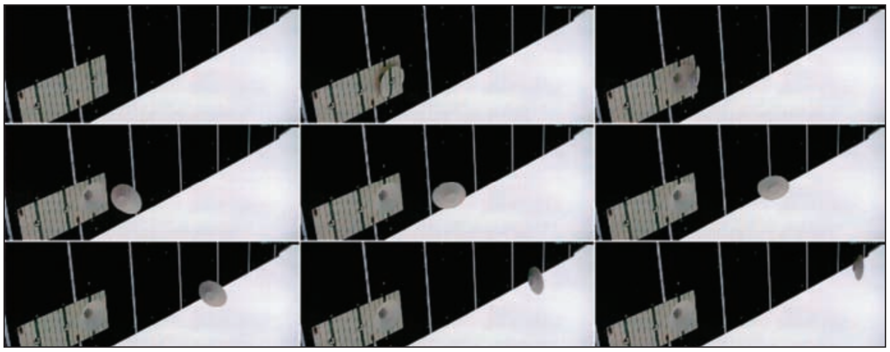

Figure 2. **Frame Captures of High-Speed Digital Video** are showing ejection of "divot" debris from F-15B Aerodynamic Flight Test Fixture underneath the aircraft centerline. Flight conditions for the divot ejection are Mach 2 at 48,250 ft (14.7 km) altitude. Video frame rate is 2,000 pictures per second, exposure rate is 50 microseconds, and resolution is 1280×512 pixels. (Sequence starts at upper left frame and proceeds from left to right.)

sonal computer or saved on a compact flash memory card. In addition to the high-rate recording of images, the system can display images in real time at 30 pps. Inter Range Instrumentation Group (IRIG) time code can be inserted into the individual camera controllers or into the M-Hub unit. The video data could also be used to obtain quantitative, three-dimensional trajectory information.

The first use of this system was in support of the Space Shuttle Return to Flight effort. Data were needed to help in understanding how thermally insulating foam is shed from a space-shuttle external fuel tank during launch. The cameras captured images of simulated external tank debris ejected from a fixture mounted under the centerline of the F-15B aircraft. Digital video was obtained at subsonic and supersonic flight conditions, including speeds up to Mach 2 and altitudes up to 50,000 ft (15.24 km). The digital video was used to determine the structural survivability of the debris in a real flight environment and quantify the aerodynamic trajectories of the debris.

This work was done by Stephen Corda, Ting Tseng, Matthew Reaves, Kendall Mauldin, and Donald Whiteman of **Dryden Flight Research Center**. *Further information is contained in a TSP (see page 1).* *DRC-05-16*

MMIC DHBT Common-Base Amplifier for 172 GHz

This single-transistor circuit performs comparably to a prior four-transistor circuit.

NASA's Jet Propulsion Laboratory, Pasadena, California

Figure 1 shows a single-stage monolithic microwave integrated circuit (MMIC) power amplifier in which the gain element is a double-heterojunction bipolar transistor (DHBT) connected in common-base configuration. This amplifier, which has been demonstrated to function well at a frequency of 172 GHz, is part of a continuing effort to develop compact, efficient amplifiers for scientific instrumentation, wide-band communication systems, and radar systems that will operate at frequencies up to and beyond 180 GHz.

The transistor is fabricated from a layered structure formed by molecular-beam epitaxy in the InP/lnGaAs material system. A highly doped InGaAs base layer and a collector layer are fabricated from the layered structure in a triple mesa process. The transistor includes two separate emitter fingers, each having dimensions of 0.8 by 12 µm. The common-base configuration was chosen for its high maximum stable gain in the frequency band of interest. The input-matching network is designed for high bandwidth. The output of the transistor is matched to a load line for maximum saturated output power under large-signal conditions, rather than being matched for maximum gain under small-signal conditions.

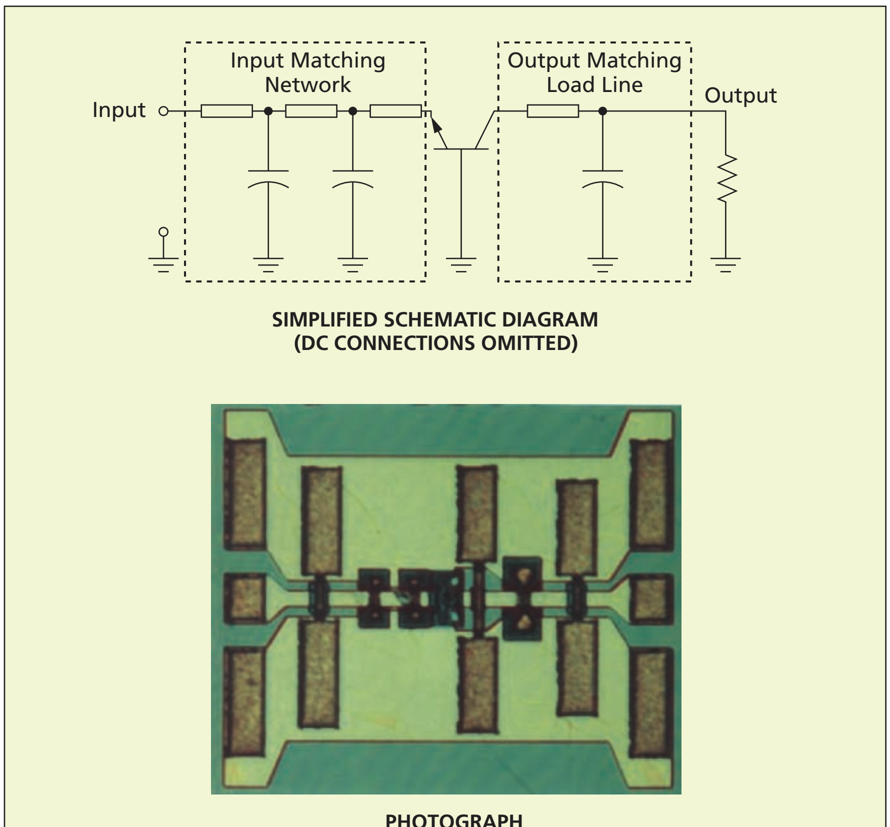

Figure 1. This **Common-Base, Single-Transistor Amplifier** is designed to provide useful power gain in the frequency band of 170 to 180 GHz.

In a test at a frequency of 172 GHz, the amplifier was found to generate an output power of 7.5 mW, with approximately 5 dB of large-signal gain (see Figure 2). Moreover, the amplifier exhibited a peak small-signal gain of 7 dB at a frequency of 176 GHz. This performance of this MMIC single-stage amplifier containing only a single transistor represents a significant advance in the state of the art, in that it rivals the 170-GHz performance of a prior MMIC three-stage, four-transistor amplifier. [The prior amplifier was reported in "MMIC HEMT Power Amplifier for 140 to 170 GHz" (NPO-30127), *NASA Tech Briefs*, Vol. 27, No. 11 (November 2003), page 49.]

This amplifier is the first heterojunction-bipolar-transistor (HBT) amplifier built for medium power operation in this frequency band. The performance of the amplifier as measured in the aforementioned tests suggests that InP/lnGaAs HBTs may be superior to high-electron-mobility (HEMT) transistors in that the HBTs may offer more gain per stage and more output power per transistor.

This work was done by Vamsi Paidi, Zack Griffith, Yun Wei, Mattias Dahlstrom, Miguel Urteaga, and Mark Rodwell of the University of California at Santa Barbara and Lorene Samoska, King Man Fung, and Erich Schlecht 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:

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Refer to NPO-40956, volume and number of this NASA Tech Briefs *issue, and the page number.*

Modular, Microprocessor-Controlled Flash Lighting System

This system can be readily reconfigured to satisfy different requirements.

John H. Glenn Research Center, Cleveland, Ohio

A microprocessor-controlled lighting system generates brief, precisely timed, high-intensity flashes of light for scientific imaging at frame rates up to about 1 kHz. The system includes an array of light-emitting diodes (LEDs) that are driven in synchronism with an externally generated timing signal (for example, a timing signal generated by a video camera). The light output can be varied in peak intensity, pulse duration, pulse delay, and pulse rate, all depending on the timing signal and associated externally generated control signals.

The array of LEDs comprises as many as 16 LED panels that can be attached together. Each LED panel is a module consisting of a rectangular subarray of 10 by 20 LEDs of advanced design on a printed-circuit board in a mounting frame with a power/control connector. The LED panels are controlled by an LED control module that contains an AC-to-DC power supply, a control board, and 8 LED-panel driver boards. In prior LED panels, the LEDs are packaged at less than maximum areal densities in bulky metal housings that reduce effective active areas. In contrast, in the present LED panels, the LEDs are packed at maximum areal density so as to afford 100-percent active area and so that when panels are joined side by side to form the array, there are no visible seams between them and the proportion of active area is still 100 percent. Each panel produces an illuminance of $\approx 5 \times 10^4$ lux at a distance of $\frac{5}{8}$ in. ($\approx$1.6 cm).

The LEDs are driven according to a pulse-width-modulation control scheme that makes it safe to drive the LEDs beyond their rated steady-state currents in order to generate additional light during short periods. The drive current and the pulse-width modulation for each LED panel can be controlled independently of those of the other 15 panels. The maximum allowable duration of each pulse of drive current is a function of the amount of overdrive, the total time to be spent in overdrive operation, and the limitations of the LEDs. The system is configured to limit the overdrive according to values specific to each type of LED in the array. These values are coded into firmware to prevent inadvertent damage to the LED panels.

This work was done by Dwayne Kiefer, Elizabeth Gray, and Robert Skupinski of QSS Group, Inc. and Arthur Stachowicz and William Birchenough of Zin Technologies, Inc. for **Glenn Research Center**. *Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17894-1.