Probing Multipactor in X-band Waveguide Components

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Multipactor is a vacuum-based resonant effect that causes detuning, heating, and ultimately component damage in microwave systems. Suppression of this effect then becomes important in high power systems such as satellite communications. To study multipactor, a plug and play setup was designed and built in to allow for quick testing in a waveguide-like structure. A tunable X-band magnetron, tuned to 9.4 GHz, with a typical pulse length of 2.5 μs delivers peak power output of 130 kW. The magnetron driver pulse duration and amplitude are freely adjustable, utilizing a modern hard-switched semiconductor-based topology. This project's primary device under test is a waveguide stepped impedance transformer that reduces the side-wall dimension of a typical WR90 waveguide down to a gap size conducive to multipactor formation.

This research evaluates the efficacy of varying methods of multipactor suppression as well as conditioning of surfaces through repeated multipactor. In this context, a residual gas analyzer is added as a diagnostic tool to check the species of gas desorbed from different surfaces. Phase detection is used as a diagnostic to determine when a multipactor event has occurred, alongside an electron multiplier tube (EMT) that allows analysis of the multipacting electron cloud.

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