Compact, Low-Overhead, MIL-STD-1553B Controller

Goddard Space Flight Center, Greenbelt, Maryland

A compact and flexible controller has been developed to provide MIL-STD-1553B Remote Terminal (RT) communications and supporting and related functions with minimal demand on the resources of the system in which the controller is to be installed. (MIL-STD-1553B is a military standard that encompasses a method of communication and electrical-interface requirements for digital electronic subsystems connected to a data bus. MIL-STD-1553B is commonly used in defense and space applications.) Many other MIL-STD-1553B RT controllers are complicated, and to enable them to function, it is necessary to provide software and to use such ancillary separate hardware devices as microprocessors and dual-port memories.

The present controller functions without need for software and any ancillary hardware. In addition, it contains a flexible system interface and extensive support hardware while including on-chip error-checking and diagnostic support circuitry. This controller is implemented within part of a modern field-programmable gate array.

This work was done by Richard Katz and Rod Barto of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15491-1

Parallel-Processing CMOS Circuitry for M-QAM and 8PSK TCM

NASA's Jet Propulsion Laboratory, Pasadena, California

There has been some additional development of parts reported in "Multi-Modulator for Bandwidth-Efficient Communication" (NPO-40807), *NASA Tech Briefs*, Vol. 32, No. 6 (June 2009), page 34. The focus was on

- The generation of M-order quadrature amplitude modulation (M-QAM) and octonary-phase-shift-keying, trellis-coded modulation (8PSK TCM),
- The use of square-root raised-cosine pulse-shaping filters,
- A parallel-processing architecture that enables low-speed [complementary metal oxide/semiconductor (CMOS)] circuitry to perform the coding, modulation, and pulse-shaping computations at a high rate; and
- Implementation of the architecture in a CMOS field-programmable gate array.

This work was done by Andrew Gray and Dennis Lee of Caltech; Scott Hoy of Lockheed-Martin; Dave Fisher of SGT Inc.; Wai Fong and Parminder Ghuman of GSFC for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-40809

Differential InP HEMT MMIC Amplifiers Embedded in Waveguides

The differential configuration confers advantages over the single-ended configuration.

NASA's Jet Propulsion Laboratory, Pasadena, California

Monolithic microwave integrated-circuit (MMIC) amplifiers of a type now being developed for operation at frequencies of hundreds of gigahertz contain InP high-electron-mobility transistors (HEMTs) in a differential configuration. The differential configuration makes it possible to obtain gains greater than those of amplifiers having the single-ended configuration. To reduce losses associated with packaging, the MMIC chips are designed integrally with, and embedded in, waveguide packages, with the additional benefit that the packages are compact enough to fit into phased transmitting and/or receiving antenna arrays.

Differential configurations (which are inherently balanced) have been used to extend the upper limits of operating frequencies of complementary metal oxide/semiconductor (CMOS) amplifiers to the microwave range but, until now, have not been applied in millimeter-wave amplifier circuits. Baluns have traditionally been used to transform from single-ended to balanced configurations, but baluns tend to be lossy. Instead of baluns, finlines are used to effect this transformation in the present line of development. Finlines have been used extensively to drive millimeter-wave mixers in balanced configurations. In the present extension of the finline balancing concept, finline transitions are integrated onto the affected MMICs (see figure).

The differential configuration creates a virtual ground within each pair of InP HEMT gate fingers, eliminating the need for inductive vias to ground. Elimination of these vias greatly reduces parasitic components of current and the associated losses within an amplifier, thereby enabling more nearly complete utilization of the full performance of each transistor. The differential configuration offers the additional benefit of multiplying (relative to the single-ended configuration) the input and output impedances of each transistor by a factor of four, so that it is possible to use large transistors that would otherwise have prohibitively low impedances.

Yet another advantage afforded by the virtual ground of the differential configuration is elimination of the need for a ground plane and, hence, elimination of the need for back-side metallization of the MMIC chip. In turn, elimination of the back-side metallization simplifies fabrication, reduces parasitic capacitances, and enables mounting of the MMIC in the electric-field plane ("E-plane") of a waveguide. E-plane mounting is consistent with (and essential for the utility of) the finline configuration, in which transmission lines lie on a dielectric sheet in the middle of a broad side of the waveguide.

E-plane mounting offers a combination of low loss and ease of assembly because no millimeter-wave wire bonds or transition substrates are required. Moreover, because there is no ground plane behind the MMIC, the impedance for the detrimental even (single-ended) mode is high, suppressing coupling to that mode. Still another advantage of E-plane mounting is that the fundamental waveguide mode is inherently differential, eliminating the need for a balun to excite the differential mode.

This work was done by Pekka Kangaslahti, Erich Schlecht, and Lorene Samoska of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Innovative Technology Assets Management
JPL
Mail Stop 202-233
4800 Oak Grove Drive
Pasadena, CA 91109-8099
(818) 354-2240
E-mail: iaoffice@jpl.nasa.gov

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