

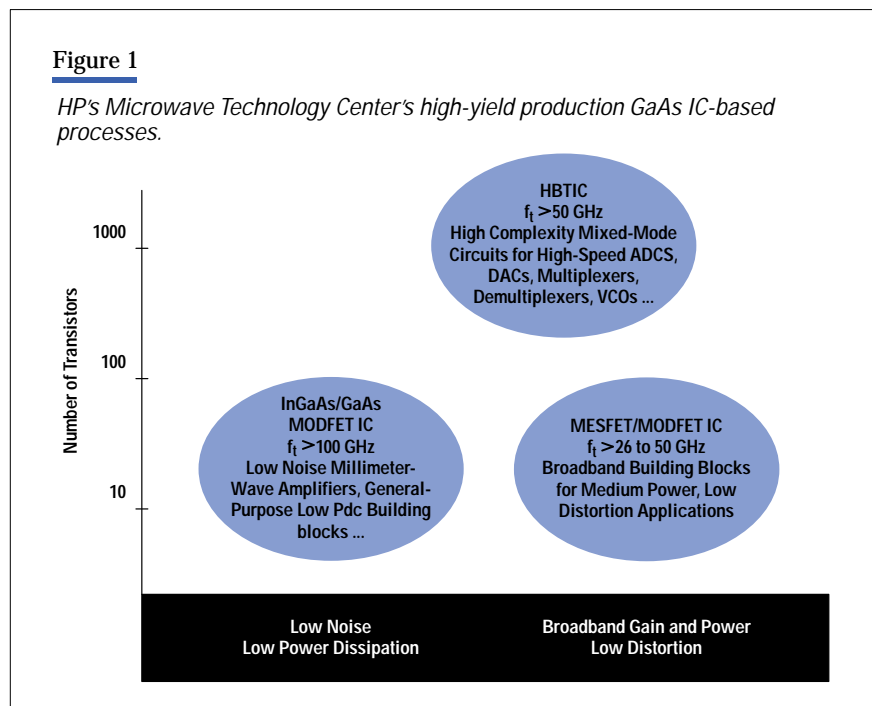
Appendix B—New Process Technology Offers Benefits in Test and Measurement and High-End Microwave and Millimeter-Wave Markets

Since the first discrete GaAs FETs were shipped in HP test equipment in the mid-1970s, HP has continued to invest in and expand its high-speed semiconductor capabilities. Several HP divisions are capitalizing on this investment, which serves customers in a diverse group of markets.

HP's Microwave Technology Center (MWTTC) in Santa Rosa, California has eight III-V-based processes in production, providing high-speed semiconductor solutions for test and measurement applications and high-end microwave and millimeter-wave markets such as point-to-point and multipoint digital radio links. The addition of InGaAs/GaAs HEMT (high-electron-mobility transistor) technology is a natural extension of MWTTC's capabilities, enabling continued improvements in test and measurement solutions.

Within the test and measurement market, the demand for ultrabroadband, highly reliable, precision solutions has been the key driver in the development of semiconductor processes and products at MWTTC. Over time, however, the focus markets that drive the development of HP's test and measurement solutions have shifted from defense and aerospace to commercial and industrial voice and data communications.

The customer's needs in these markets have elevated the importance of linearity, noise figure, phase noise, and power dissipation. HP has addressed these changing needs by adding new process, packaging, and test capabilities. The recent



release of HP's heterostructure bipolar transistor integrated circuit (HBTIC) process enables the design of fast-switching VCOs, precision I/Q modulators and demodulators, and other complex mixed-mode circuits that are required to test digital communications systems. The InGaAs/GaAs HEMT capability, with its high cutoff frequency f_T provides advantages over the 0.25- μm PHEMT (pseudomorphic high-electron-mobility transistor) process, such as lower power dissipation, lower noise figure, and high-frequency coverage. Size and weight are becoming key differentiators when discussing customer needs in the service test market. The high-gain transistor available in the InGaAs/GaAs process results in fewer stages required in a given system architecture, which leads to smaller, lighter, and more portable test solutions. This process also offers a significantly lower noise figure at millimeter-wave frequencies, which in turn eases transmit power requirements for short-haul digital radio links. The high intrinsic f_T also enables simplified, fundamental solutions that are well-matched to customer needs in a variety of commercial low-cost millimeter-wave markets in the 60-to-100-GHz range.

Most important, these benefits can be realized with minimum impact on cost since the process heavily leverages the substrate technology and the passive component chassis currently used in MWTC's existing high-yield production GaAs IC-based processes (see Fig. 1). Overall, the addition of InGaAs/GaAs HEMT technology provides HP with a more complete portfolio to satisfy a continuously evolving set of customer needs.

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- ▶ [Return to Article 4](#)
 - ▶ [Return to Appendix A](#)
 - ▶ [Go to Next Article](#)
 - ▶ [Go to Journal Home Page](#)