Books & Reports

MMICs With Radial Probe Transitions to Waveguides

A document presents an update on the innovation reported in "Integrated Radial Probe Transition From MMIC to Waveguide" (NPO-43957), *NASA Tech Briefs* Vol. 31, No. 5 (May 2007), page 38. To recapitulate: To enable operation or testing of a monolithic microwave integrated circuit (MMIC), it is necessary to mount the MMIC in a waveguide package that typically has cross-sectional waveguide dimensions of the order of a few hundred microns. A radial probe transition between an MMIC operating at 340 GHz and a waveguide had been designed (but not yet built and tested) to be fabricated as part of a monolithic unit that would include the MMIC.

The radial probe could readily be integrated with an MMIC amplifier because the design provided for fabrication of the transition on a substrate of the same material (InP) and thickness (50 μm) typical of substrates of MMICs that can operate above 300 GHz. As illustrated in the updated document by drawings, photographs, and plots of test data, the concept has now been realized by designing, fabricating, and testing several MMIC/radial-probe integrated-circuit chips and designing and fabricating a waveguide package to contain each chip.

This work was done by Lorene Samoska, Goutam Chattopadhyay, David Pukala, Mary Soria, King Man Fung, and Todd Gaier of Caltech for NASA's Jet Propulsion Laboratory, and Vesna Radisic, Stella Makishi, William Deal, and Richard Lai of Northrop Grumman Corporation (NGC). The work was sponsored under the DARPA SWIFT program and the contributors would like to acknowledge the support of Dr. Mark Rosker (DARPA) and Dr. H. Alfred Hung (Army Research Laboratory). Further information is contained in a TSP (see page 1). NPO-45460

Tests of Low-Noise MMIC Amplifier Module at 290 to 340 GHz

A document presents data from tests of a low-noise amplifier module operating in the frequency range from 290 to 340 GHz — said to be the highest-frequency low-noise, solid-state amplifier ever developed. The module comprised a three-stage monolithic microwave integrated circuit (MMIC) amplifier integrated with radial probe MMIC/waveguide transitions and contained in a compact waveguide package, all according to the concepts described in the immediately preceding article and in the referenced prior article, "Integrated Radial Probe Transition From MMIC to Waveguide" (NPO-43957), *NASA Tech Briefs* Vol. 31, No. 5 (May 2007), page 38.

The tests included measurements by the Y-factor method, in which noise figures are measured repeatedly with an input noise source alternating between an "on" (hot-load) condition and an "off" (cold-load) condition. (The Y factor is defined as the ratio between the "on" and "off" noise power levels.) The test results showed that, among other things, the module exhibited a minimum noise figure of about 8.7 dB at 325 GHz and that the gain at that frequency under the bias conditions that produced the minimum noise figure was between about 9 and 10 dB.

This work was done by Todd Gaier, Lorene Samoska, and King Man Fung of Caltech for NASA's Jet Propulsion Laboratory, and William Deal, Xiaobing Mei, and Richard Lai of Northrop Grumman Corporation (NGC). The work was sponsored under the DARPA SWIFT program and the contributors would like to acknowledge the support of Dr. Mark Rosker (DARPA) and Dr. H. Alfred Hung (Army Research Laboratory). Further information is contained in a TSP (see page 1). NPO-45461

Extending Newtonian Dynamics to Include Stochastic Processes

A paper presents further results of continuing research reported in several previous *NASA Tech Briefs* articles, the two most recent being "Stochastic Representations of Chaos Using Terminal Attractors" (NPO-41519), [Vol. 30, No. 5 (May 2006), page 57] and "Physical Principle for Generation of Randomness" (NPO-43822) [Vol. 33, No. 5 (May 2009), page 56]. This research focuses upon a mathematical formalism for describing postinstability motions of a dynamical system characterized by exponential divergences of trajectories leading to chaos (including turbulence as a form of chaos).

The formalism involves fictitious control forces that couple the equations of motion of the system with a Liouville equation that describes the evolution of the probability density of errors in initial conditions. These stabilizing forces create a powerful terminal attractor in probability space that corresponds to occurrence of a target trajectory with probability one. The effect in configuration space (ordinary three-dimensional space as commonly perceived) is to suppress exponential divergences of neighboring trajectories without affecting the target trajectory. As a result, the postinstability motion is represented by a set of functions describing the evolution of such statistical quantities as expectations and higher moments, and this representation is stable.

This work was done by Michail Zak of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-45594