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Analysis of the Microsized Microwave Atmospheric Satellite (MicroMAS) Communications Anomaly

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Abstract

The Micro-sized Microwave Atmospheric Satellite (MicroMAS) is a dual-spinning 3U CubeSat equipped with a passive microwave spectrometer that operated nine channels near the 118.75-GHz oxygen absorption line. The focus of this first MicroMAS mission (hereafter, MicroMAS-1) was to observe convective thunderstorms, tropical cyclones, and hurricanes from a near-equatorial orbit. A small fleet of Micro-sized Microwave Atmospheric Satellites could yield high-resolution global temperature and water vapor profiles, as well as cloud microphysical and precipitation parameters.

MicroMAS-1 was delivered in March 2014 to the launch provider, and was deployed from the International Space Station in March 2015. Engineering data and sensor telemetry were successfully downlinked within the first few days of on-orbit operation, but an anomaly prevented the successful validation of the science instrument.

This paper discusses the data reconstruction process used to determine the spacecraft state and diagnose potential failure modes using combinations of simulations and engineering models of key components. After analyzing the potential failure modes on both the ground station and the spacecraft, results indicate that one of the solar panels may have not properly deployed, leading to the most likely cause of failure: damage to the onboard radio transmitter power amplifier. A re-flight mission, MicroMAS-2, has two launches (2a and 2b) planned for 2018.

1. Introduction

The term “nanosatellite” is applied to satellites that weigh less than 10 kg; a mass that is small enough to be easily accommodated as an auxiliary payload on launch vehicles. A CubeSat is a standardized form of nanosatellite. The CubeSat specification document developed by the California Polytechnic State University in 2000 (California Polytechnic State University CubeSat Program, 2014) defines a

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