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PERFORMANCE AND STATUS OF JHUAPL FRONTIER RADIO LITE TT&C PLATFORM

Abstract

The original prototype of the low size, weight, and power (SWaP) variant to the JHUAPL Frontier Radio, dubbed Frontier Radio Lite (FR-Lite), was introduced in 2014 [1]. Complete versions of this new variant have now been flown for LEO and deep space missions as the S-band Telemetry, Tracking, and Command (TT&C) solution. Improved X-band and C-band versions are currently in testing, and new S-band, L-band, and VHF-band versions will be completed within the next year to transition to a modular 1U CubeSat form factor.

Compared to the Frontier Radio, total volume (1178 cm3 FR-Lite vs. 2050 cm3 Frontier Radio) and weight (0.92 kg vs. 2.6 kg) has been reduced the by utilizing advances in modern space-grade parts as well as majorly improving parts density of the cards. New integrated synthesizers allowed for more compact routing, and new mixers enable direct frequency conversion to desired bands. There were also size and weight saving in converting filters to smaller packages or lumped element equivalents.

Power consumption of the RF analog circuitry was modestly increased (4.9 W full duplex vs. 4.2 W full duplex) and of the digital circuitry was slightly decreased (2.1 W vs. 2.3 W). This with improvements in the efficiency of the power converter (75% vs. 68%) lead to a reduction in power consumption (9.3 W vs. 9.7 W) for a single band radio.

With these changes, we saw minimal performance degradation. Measured receive noise figure increased (1.8 dB vs. 1.2 dB) and worst case transmitter spurious increased (-44 dBc vs -55 dBc). The on-board oscillator is selectable due to multi-footprint compatible layout, so the oscillator performance and power consumption can be tailored to mission use. The main drawback of the lighter platform, is its reduced radiation tolerance (40 krad vs 100 krad).

A standardized reusable mechanical and electrical interface enables easier development of RF cards to support new frequency bands, support for multiple modem cards with different processing backbones,

and allow the ability for processing and interfaces to be supplemented via coprocessors that can share data via high-speed serial digital data distribution. Improvements in the modem software allow for rapid new feature implementation.

These improvements allow for the use our traditionally deep space radio design, reliability, and heritage on missions that are more mass or cost constrained. It also allows for more flexibility in our radio portfolio to meet mission needs.