180-GHz I-Q Second Harmonic Resistive Mixer MMIC

NASA's Jet Propulsion Laboratory, Pasadena, California

An indium phosphide MMIC (monolithic microwave integrated circuit) mixer was developed, processed, and tested in the NGC 35-nm-gate-length HEMT (high electron mobility transistor) process. The MMIC mixers were tested and assembled in the miniature MMIC receiver module described in "Miniature Low-Noise G-Band I-Q Receiver" (NPO-47442), *NASA Tech Briefs*, Vol. 34, No. 11 (November 2010), p. 45. This innovation is very compact in size and operates with very low LO power. Because it is a resistive mixer, this innovation does not require DC power. This is an enabling technology for the miniature receiver modules for the GeoSTAR instrument, which is the only viable option for the NRC decadal study mission PATH.

This work was done by Pekka P. Kangaslahti of Caltech and Richard Lai and Xiaobing Mei of Northrop Grumman Corporation for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice @jpl.nasa.gov. NPO-47443

Ultra-Low-Noise W-Band MMIC Detector Modules

NASA's Jet Propulsion Laboratory, Pasadena, California

A monolithic microwave integrated circuit (MMIC) receiver can be used as a building block for next-generation radio astronomy instruments that are scalable to hundreds or thousands of pixels. W-band (75–110 GHz) low-noise receivers are needed for radio astronomy interferometers and spectrometers, and can be used in missile radar and security imagers.

These receivers need to be designed to be mass-producible to increase the sensitivity of the instrument. This innovation is a prototyped single-sideband MMIC receiver that has all the receiver front-end functionality in one small and planar module. The planar module is easy to assemble in volume and does not require tuning of individual receivers. This makes this design low-cost in large volumes.

This work was done by Todd C. Gaier, Lorene A. Samoska, and Pekka P. Kangaslahti of Caltech; Dan Van Vinkle, Sami Tantawi, John Fox, Sarah E. Church, Judy M. Lau, Matthew M. Sieth, and Patricia E. Voll of Stanford University; and Eric Bryerton of NRAO for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). ***.*** *NPO-47348*

338-GHz Semiconductor Amplifier Module

NASA's Jet Propulsion Laboratory, Pasadena, California

A 35-nm-gate-length InP, high-electron-mobility transistor (HEMT) with a high-indium-content channel as the key component was developed to produce an MMIC (monolithic microwave integrated circuit) power amplifier. With a shorter gate length than previous transistor generations, it allows for electrons to travel shorter distances. This results in higher frequency functionality. In addition, the fabrication process provides for a comprehensive passive component library of resistors, capacitors, airbridge wiring, and through-wafer vias that allow for transistor RF matching and power combining on-chip, making the measured 10-mW 338-GHz chip possible.

The amplifier module can be used in series with current ≈340 GHz RF sources to boost RF output power. The extremely high-frequency power amplifier module can be used for very-high-frequency wide-bandwidth communication, and higher resolution radars for civilian applications.

This work was done by Lorene A. Samoska, Todd C. Gaier, Mary M. Soria, and King Man Fung of Caltech and Vesna Radisic, William Deal, Kevin Leong, Xiao Bing Mei, Wayne Yoshida, Po-Hsin Liu, Jansen Uyeda, and Richard Lai of Northrop Grumman Corp. for NASA's Jet Propulsion Laboratory.

The software used in this innovation is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47307.

Power Amplifier Module With 734-mW Continuous Wave Output Power

NASA's Jet Propulsion Laboratory, Pasadena, California

Research findings were reported from an investigation of new gallium nitride (GaN) monolithic millimeter-wave integrated circuit (MMIC) power amplifiers (PAs) targeting the highest output power and the highest efficiency for class-A operation in W-band (75–110 GHz). W-band PAs are a major component of many frequency multiplied submillimeter-wave LO signal sources. For spectrometer arrays, substantial W-band power is required due to the passive lossy frequency multipliers used to generate higher frequency signals in nonlinear Schottky diode-based LO sources. By advancing PA technology, the LO system performance can be increased with possible cost reductions compared to current GaAs PAs.

High-power, high-efficiency GaN PAs are cross-cutting and can enable more efficient local oscillator distribution systems for new astrophysics and planetary receivers and heterodyne array instruments. It can also allow for a new, electronically scannable solid-state array technology for future Earth science radar instruments and communications platforms.

This work was done by King Man Fung, Lorene A. Samoska, Pekka P. Kangaslahti, Bjorn H. Lambrigtsen, Paul F. Goldsmith, Robert H. Lin, Mary M. Soria, and Joelle T. Cooperrider of Caltech and Miroslav Micovic and Ara Kurdoghlian of HRL Laboratories for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47364