

Approximately four years ago, RF Micro Devices began an investigation of process technologies for use in wireless communications products. Our studies indicated that the best approach is to match the technology to the application thus providing the customer with the optimum price/performance solution. Our investigation revealed that Gallium Arsenide Heterojunction Bipolar Transistor technology is the optimum technology for many wireless components; in particular the power amplifier function. In general HBT components have the following characteristics which are essential to wireless communication components:

- 1) High linearity
- 2) Very wide frequency response F max higher than 50 GHz
- 3) High voltage breakdown (greater than 20 volts)
- 4) High gain per stage resulting in high efficiency designs
- 5) Very low parasitics resulting in high Q capacitors and inductors
- 6) No negative power supply required
- 7) Low phase noise
- 8) Thermally rugged

From these advantages it appeared that HBT was the optimum technology for all wireless components. However there were some perceived disadvantages, namely:

- 1) Perception of low reliability
- 2) High cost
- 3) Poor manufacturing uniformity resulting in unreliable deliveries and additional costs

Fortunately for the wireless market, RF Micro Devices and TRW have been able to significantly reduce or eliminate the above mentioned disadvantages. TRW, through their use of Molecular Beam Epitaxy and their vast working knowledge of HBTs (in excess of eight

years), has produced devices which are extremely reliable. These HBT devices have Mean Time Between Failures of 1100 years at an operating temperature of 125 degrees Celsius. Additionally, RF Micro Devices has performed numerous life tests on several different types of components produced using HBT.

Our life tests have indicated devices which are extremely rugged thermally. In addition, TRW has performed a space qualification on an HBT MMIC, therefore the HBT process is now space qualified.

No matter how superior the technology, if its cost is prohibitive for the application (typically consumer products), a good match does not exist. RF Micro Devices has taken the lead in reducing the die size of various wireless components through proprietary techniques. By reducing the die area, the cost per component has been reduced to the point where HBTs are effectively competing with GaAs MESFET and high performance Silicon Bipolar devices. As an example, RF Micro Devices offers HBT components which, in OEM quantities, sell below one dollar.

TRW has perfected a manufacturing process flow which has enabled uniformity of production. This uniformity of production is indicated by consistent betas from lot to lot and by extremely high wafer yields. HBT is the optimum process technology for many wireless applications because it meets the requirement of the best price and performance of any commercially available process.

This article was originally presented in Wireless Design & Development; April 1995.

Author: Jerry D. Neal
Company Founder
Vice President of Sales and Marketing
RF Micro Devices, Inc.