

Verification of Spectral Purity in the HIFI Local Oscillator

J. Pearson^{1*}, David Teyssier², F. Maiwald¹, J. Ward³, R. Lin¹, I. Mehdi¹, Jacob Kooi⁴, Thomas Klein⁵,
Christian Leinz⁵, William Jellema⁶, Christophe Risacher⁶

1 Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA, 91109, USA

2 European Space Astronomy Centre (ESAC), P.O. Box 78, 28691 Villanueva de la Cañada, Madrid - Spain

3 Raytheon Company, Fort Wayne, Indiana, USA

4 California Institute of Technology, Pasadena, CA, 91125, USA

5 MPIfR Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany

6 SRON Netherlands Institute for Space Research, P.O. Box 800, 9700 AV Groningen, The Netherlands

* Contact: John.Pearson@jpl.nasa.gov, phone +1-818-354-6822

This work was sponsored by NASA.

Abstract—Many high efficiency varactor diode multipliers rectify a small amount of RF input power and act as a charge pump into the bias network. If the phase and the frequency of the pumped charge resonates with the bias circuit it will result in a forced parametric oscillation, which is as spectrally pure as the fundamental input signal. In HIFI these oscillations were observed in half the local oscillator bands over a range of output frequencies up to 50 GHz wide. The oscillation at the resonant bias network frequency results in AM side bands on the carrier. After several subsequent multiplier stages one or more sidebands can exceed the carrier signal. This effect can not be detected in a Y-factor measurement. It is also extremely hard to detect in the pumped SIS mixer IV curve due to the relatively small frequency offset of the extra LO frequencies, so determination of the mixer response usually requires spectroscopic measurements.

These oscillations have been observed in half of the HIFI local oscillator bands. We describe a method for detecting and suppressing of parametric oscillations by reviewing the pumped IV curves of the multiplier as function of input power and bias. This has successfully been used to mitigate the oscillations in HIFI band 1 and 5. Further studies need to be done to provide design criteria to prevent parametric oscillations in varactor multipliers.