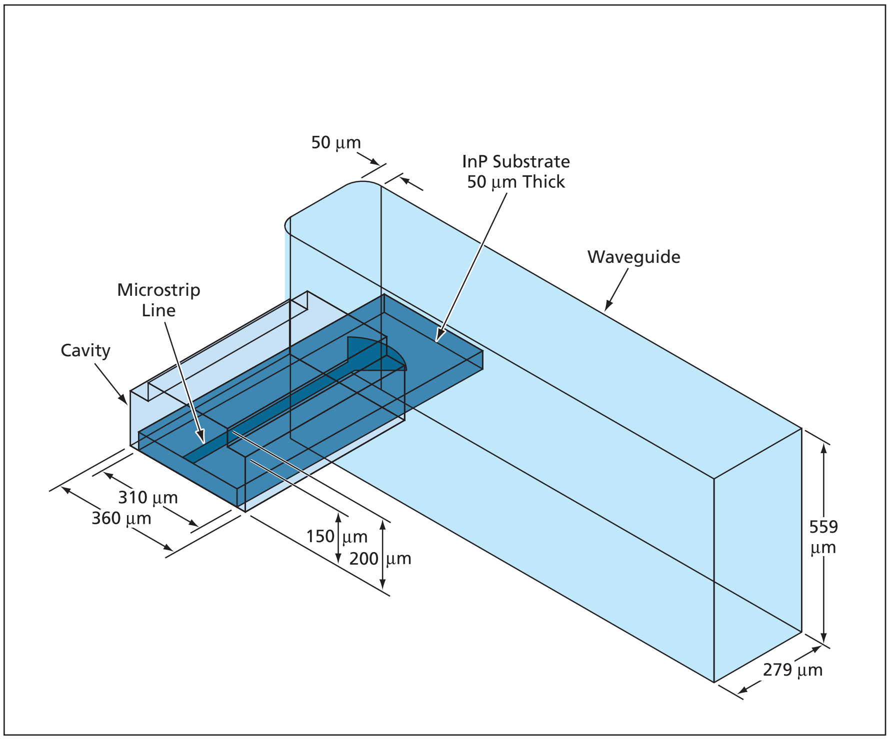


Figure 1. The **Integrated Radial Probe Transition** would couple 340-GHz electromagnetic radiation from an MMIC (not shown) on the InP substrate to the waveguide.

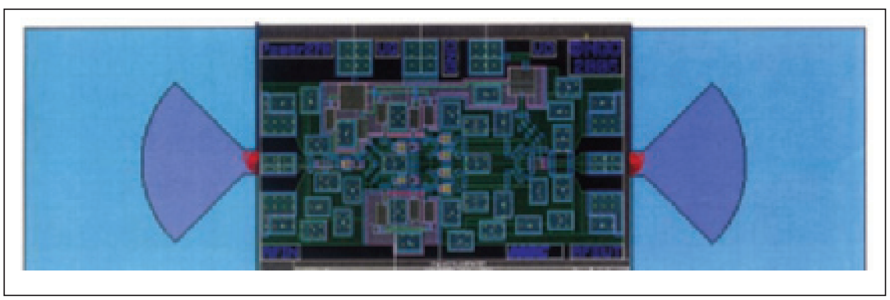


Figure 2. **This Is an Example Plan View of a 340-GHz MMIC** amplifier chip that would incorporate radial probe transitions like that of Figure 1 at both ends. Backside metal would be removed in the probe areas.

The radial probe design could readily be adapted to integration with an MMIC amplifier because it provides for the fabrication of the transition on a substrate of the same material (InP), width (310 µm), and thickness (50 µm) typical of substrates of MMICs that can operate above 300 GHz. The figure depicts the basic geometric features of the design. The conductive part of the transition would be deposited on the InP substrate. The transition (and the rest of the MMIC chip if the transition were integrated with the MMIC) would reside in a metal cavity 360 µm wide having a stepped vertical dimension of total height 200 µm. The metal cavity would be essentially a reduced-cross-section lateral extension of the waveguide. The waveguide would be of a standard rectangular cross section, known in the art as WR2.2, having dimensions of 559 µm by 279 µm. There would be a 50-µm backshort between one vertical side of the metal cavity and the near end of the waveguide. The transition is designed to effect coupling between the microstrip mode of the MMIC chip and the transverse electric 10 (TE_{10}) electromagnetic mode of the waveguide. The choice of dimensions of the metal cavity and the waveguide is governed partly by the requirement that the cutoff frequency of the waveguide be less than the frequency of operation while the cutoff frequency of the transition's cavity must exceed the frequency of operation.

This work was done by Lorene Samoska and Goutam Chattopadhyay of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-43957

Bar-Code System for a Microbiological Laboratory

Time is saved and the incidence of errors is greatly reduced.

NASA's Jet Propulsion Laboratory, Pasadena, California

A bar-code system (see figure) has been assembled for a microbiological laboratory that must examine a large number of samples. The system includes a commercial bar-code reader, computer hardware and software components, plus custom-designed database software. The software generates a user-friendly, menu-driven interface.

Traditionally, microbiological samples have been labeled by hand, and recording of results of microbiological assays has entailed handwriting of bacterial-colony counts in notebooks. This traditional approach is both time-consuming and susceptible to human error, especially when large numbers of samples are involved. By automating the routine aspects of tracking microbiological samples, recording data, and documentation of samples and results, the bar-code system saves time and greatly reduces the incidence of errors.

The bar-code system prints unique bar-code labels that can be easily affixed to test tubes and Petri dishes. During sampling, a technician or microbiologist affixes the labels and uses a personal digital assistant (PDA) with a built-in bar-code scanner to scan the bar codes and record notes. After sampling, the data acquired by the bar-code scanner are downloaded to the bar-code-system database, and then a microbiologist assays the samples.

To record assay results, the microbiologist scans the bar-code label on each test tube or Petri dish and records the data specific to that sample container on

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

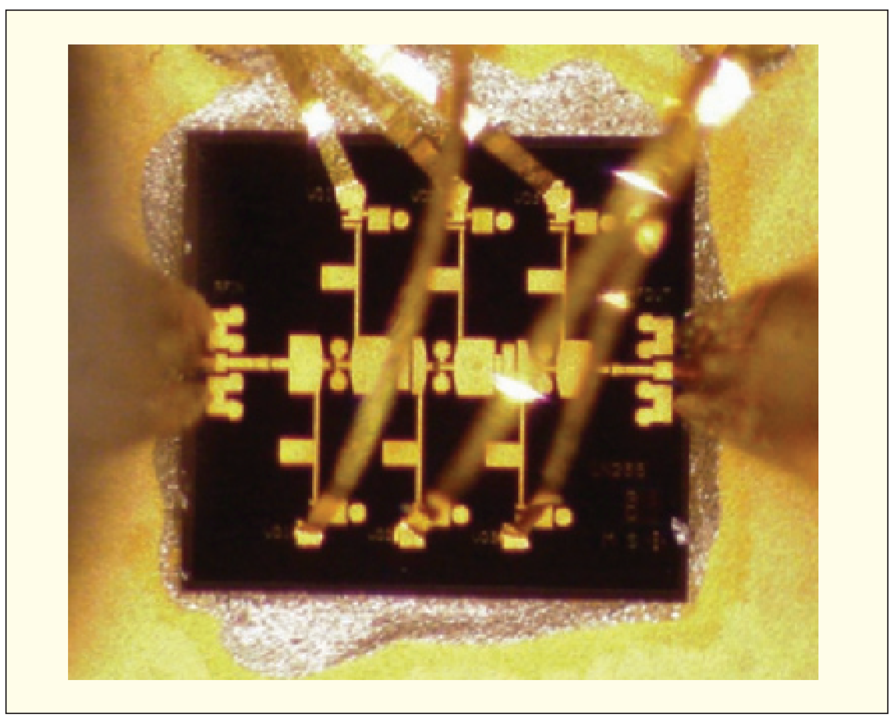
MMIC Amplifier Produces Gain of 10 dB at 235 GHz

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