Development of a piezoelectric MEMS Electrostatic field sensor

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Abstract:

Electrostatic fields sensors may be employed for the local detection of the risk of electrostatic discharge (ESD) on satellites and other sensitive equipment or solar panels, or as a sensor network for the detection and the prediction of lightning events [1]. For these applications, electrostatic field sensors need to combine good resolution, which should be below 1V/m, a high measurement range, which should be at least 1MV/m, compacity and low power consumption. We describe in this contribution the development of a quartz crystal resonator-based sensor, which offers these advantages [2]. Quartz, due to its piezoelectric properties and resistance to environmental degradation, provides an ideal platform for detecting weak variations in electrostatic fields with high precision. The sensor consists in a quartz tuning fork located between two grounded plates, thus hidden from the environment electrostatic field. When the tuning fork is actuated at resonance, the upper part of its arms is partially exposed to the ambient field. The resonator due to the piezoelectric properties of the quartz, generates a restoring force at its oscillation frequency will produce a slight change in the oscillation frequency is proportional to the amplitude of the electrostatic field. The principle of operation will be detailed in the poster, as well as the finite elements simulation carried out for the sensor's optimization, and the fabrication process and first measurements.

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