COMMERCIAL GaAs MMIC APPLICATIONS

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ABSTRACT

The future of the GaAs MMIC industry is in the commercial sector. There is a cornucopia of high volume applications, such as DBS cellular telephone, PCM, fiber optics and GPS that are targets for cost effective GaAs MMIC solutions. The key to success is the ability to produce functional circuits in high volume at low cost. To be successful takes a shift in emphasis from low volume, high selling price "jewelry" applications, to the rigors and discipline of high volume manufacture.

INTRODUCTION

Commercializing GaAs MMICs is analogous to the biblical pronouncement to "turn your swords into plowshares..." For most of the researchers and companies in the U.S. making and creating GaAs ICs, the end use market, if you will, was in a missile, a radar, an E.W. receiver, a jammer, or rad hard computer. In short, the end mission of GaAs IC development was an "electronic sword ..." a weapon.

Ever mindful of the great success of Desert Storm, the realities of the 1990s are that defense end markets are likely to decline. The good news for GaAs MMIC suppliers, however, is that a large and fertile commercial field exists, ready to be plowed.

Questions facing the GaAs MMIC industry in pursuing commercial applications are as follows:

- What are the large fertile markets?

- How do I compete in these markets?

- What do I do differently as a company?

MARKETS

From our perspective, the key attribute of the commercial GaAs MMIC market is "high annual production volume;" for with it means millions of units/year, not thousands. Where are these million unit/year markets?

Start with products you can find in every:

- home
- office
- pocket
- vehicle

throughout the world.

Examples of these products are:

Home:

- DBS - TV Receivers
- TV/VCR Receivers
- Intrusion Alarms

Office:

- Computer Networks
- Wireless Telephone
- V-SAT

Pocket:

- Wireless Telephone (PCN)
- Pagers

Vehicle:

- Cellular Telephone
- Collision Avoidance/Braking
- Toll Collection
- Navigation

The key characteristics of these applications are that:

a) most are currently in existence

b) most are served by discrete components, and

c) most are worldwide markets.

These markets are available and accessible to GaAs MMIC technology.

Figure 1 shows the forecasted commercial GaAs IC market by Strategies Unlimited. As you can see from this chart, the highest probability of insertions in the 1990-94 period are analog (MMIC) GaAs ICs. The beauty of analog GaAs ICs is that the market is large, ubiquitous and an excellent fit with the technology.

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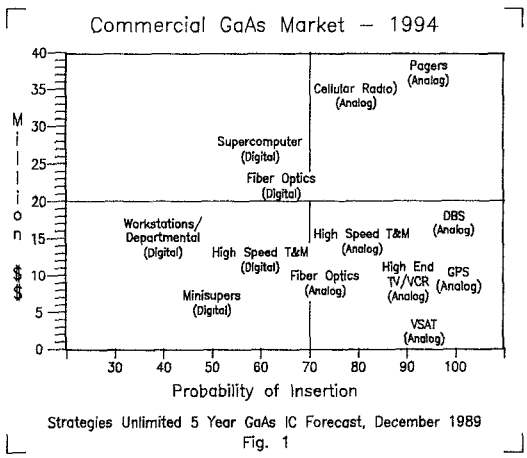

Fig. 1

COMPETITIVE ENVIRONMENT

To compete in these markets you have to be a high volume, low cost supplier. This is a paradigm shift for most U.S. GaAs IC technologists used to supporting the "jewelry" business that is defense applications. Figure 2 is a comparison of serving defense versus commercial applications.

	DEFENSE	COMMERCIAL
APPLICATIONS	RADAR, EW	TV, PCN
TERRITORY	U.S.A. ORIENTED	GLOBAL
R & D	PERFORMANCE DRIVEN	COST DRIVEN
PRODUCTION	FUTURE	IMMEDIATE
QUANTITIES	1000's	1,000,000's
PRICING	HIGH	LOW

Fig. 2

In order to successfully penetrate the commercial GaAs IC market, certain "culture" changes have to be made within an organization. The first is adjusting to "sticker shock" associated with the selling price, typically $1-$10/unit for functions that in the defense industry might be ten times that. The key to addressing these conditions is to design for low cost.

What are the main factors involved in these cost breakthroughs?:

1. Smallest die size possible for the function.
2. The most functionality possible.
3. Margin to final specification.
4. High yield at die probe.
5. Low cost packaging.
6. High speed automated testing.
7. High yields throughout the process.

Some important figures of merit to achieve these goals are as follows: Typical DBS die size in reported papers was 4-6 mm^2 with via holes. ANADIGICS' DBS die size is approximately 2 mm^2 and no via holes. Typical parts have 5 dB more gain and 2 dB better noise figure than specification. Packaging is moving from low cost TO-5 cans to surface mount plastic. Probe yields are typically 80%. Test times are 3-15 seconds per unit for fully functional 100% tests. One operator can handle 2-4 test stations. Overall yields from wafer start to tested packaged product will approach 50%. This means shipping 2,000 mm^2 of product for every 75 mm diameter wafer start. Annual quantities of 1 million units/year allow this type of manufacturing performance through learning curve and investment.

CULTURE CHANGE

The key to success in commercializing GaAs ICs is to see the world differently. For GaAs MMICs this means:

- markets and customers are global
- competitors are global (i.e., Japan)
- cycle time to market is critical
- low cost high volume capacity is essential
- Continuous improvement is the key to market share
- know your customer and their customer.

I firmly believe that commercial markets for GaAs MMICs are enormous, and we are now just scratching the surface. Commercial markets will dwarf defense markets in the 1990s. In order to participate, you must focus on segments and totally commit resources. Furthermore, I believe that the rewards for individuals, companies and this country will be substantial if we seize the opportunity.