amplifiers are less likely to go into oscillation. In order to design this amplifier, it was necessary to derive mathematical models of microwave power transistors for incorporation into a larger mathematical model for computational simulation of the operation of a class-D microwave amplifier. The design incorporates state-of-the-art switching techniques applicable only in the microwave frequency range. Another major novel feature is a transmission-line power splitter/combiner designed with the help of phasing techniques to enable an approximation of a square-wave signal (which is inherently a wideband signal) to propagate through what would, if designed in a more traditional manner, behave as a more severely band-limited device (see figure). The amplifier includes an input, a driver, and a final stage. Each stage contains a pair of GaAs-based field-effect transistors biased in class D. The input signal can range from –10 to +10 dBm into a 50-ohm load. The table summarizes the performances of the three stages.

Improvements of ModalMax High-Fidelity Piezoelectric Audio Device

Langley Research Center, Hampton, Virginia

ModalMax audio speakers have been enhanced by innovative means of tailoring the vibration response of thin piezoelectric plates to produce a high-fidelity audio response. The ModalMax audio speakers are 1 mm in thickness. The device completely supplants the need to have a separate driver and speaker cone. ModalMax speakers can perform the same applications of cone speakers, but unlike cone speakers, ModalMax speakers can function in harsh environments such as high humidity or extreme wetness. New design features allow the speakers to be completely submerged in salt water, making them well suited for maritime applications. The sound produced from the ModalMax audio speakers has sound spatial resolution that is readily discernable for headset users. [The ModalMax product line was described in “High-Fidelity Piezoelectric Audio Device” (LAR-15959), NASA Tech Briefs, Vol. 27, No. 8 (August 2003), page 36.] Other improvements of the ModalMax audio speakers include methods to reduce size, reduce power demand, and increase audio fidelity by increasing vibrational responses at the low and high ends of the audio frequency range.

This work was done by Stanley E. Woodard of Langley Research Center. Further information is contained in a TSP (see page 1). LAR-16321-1

Alumina or Semiconductor Ribbon Waveguides at 30 to 1,000 GHz

Ribbon waveguides made of alumina or of semiconductors (Si, InP, or GaAs) have been proposed as low-loss transmission lines for coupling electronic components and circuits that operate at frequencies from 30 to 1,000 GHz. In addition to low losses (and a concomitant ability to withstand power levels higher than would otherwise be possible), the proposed ribbon waveguides would offer the advantage of compatibility with the materials and structures now commonly incorporated into integrated circuits.

Heretofore, low-loss transmission lines for this frequency range have been unknown, making it necessary to resort to designs that, variously, place circuits and components to be coupled in proximity of each other and/or provide for coupling via free space through bulky
HEMT Frequency Doubler With Output at 300 GHz
This is the highest-frequency HEMT doubler reported to date.

NASA's Jet Propulsion Laboratory, Pasadena, California

An active frequency doubler in the form of an InP-based monolithic microwave integrated circuit (MMIC) containing a high-electron-mobility transistor (HEMT) has been demonstrated in operation at output frequencies in the vicinity of 300 GHz. This is the highest-frequency HEMT doubler reported to date, the next-highest-frequency active HEMT doubler having been previously reported to operate at 180 GHz. While the output power of this frequency doubler is less than that of a typical Schottky diode, this frequency doubler is considered an intermediate product of a continuing effort to realize the potential of active HEMT frequency doublers to operate with conversion efficiencies greater than those of passive diode frequency doublers. An additional incentive for developing active HEMT frequency doublers.