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Author: Mr. Remi LaBelle
National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory, United States, remi.labelle@jpl.nasa.gov

Mr. David Rochblatt
Jet Propulsion Laboratory - California Institute of Technology, United States, *(email is not specified)*
Dr. Lisa Locke
NASA JPL, United States, lisa.locke@jpl.nasa.gov

CALIBRATION AND PERFORMANCE MEASUREMENTS FOR THE NASA DEEP SPACE NETWORK LUNAR EXPLORATION UPGRADE (DLEU)

Abstract

The NASA Deep Space Network (DSN) has recently upgraded two of its 34-meter antennas, with feeds and electronics for K-band (22 - 27 GHz) uplink and downlink. The first upgrade was done at the Goldstone Deep Space Communications Complex (GDSCC) and the 2nd was at the Canberra Complex (CDSCC). These upgrades are part of the larger NASA / DSN Lunar Exploration Upgrade (DLEU) project, which will be done at six antennas in the DSN, in support of the NASA Artemis lunar program. The DLEU project included development and implementation of several new technologies for K-band uplink and downlink electronics, as previously reported. The electronics upgrades were done to add K-band uplink capability to all six antennas, as well as add the K-band downlink capability to 3 antennas that did not previously have it. The upgraded antennas are required to support high-rate TTC links for the Artemis lunar gateway and lunar landers, as well as other NASA spacecraft that use K-band such as JWST and TESS. At the completion of these upgrades, a comprehensive campaign of tests and measurements took place at K-band (22-27 GHz) frequency range, to calibrate, optimize, and characterize the performance of the antennas and electronics and bring their performance parameters to within specification. The total power radiometric measurement techniques which were applied during these campaigns, are described in this article. These two antennas which are 34-meter diameter, dual shaped Cassegrain beam-waveguide (BWG) design achieved a vacuum aperture efficiency of 67Both antennas (DSS-26 and DSS-36) were upgraded and returned to operations in 2022, with an additional 4 antennas planned for the next 2 years. This paper describes the measurement techniques and results of the testing and calibration for both antennas, along with the driving requirements.