The **Bar-Code System Hardware** includes a personal computer, a desktop bar-code scanner (on the right by tubes and plates), and a PDA with a built-in bar-code scanner (left of the keyboard).

an interactive computer display in a location reserved for those specific data. Inasmuch as the database software is designed to display only the record that corresponds to a given bar code, the possibility of accidentally recording data in the wrong place is eliminated (except, of course, for rare instances of computer error or errors in re-affixation of labels that have fallen off). In addition, because the microbiologist no longer needs to painstakingly find the correct place to enter data for each assay plate, the bar-code system accelerates the process of reading plates and recording data.

The bar-code system greatly simplifies the documentation of the sampling process. During sampling, the note-taking capability of the PDA is complemented by the use of a digital camera: The sampling technician or microbiologist takes a picture of each sample and records the picture number (as assigned by the digital camera) in the PDA. Once the data and pictures are downloaded to the database, only a few mouse clicks are necessary to generate a two-column report that displays the pictures in one column and lists the corresponding samples and pertinent information in the other column. In addition, the bar-code system automatically generates a report of assay results. The data in the report can be exported to a spreadsheet for analysis.

This work was done by Jennifer Law and Larry Kirschner of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-30815

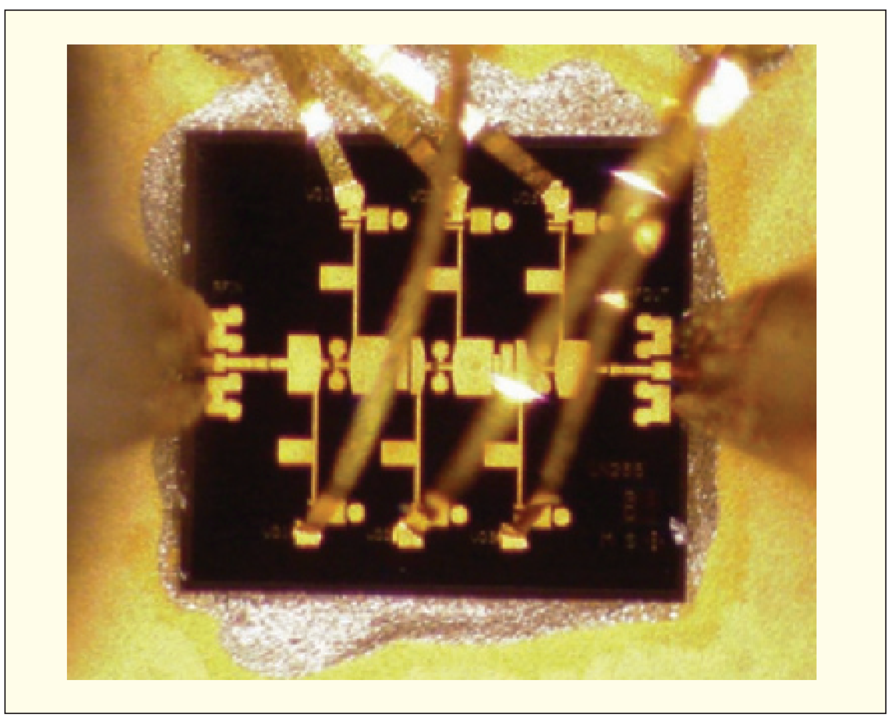
MMIC Amplifier Produces Gain of 10 dB at 235 GHz

This is the fastest MMIC amplifier reported to date.

NASA's Jet Propulsion Laboratory, Pasadena, California

The first solid-state amplifier capable of producing gain at a frequency >215 GHz has been demonstrated. This amplifier is an intermediate product of a continuing effort to develop amplifiers having the frequency and gain characteristics needed for a forthcoming generation of remote-sensing instruments for detecting water vapor and possibly other atmospheric constituents. There are also other potential uses for such amplifiers in wide-band communications, automotive radar, and millimeter-wave imaging for inspecting contents of opaque containers.

This amplifier was fabricated as a monolithic microwave integrated-circuit (MMIC) chip containing InP high-electron-mobility transistors (HEMTs) of 0.07-μm gate length on a 50-μm-thick InP substrate. The passive components on the chip are of the microstrip type and were designed by use of advanced electromagnetic-behavior-simulatin software. The amplifier contains three stages of HEMTs with matching networks that comprise microstrip transmission lines and metal/insulator/metal capacitors. Bias is supplied via transmission-line networks with bypass capacitors on the gate and drain sides of the HEMTs.



The **MMIC Amplifier** described in the text is shown mounted for testing with custom wafer probes for testing at 220 to 325 GHz.

The performance of the amplifier was measured by use of the instrumentation system described in "Equipment for On-Wafer Testing From 220 to 325 GHz" (NPO-40955), *NASA Tech Briefs*, Vol. 30, No. 1 (January 2006), page 38. This instrumentation system, equivalent to a two-port vector network analyzer, was equipped with custom wafer probes (see figure) designed for the noted frequency band, which is that of WR-3 waveguides [waveguides having a standard rectangular cross section of 0.0340 by 0.0170 in. (0.8636 by 0.4318 mm)]. Among other things, the measurements showed a peak gain of 10 dB at a frequency of 235 GHz.

This work was done by Douglas Dawson, King Man Fung, Karen Lee, Lorene Samoska, Mary Wells, Todd Gaier, and Pekka Kangaslahti of Caltech; and Ronald Grundbacher, Richard Lai, Rohit Raja, and Po-Hsin Liu of NGST for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).
NPO-42202

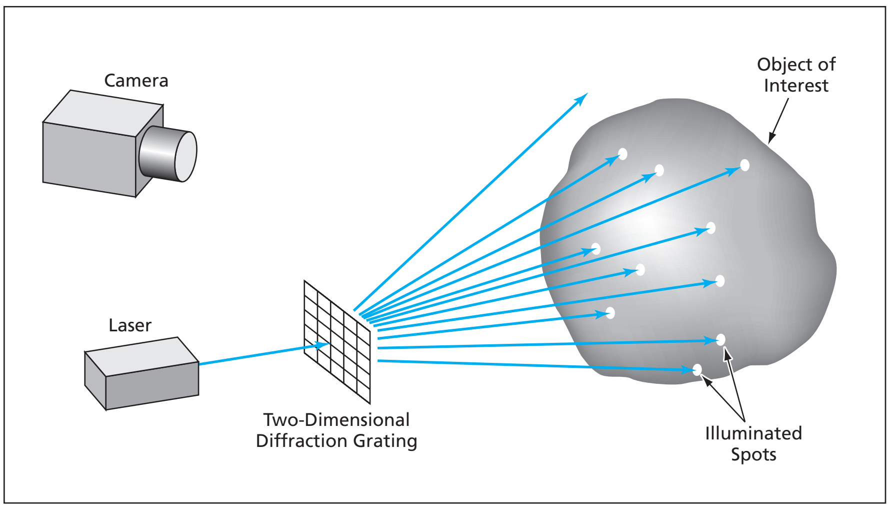
Mapping Nearby Terrain in 3D by Use of a Grid of Laser Spots

A relatively simple system would utilize triangulation.

NASA's Jet Propulsion Laboratory, Pasadena, California

A proposed optoelectronic system, to be mounted aboard an exploratory robotic vehicle, would be used to generate a three-dimensional (3D) map of nearby terrain and obstacles for purposes of navigating the vehicle across the terrain and avoiding the obstacles. Like some other systems that have been, variously, developed and proposed to perform similar functions, this system would include (1) a light source that would project a known pattern of bright spots onto the terrain, (2) an electronic camera that would be laterally offset from the light source by a known baseline distance, (3) circuitry to digitize the output of the camera during imaging of the light spots, and (4) a computer that would calculate the 3D coordinates of the illuminated spots from their positions in the images by triangulation.

The difference between this system and the other systems would lie in the details of implementation. In this system, the illumination would be provided by a laser. The beam from the laser would pass through a two-dimensional diffraction grating, which would divide the beam into multiple beams propagating in different, fixed, known directions (see figure). These beams would form a grid of bright spots on the nearby terrain and obstacles. The centroid of each bright spot in the image would be computed. For each such spot, the combination of (1) the centroid, (2) the known direction of the light beam that produced the spot, and (3) the known baseline would constitute sufficient information for calculating the 3D position of the spot.



A **Diffraction Grating Would Split a Laser Beam** into multiple beams to project a grid of bright spots onto an object of interest. A camera offset from the laser and diffraction grating would capture an image of the illuminated spots. The 3D positions of the spots would be computed from their positions in the image by triangulation.

Concentrating the illumination into spots, instead of into lines as in some other systems, would afford signal-to-noise ratios greater than those of such other systems and would thereby also enable this system to image terrain and obstacles out to greater distances. The laser could be pulsed to obtain momentary illumination much brighter than ambient illumination, and the camera could be synchronized with the laser to discriminate against ambient light between laser pulses.

This work was done by Curtis Padgett, Carl Liebe, Johnny Chang, and Kenneth Brown of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).
NPO-40611

Digital Beam Deflectors Based Partly on Liquid Crystals

Laser beams are switched to different directions, without using solid moving parts.

John H. Glenn Research Center, Cleveland, Ohio

A digital beam deflector based partly on liquid crystals has been demonstrated as a prototype of a class of optical beam-steering devices that contain no mechanical actuators or solid moving parts. Such beam-steering devices could be useful in a variety of applications, including free-space optical communications, switching in fiber-optic communications, general optical switching, and optical scanning. Liquid crystals are of special interest as active materials in nonmechanical beam steerers and deflectors because of their structural flexibility, low operating voltages, and the relatively low costs of fabrication of devices that contain them. Recent advances in synthesis of liquid-crystal ma-