

# **Stabilized Reference Frequency Distribution for Radio Science with the Cassini Spacecraft and the Deep Space Network**

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The preliminary design and prototype development of the Stabilized Fiber Optic Distribution Assembly (SFODA) and the Compensated Sapphire Oscillator (CSO) was reported at the 1998 PTTI. These systems were developed to enable gravitational wave searches and atmospheric occultation experiments between the Cassini spacecraft and the NASA Deep Space Network (DSN). These experiments are conducted at Ka band (32 GHz) frequencies and demand the highest possible short term and long term stability. A frequency standard located 16 km from the remote antenna acts as the source of the reference frequency. The SFODA is the conveyance device to deliver the reference signal to the remote antenna while the CSO provides the short term stability and low phase noise.

This paper will provide an overview and update of the end to end high performance frequency and timing subsystem. Focus will be given to the final SFODA design and test results using a 16 km optical fiber under controlled test conditions. The SFODA utilizes active feedback with a temperature compensating fiber optic reel to compensate for thermally induced phase variations over the 16 km fiber cable. A reference frequency signal at 1 GHz is transmitted over the fiber link to the remote antenna site where the stability of the source frequency standard is maintained. This signal is used to steer the CSO which provides the required ultra-stable reference signal for the Cassini Ka band users. Test data show a factor of 1000 improvement in long term stability when the active phase compensator is used thus enabling degradation free distribution from the highest performing atomic frequency standards.

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