



Making MPAR a Reality

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Take Away

- The Technology to Make MPAR a Success Exists Today
 - It is Proven, Robust, and Reliable
- Integration is *THE* Path to Lower Cost
 - At the: MMIC, Module and Sub-Array Level
- Tyco Electronics/M/A-COM Endorses and Supports the Cost and Technology Goals of the MPAR Program

Business Overview

Tyco Electronics

Tyco Electronics is a leading global provider of engineered electronic components, network solutions and wireless systems with 2006 sales of \$13 billion to customers in 150 countries. We design, manufacture and market products for customers in industries from automotive, appliances and aerospace and defense to telecommunications, computers and consumer electronics. With over 8,000 engineers and worldwide manufacturing, sales and customer service capabilities, Tyco Electronics' commitment is our customers' advantage.

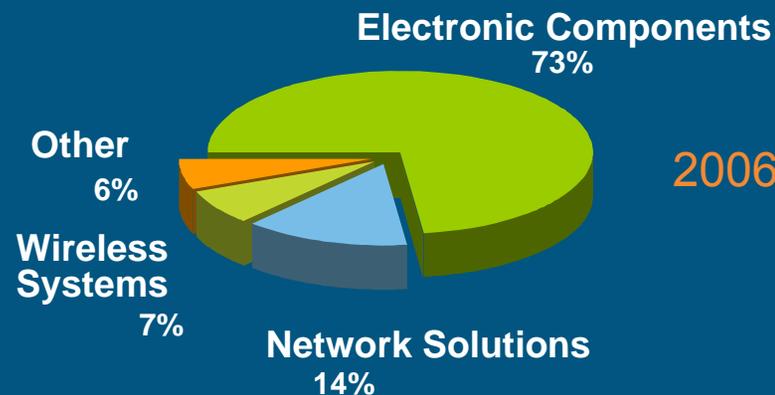
Segments

Electronic Components – Electronic Components is the world's largest supplier of passive electronic components, including connectors and interconnect systems, relays, switches, circuit protection devices, touchscreens, sensors, and wire and cable.

Network Solutions – Network Solutions is one of the world's largest suppliers of infrastructure components and systems for telecommunications and energy markets.

Wireless Systems – Wireless Systems is a leading innovator of wireless technology for critical communications, radar and defense applications.

Sales by Segment



2006 Sales = \$ 12.7 billion

Dual-Use Manufacturing Strategy



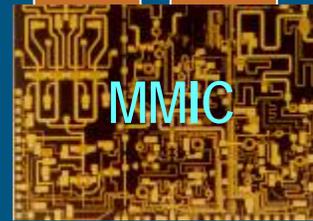
Wireless Data



Mobile and Cordless Phones



Automotive Sensors



MMIC



Shipboard Radar



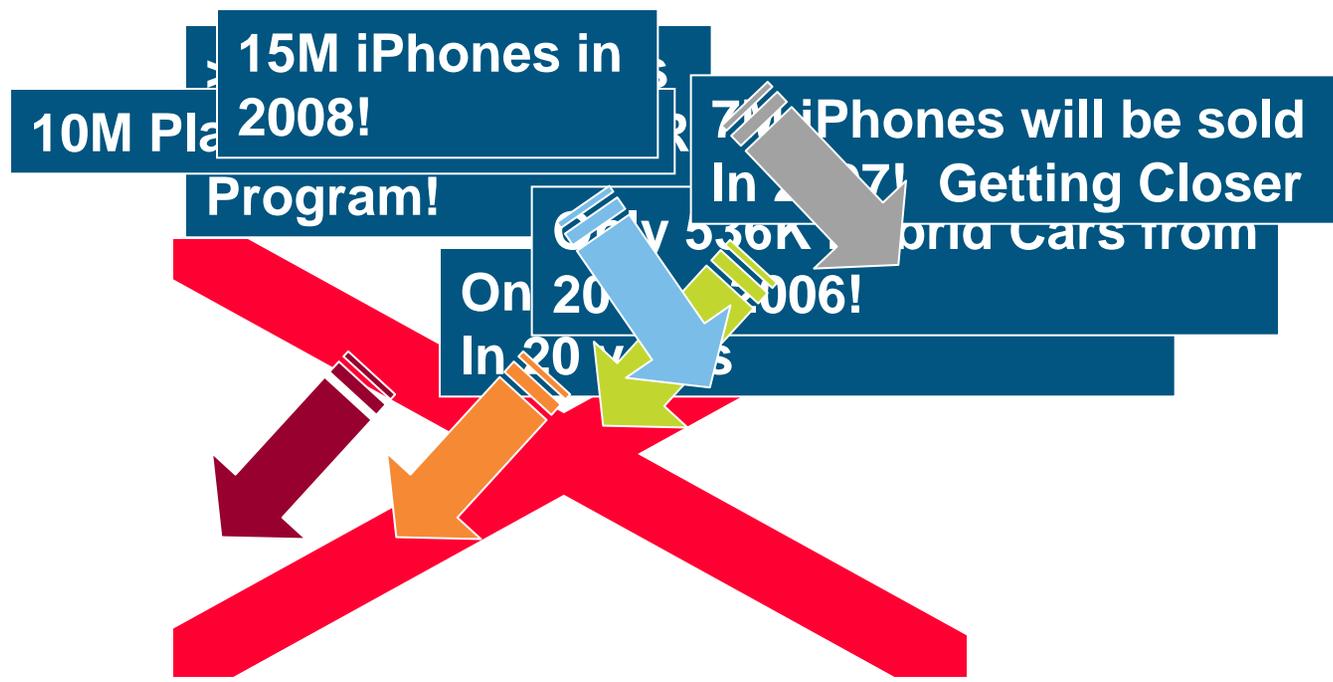
Airborne Radar



Surveillance and Landing Radar



A Matter of Scale



Approach

- Historic Approach to T/R Modules for AESA's will not work
 - Does not fit the scale of the problem
 - Will not achieve required cost/performance goals
- Need to emulate commercial practices
 - Get the scale right
 - Get the cost right
 - Get the performance right



Think iPhone not F/16!

Foundries



Roanoke FAB

5310 Valley Park Drive, Roanoke, VA 24019



- 43,400 ft²-two buildings
- 3,000 ft² clean manufacturing space
- 6,000 ft² wafer fab space
- GaAs Power MESFET based Integrated Circuits

Lowell FAB

100 Chelmsford St.
Lowell, MA 01851



- 157,605 ft²
- 31,273 ft² clean manufacturing space
- 16,700 ft² wafer fab space
- GaAs MESFETs, pHEMT
- Captive GaAs material source

Device Technologies

Internal Technologies

Technology

- GaAs MESFETS
- GaAs PHEMTs
- GaAs E/D MESFETs

- GaAs E/D PHEMTs
- Silicon Bipolar
- Silicon LDMOS
- Silicon Diodes
- GaAs Diodes
- Glass Technology
- GaN/Si and GaN/SiC

External Technologies

Technology

- SiGe
- RF CMOS

Applications

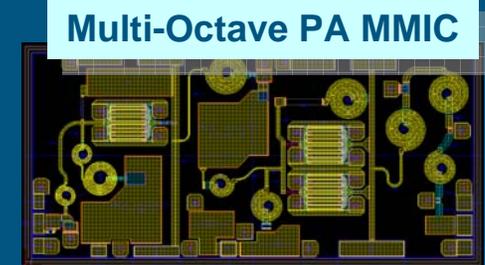
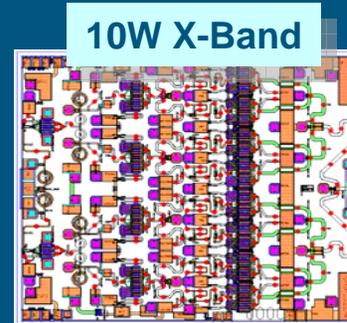
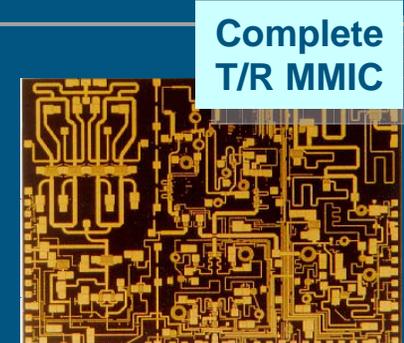
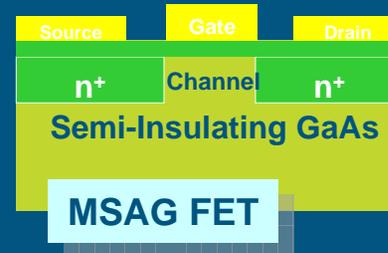
- Switches, LNAs, Mixers, PAs
- MMWave, PAs, Switches, LNAs
- Converters, LNAs, Mixers, Limiters
- Multi-functions
- Low Current Converters, LNAs, Mixers
- Power Transistors
- Linear Power Amplifiers
- Switching, Detecting, Tuning
- Tuning, Switching
- Integration

Applications

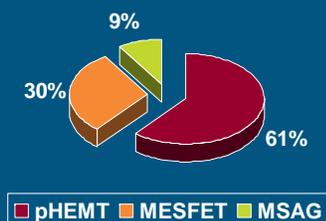
- Power Amplifiers
- SoC

Monolithic Microwave Integrated Circuits (MMICs)

- **Design Flexibility**
 - Multifunction Self Aligned Gate (MSAG)
 - Analog & Digital
 - Low Noise & High Power
 - RadHard Control Circuitry
- **Broadband Power MMIC's**
 - High Voltage MSAG (HV-MSAG)
 - Wide Bandgap Performance
 - Proven Fabrication Process
- **Lower Cost & Higher Reliability**
 - Reduced Parts Count
 - Reduced Handling/Bonding
 - Dual Use Foundries



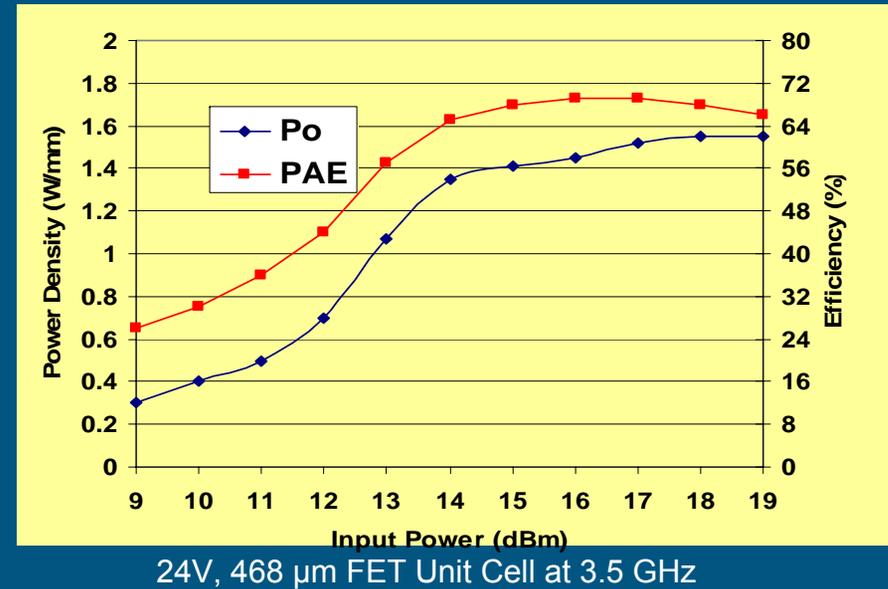
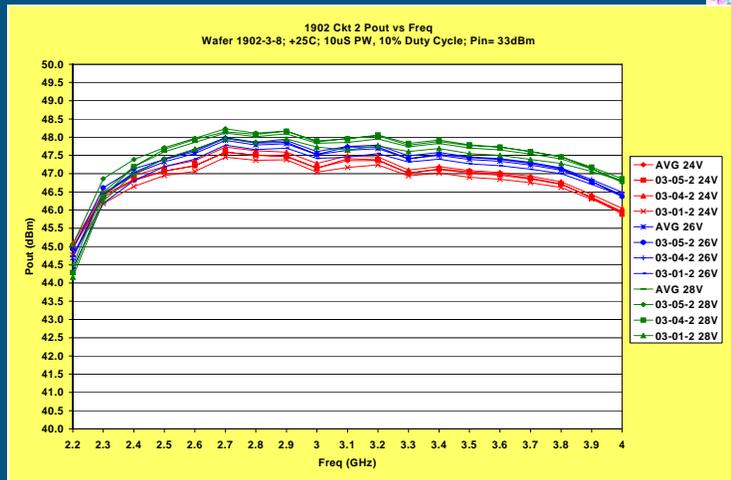
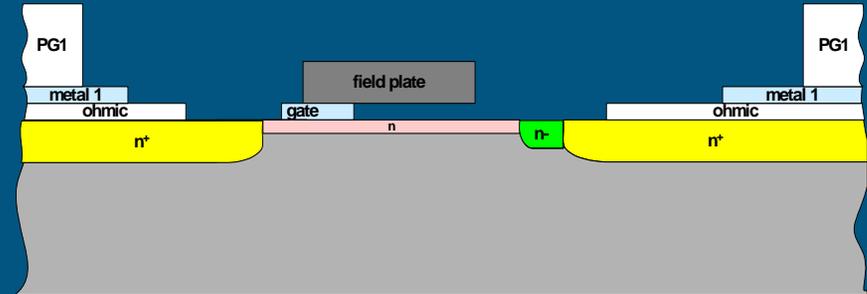
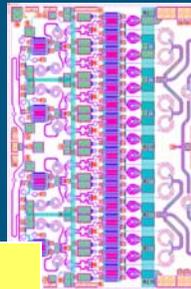
250 Million Commercial MMICs in 2 Years



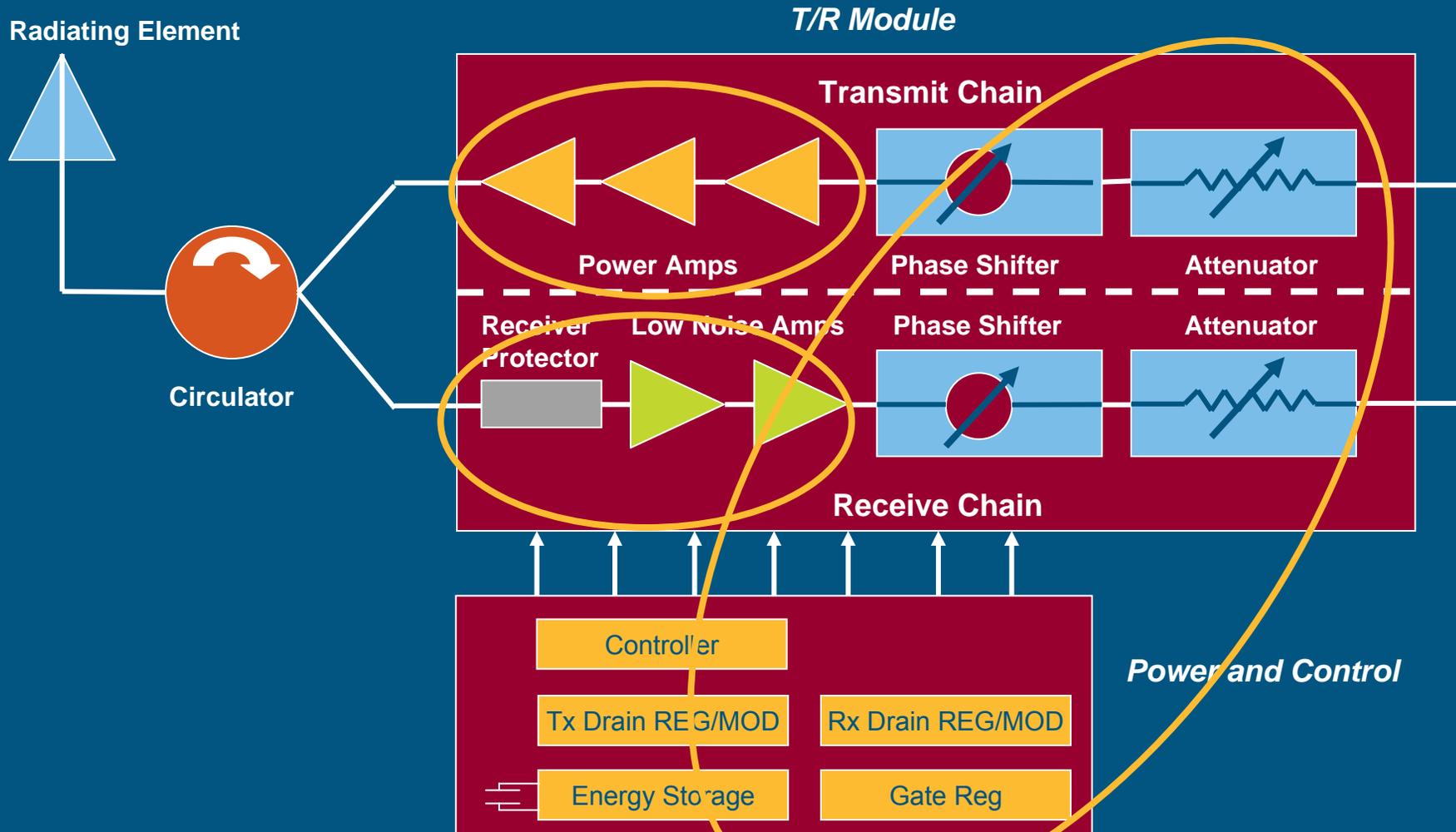
High Voltage MSAG

High Voltage – High Power - Today

- Only HV – HPA Process to ship production volume
- Demonstrated reliable and robust: MTTF >10⁶ hrs
- Multifunction integration



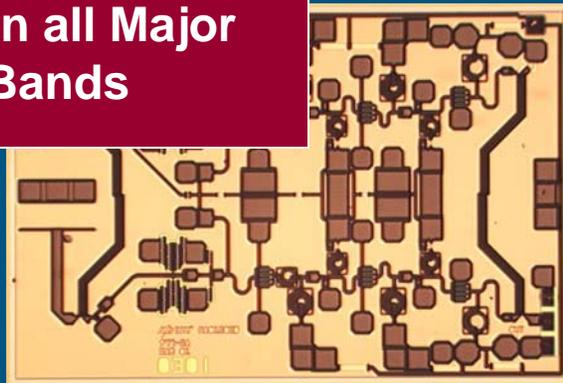
Integration Path



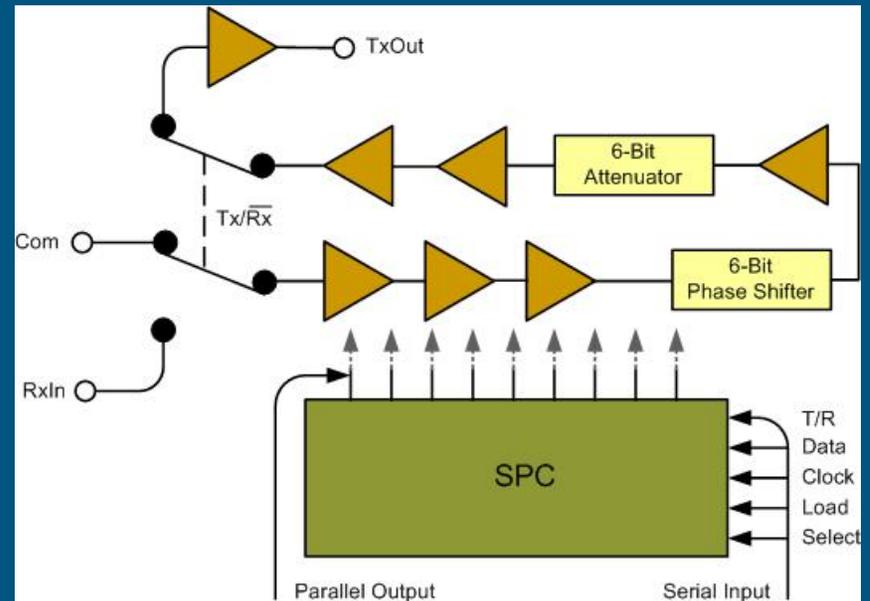
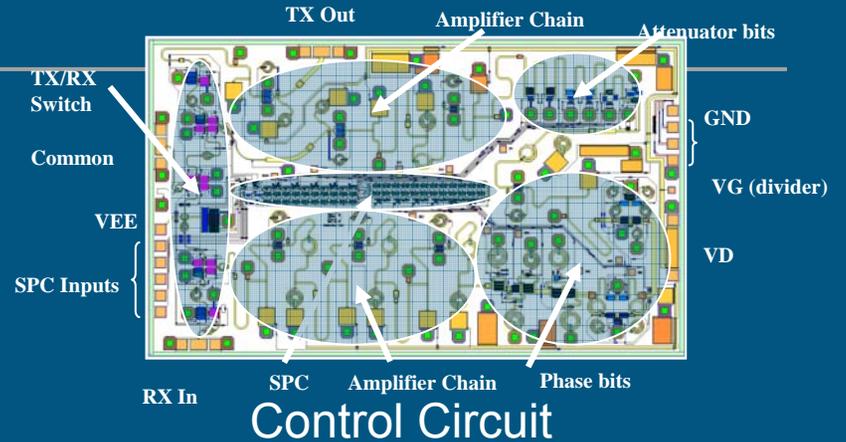
“Semi” Integrated Solution

- Limiter/LNA Combined
- Switches, Phase Shifter, Attenuator, and Drivers (Common Leg Circuit) Combined with Serial/Parallel Interface
- HPA separate

Product in all Major Radar Bands

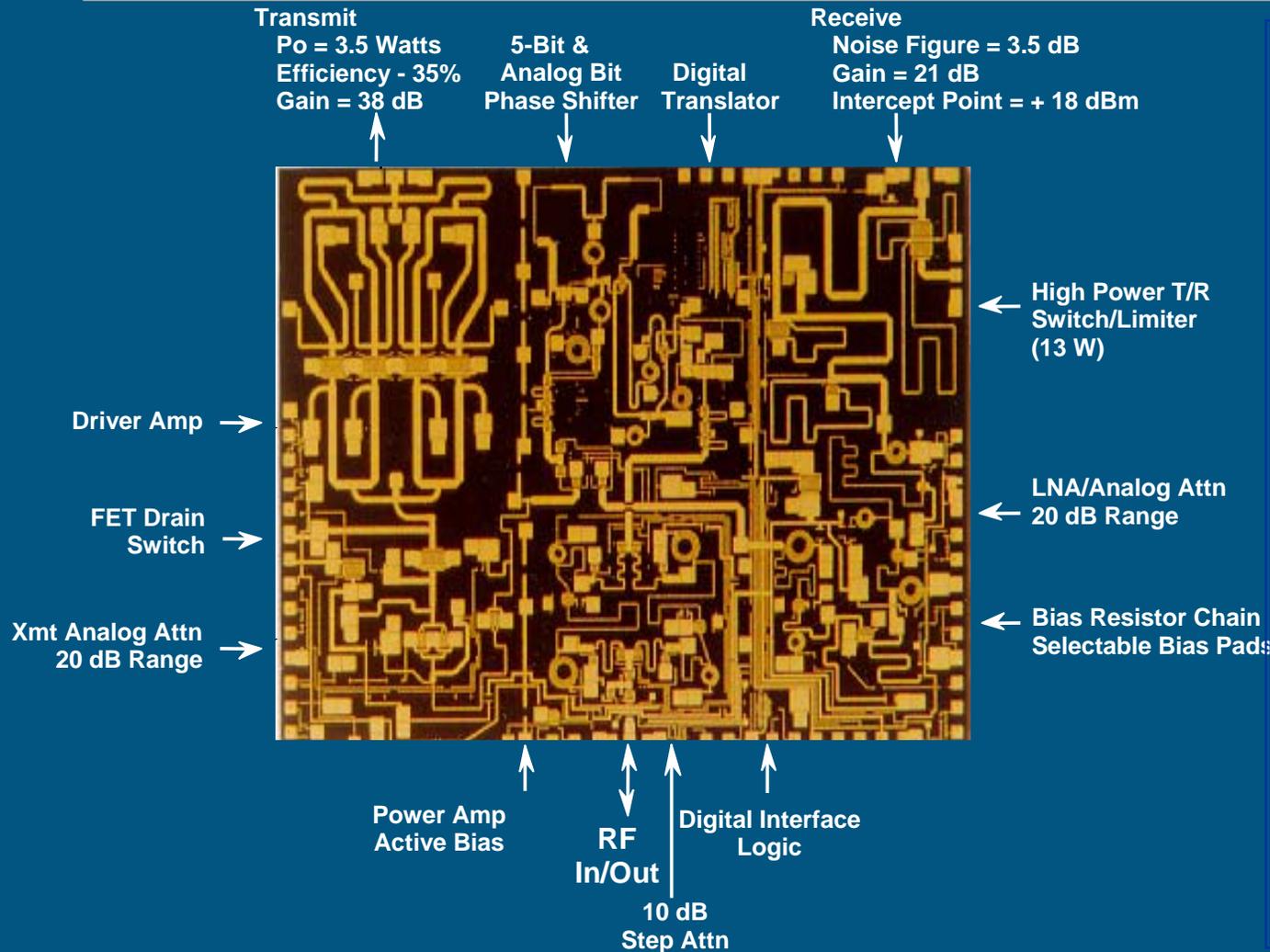


Limiter/LNA



Block Diagram

Fully Integrated Solution



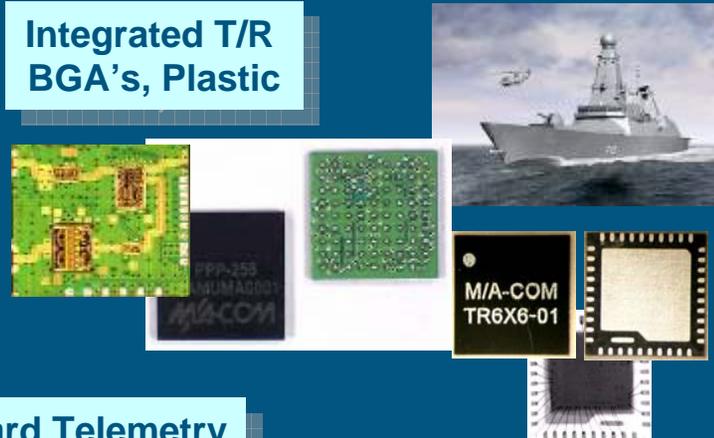
Benefits

- ✓ Simplifies next level assembly
- ✓ Improves reliability by reducing interconnections
- ✓ Transfers more of microwave testing to a lower value added point-on wafer
- ✓ Improves next level assembly yield
- ✓ Best value in reducing overall cost

Low Cost Modules

- Design Flexibility
 - Vertically Integrated Solutions
 - Tx, Rx, Phase, Atten, Full T/R Modules
 - Sub-array development
- Wide Operating Range
 - UHF to W-Band
 - Power Modules
 - High Dynamic Range
- Applications
 - Missiles/Seekers/PGMs
 - Airborne & Shipboard Radar
 - Gun Hardened Telemetry Modules
 - Data Links
 - SATCOM
 - SIGINT, COMINT

Integrated T/R
BGA's, Plastic



Gun Hard Telemetry



High Power Land Grid Array



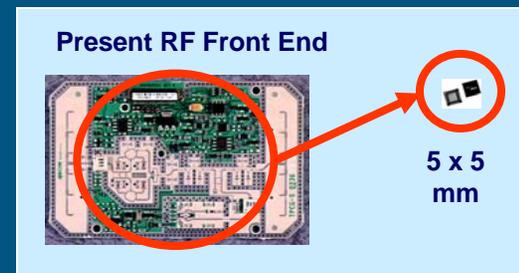
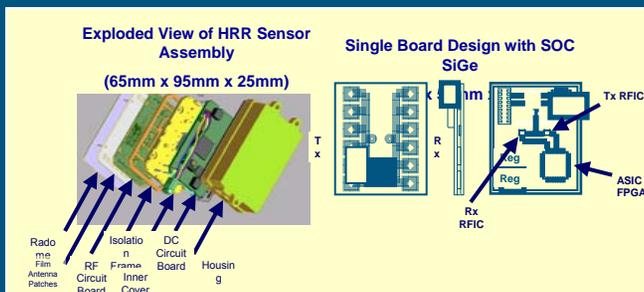
State of the Art Infrastructure



Two Examples of Cost Reduction

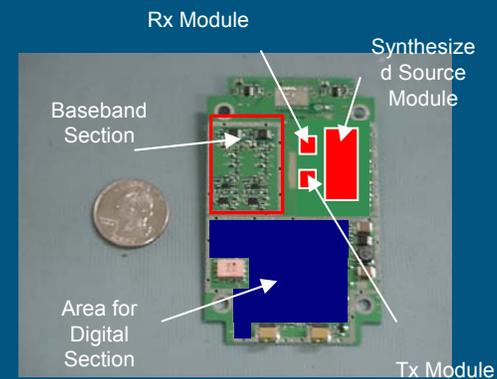
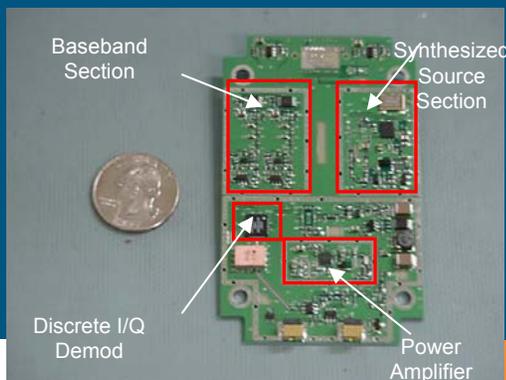
- **24 GHz Automotive Radar**

- Initially designed for Cost and Manufacturing
- Cost Reduction: Integration of RF to 2 Chip SiGe Solution → Further Reduction to 1 Chip CMOS Solution



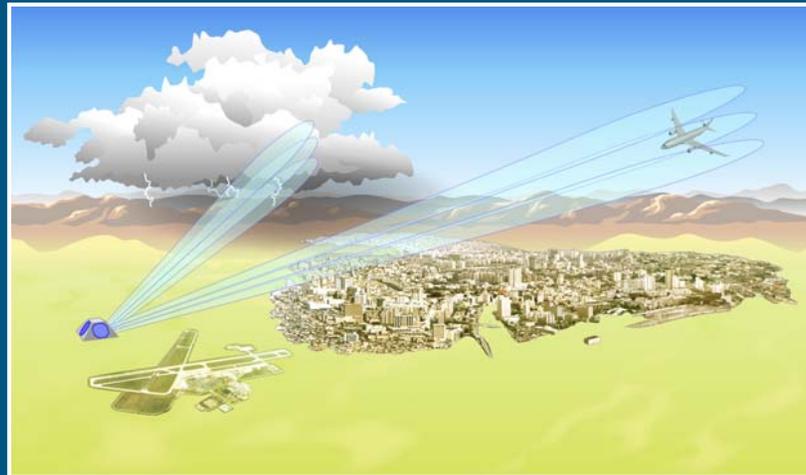
- **RFID Reader**

- Initial Design Large and High Cost
- Cost Reduction: Integrate RF functionality



Summary

- The Technology to make MPAR a success exist today
 - Proven, Robust and Reliable
 - At the MMIC, Module and Subsystem Level
- Integration is a key cost reduction tool
- Dual Use “Commercial” Manufacturing to drive cost down
- Next Step: Demonstrate the approach to prove the concept



Weber et al ... MIT - LL