

RF Electronics Miniaturization in Advanced Spacecraft Transponders Using MMICs

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Abstract

RF telecommunications transponders for deep-space spacecraft provide independent uplink command, downlink telemetry, and turnaround ranging functions. The next generation transponders at X-band and Ka-band are under development by JPL using technology advances in electronic devices, MMICs, packaging and manufacturing techniques enabling substantial reductions in transponder mass, power, and volume. The advanced transponder architecture will greatly benefit particularly from the MMIC technology. GaAs MMIC devices will also enable improvements in reliability and performance, although more work needs to be done on the qualification and screening procedures and standards for space applications of MMICs.

A reduced size X-band double-conversion RF Converter/IF assembly that provides an automatic gain control (AGC) using highly integrated MMIC devices has been developed to demonstrate application of MMIC technology to miniaturization of transponders. The module is four times smaller in mass and volume as compared to the equivalent hybrid circuitry in the Cassini spacecraft transponder. This paper describes the MMIC components used in the demonstration RF Converter module and the measured performance results. Further miniaturization of RF electronics in transponders can be achieved with the utilization of MMIC filters and the application of MMIC multi-chip module (MMIC-MCM) technology.