

Ultra-Stable Oscillators for Radio Science Investigations on Planetary Entry Probes

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Abstract

Ultra-stable oscillators (USO) were developed for Radio Science instrumentation on deep space missions functioning as frequency references for the one-way downlink during atmospheric occultations and other experiments. They have also proven to be very stable references for all one-way communication links. USOs have also been flown on planetary entry probes including the Galileo Jupiter probe and the Cassini-Huygens Titan probe for the purposes for Doppler Wind Experiments. These two probes utilized different oscillators, quartz USO for Galileo and Rubidium USO for Huygens. This paper presents the historical development and the latest technologies for ultra-stable oscillators including the latest trends in improved stability and reduction in mass, volume and consumed power. It also discusses the tradeoffs for USO type selection, including factors such as duration of the experiment, the available warm-up time and the Allan deviation and phase noise requirements.