National Aeronautics and Space Administration

Communications

Radiation-Hardened, High-Data-Rate Ka-Band Modulator and Transmitter

Increase performance and data return while decreasing cost

NASA Goddard Space Flight Center invites companies to license its new Ka-band modulator and transmitter for use in commercial applications. The higher frequencies made possible by the Ka-band offer many benefits both for space missions and commercial communications on Earth. Not only can more data be transferred as a result of higher link performance, but costs can be reduced because of smaller and lighter weight components, including a smaller antenna on the ground. GSFCs radiation-hardened design supports quadriphase-shift keying (QPSK) / Offset QPSK modulation at data rates up to 800 mega-samples per second (Msps). This technology, and the circuits and manufacturing procedures developed to build it, will enable future high-data-rate missions to build Ka-band systems with lower risk and lower non-recurring development costs.

BENEFITS

- Cost effective use: Uses commercially available, high-power monolithic microwave integrated circuits amplifiers, has completed all non-recurring engineering, and has been proven through rigorous environmental testing;
- Versatility: Can be applied to other frequency bands;
- Improved packaging: Uses a space-qualified, compact, back-to-back cavity enclosure design;
- Protected transmission: Uses radiation-hardened parts and design;
- Superior link margin;
- Increases overall communi-cation system link margin through low transmitter implementation loss; and
- Simplified requirements: Uses local oscillator driver one quarter the frequency of the output center frequency, and exceeds spectral shaping requirements without lossy output filters.

technology solution

THE TECHNOLOGY

NASA requires that all future near-Earth missions (near-Earth defined as any spacecraft within one million kilometers of Earth) requiring more than 10 MHz of downlink data bandwidth operate in the 25.5 to 27.0 GHz band. Developed for NASAs Solar Dynamics Observatory mission and adapted for the Lunar Reconnaissance Orbiter mission, this spaceflight transmitter meets and/or exceeds all of NASAs performance requirements and is the first to be designed for Ka-band.

This design consists of a phase-locked oscillator; a high-bandwidth, QPSK vector modulator; a medium-power, Ka-band solid-state power amplifier, a highly efficient DC-DC converter; and radiation-hardened, high-rate driver circuitry that receives I and Q channel data. The radiation-hardened design enables the Ka-band communications downlink system to transmit 130 Mbps of data (300 Msps after data encoding) to the ground system. The low error vector magnitude of the modulator reduces the implementation loss of the transmitter in which it is used, thereby increasing the overall communication system link margin.

Prior high-rate transmitters exist for X-band (~8 GHz) and Ku-band (~15 GHz), but those cant take advantage of the Ka-band frequencies. This new Ka-band transmitter and modulator offer several unique design features that improve upon the current state of the art and enable the use of this high-frequency radio band. One design element that sets this technology apart is its unique packaging scheme and mechanical design that creates a compact, back-to-back cavity enclosure that utilizes die attach, substrate attach, wire bonding, and conventional surface mount technologies.

APPLICATIONS

The technology has several potential applications:

- Direct satellite broadcast TV;
- Broadband Internet service providers;
- Near-Earth space science missions;
- Military and other communications; and
- Satellite or SmallSat/CubeSat communications.

PUBLICATIONS

Patent No: 8139674

More Information

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