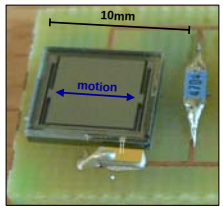


MEMS Energy Harvester Device

Electrostatic transduction principle

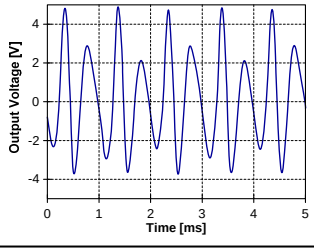


- Electret as bias for the transducer
- In-plane motion
- High aspect ratio micromachining



MEMS Prototype

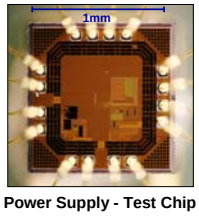
Laboratory measurements



- Simulations show that a few µW of in-tire harvested power is possible at driving speeds down to 50km/h
- Measurement of first prototype confirms the workability of our design concept

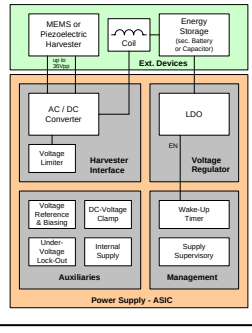
Energy Conversion Unit

- Compatible to MEMS- or piezoelectric-harvester
- On-chip handling of AC input voltage up to 36V$_{pp}$
- Total current consumption < 50nA
- Measurements on first test chips prove feasibility

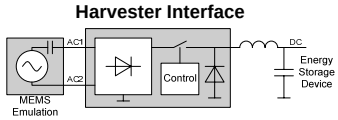


Power Supply - Test Chip

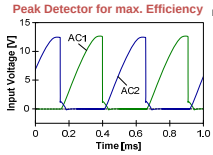
Power Supply Blockdiagram



Harvester Interface



Peak Detector for max. Efficiency



Output Power @ 3VDC