High Power Multipactor Suppression in S-band Waveguide

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To investigate multipactor (MP), a rectangular waveguide testbed was designed for S-band frequencies with the broad wall dimension matching the standard WR-284 waveguide geometry. Setting the waveguide height to 5.5 mm yielded a frequency-gap product susceptible to MP. One of the test sources, a coaxial magnetron provides test input power at a frequency of 2.85 GHz with a peak power output of 4 MW and 3.5 μs pulse width. The other, a RF solid-state source using GaN HEMTs delivers a pulse width of 100 μs with a test input power of 3 kW for comparison of threshold power. With the two sources a range of 3 kW to 4 MW of input power was accessed.

For MP detection, local (electron multiplier tube) and global (phase/power) diagnostic methods were implemented. At power levels tested (MW) and a 5.5 mm gap, low multipactor orders (N = 1) are observed, whereas an order of N = 9 are observed at the lower power level. To suppress MP, previous numerical simulations of the geometry have shown that adding a grooved structure to one of the broadsides should aid in mitigating multipactor. In this case, grooves are machined into the broad wall in the direction of propagation, which avoids continuous impedance mismatching and large E-field perturbations. The efficacy of this mitigation technique was experimentally evaluated. Experimentally, there were distinct differences between the standard case (smooth broadside wall) and the case with grooves in MP delay and magnitude. The difference in power transmitted before MP onset was limited, however, an about 12% improvement was measured.

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