



A Broadband Silicon Seismic Package for Planetary Exploration

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The Silicon Seismic Package (SSP) is a compact, 0.3 ng/rtHz sensitivity silicon microseismometer based on the hardware successfully delivered to the InSight Mars 2018 mission. The SSP provides a sensitivity and dynamic range comparable to significantly more massive broadband terrestrial instruments in a robust, compact package. Combined with a high resolution radiation-hardened digitiser under development, the SSP offers high performance seismic monitoring under a range of planetary environments.

The sensor is micromachined from single-crystal silicon by through-wafer deep reactive-ion etching to produce a non-magnetic suspension and proof mass. It is robust to high shock (> 1000 g) and vibration (> 30 grms). For qualification SP units have undergone the full thermal cycles of the InSight mission and has been noise tested down to 208K and up to 330K, with no degradation in the performance in both cases. In addition, the sensor has been tested as functional down to 77K. The total mass for the three-axis SP delivery is 635g while the power requirement is less than 400 mW.

The SSP has particular advantages for a planetary deployment. All three axes deliver full performance over a tilt range of ± 1 m/s² which allows for operation without levelling. With no magnetic sensitivity and a temperature sensitivity below $2E-5$ m/s², there is no need for magnetic field monitoring and the additional resources for thermal isolation are also much reduced.

In terms of performance the SSP has fast initialisation, reaching a noise floor below 1 ng/ $\sqrt{\text{Hz}}$ in less than a minute from an untilted configuration. The noise floor is 0.3 ng/rtHz from 10 s to 10 Hz, with a long period noise below 10 ng/rtHz at 1000s. This allows tidal measurements as well as seismic monitoring for a number of proposed planetary missions.