# ABSTRACT

## W Band Power Amplifier Development for the Herschel HIFI Instrument

Robert R. Ferber, Ph.D., Todd Gaier, Ph.D., Mary Wells,
Jet Propulsion Laboratory
Gerald Swift, Paul Yocom, Yun Chung
TRW

This paper relates to the development of W Band amplifiers for the Local Oscillator(LO) chains for the Herschel HIFI(Heterodyne Instrument For Far Infrared) Instrument. The HIFI receivers cover the frequency range of 480 GHz to 1900 GHz in six bands, using low noise superheterodyne receivers having superconducting HEB(Hot Electron Bolometers) or SIS(Semiconductor-Insulator-Semiconductor) mixers. These receivers comprising HIFI will be a part of the Herschel Great Observatory, to be launched in 2007 to the L-2 Libration Point, where it will perform a 5 year mission to conduct a variety of Astrophysics observations of star forming regions in the Milky Way Galaxy, as well as others.

The local oscillator(LO) chains consist of a frequency synthesizer having a K Band output from 23.6 to 37.6 GHz. This source frequency is tripled to produce the "W" band input for the power amplifiers. The amplifiers, operating at approximately 130K, amplify this 0 to +3dBm "W" Band signal up to + 23.6 dBm, or ~240 mW. The amplifier output is then coupled into a multiplier chain to produce the final LO injection signal in the range of 480 GHz to 1900 GHz. This LO injection signal is then optically coupled into the receiver mixers operating at ~2K.

This paper describes key amplifier development issues and their solutions applied on the way to realizing stable, wide-band amplifiers capable of producing 240 mw or greater rf power output across the 71 to 106 GHz frequency range. The HIFI Power Amplifier design embodiment is based on an A-40 silicon-aluminum package with six GaAs(Gallium Arsenide) HEMT(High Electron Mobility Transistors) MMIC(Monolithic Microwave Integrated Circuit) amplifier chips used in each amplifier. Development challenges to be discussed include: connector and package design to fit available space, MMIC chip designs which had a variety of oscillation propensities (mostly out-of-band), signal splitter and combiner development and matching across the band, matching of chip characteristics for those chips installed in the parallel power combined arms of the amplifier, power output leveling across the band, moding of the microstrip line sections installed between MMICS and moding in the MMIC cavities, both in-band and out-of-band.

Device, component and material selection issues for operation at cryogenic temperatures will also be discussed, and performance data on the amplifier while operating at 120 degrees Kelvin will be presented.