

ABSTRACT

W Band MMIC Power Amplifier Development for the Herschel HIFI Instrument

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This paper presents an overview of the development and manufacture of W Band amplifiers for the Local Oscillator (LO) chains for the Herschel HIFI (Heterodyne Instrument For Far Infrared) Instrument. 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 120K, amplify this 0 to +3dBm "W" Band signal up to + 23.6 dBm, or ~240 mW. The amplifier output drives a multiplier chain to produce the final LO injection signal in the range of 480 GHz to 1900 GHz. The L.O. injection signal is then optically coupled into the receiver mixers operating at ~ 2K.

Key amplifier development issues and their solutions are described on the way to realizing stable, wide-band, flight qualified 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 a silicon-aluminum package with six GaAs(Gallium Arsenide) HEMT(High Electron Mobility Transistor) MMIC(Monolithic Microwave Integrated Circuit) amplifier chips used in each amplifier. Development challenges to be discussed include: 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 problem solutions for the microstrip line sections installed between MMICS and for moding in the MMIC cavities, both in-band and out-of-band. Flight hardware qualification and manufacture will be presented.

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