Resonant MEMS Acoustic Switch Package with Integral Tuning Helmholtz Cavity

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Abstract

For unattended ground sensors and the Internet of Things (IOT), wake-up sensors are needed that draw extremely low power to extend battery life. We describe in this paper a MEMS acoustic switch actuated by ambient sound pressure waves, which allows current to pass when an acoustic input at a specific frequency passes a threshold amplitude. The MEMS switch draws zero power in the absence of the target acoustic signal, and less than 10 nW when the target frequency is present. This device requires a novel package with an integral Helmholtz cavity. This cavity is designed with a threaded plunger that allows the cavity volume and the switch resonant frequency to be adjusted with 0.1 Hz accuracy.

The system uses a battery to charge a capacitor through MEMS switches activated only by the target signals. The sensor is of rotational design allowing it to be insensitive to linear vibration and static gravity forces. Analysis and experimental results demonstrating operation of these resonators in air is presented. A simple, novel fabrication process is presented which uses SOI bonded wafers and still provides metal-metal electrical contacts. These devices have successfully detected 80 Hz sound as low as 0.005 Pa RMS (48 dB SPL ref. 20 µPa) from a gas powered generator.

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