

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Fixed and Broadcast Communications (7)

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TRANSMITTER MICRO DISCHARGES IN COMMUNICATIONS AND BROADCAST SATELLITES

Abstract

Most commercial communications and broadcast satellites operating at microwave radio frequencies use traveling wave tube amplifiers (TWTAs) as high power transmitters. Since TWTAs work at high voltages, it is not uncommon to experience micro discharges, especially early in life. This observation led to the introduction of an autonomous restart function in the companion high voltage power supply (the electronic power conditioner or EPC) of the TWTA as a safety feature. A micro discharge with enough energy above a threshold would lead to a momentary loss of high voltages, followed by an automatic restart, which is usually sufficient to allow the micro-discharge event to clear with minimal loss of RF transmission. In most cases energy involved in the micro discharge is low enough that the removal of high voltages is not required and the event may go undetected. However, an unusual signature was first noted in early 1997 on a Ku-band satellite transmitter, where the characteristics of the micro discharge event were such that the control anode voltage dropped below nominal typically recovering over a 20 minute period. Such micro discharge events became known as the "20 Minute Effect". This "20 Minute Effect" has been observed over subsequent years on other Ku-band TWTAs, as well as on Ka-band and S-band satellite transmitters in numerous satellites. This paper summarizes the in-orbit data on such micro discharges as well as the believed cause. In addition, the paper includes results from three S-band TWTAs which have operated on life test for several years. Due to ease of their monitoring instrumentation as contrast to monitoring micro discharges on orbiting operational satellites via telemetry, new data have been accumulated on this effect. The data substantiate the previous findings that micro discharges do not significantly affect satellite operation or their transmissions nor diminish the TWTAs performance, including long lifetime.