THERMAL ISSUES IN ELECTRONICS APPLICATIONS

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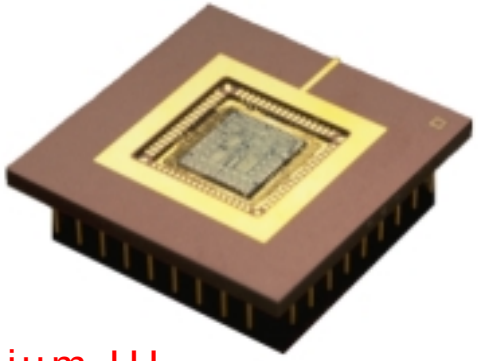
40 Watts! What's the big deal?



Pentium III

- 0.25 micron CMOS technology
- 9.5 million transistors
- 450 - 550 MHz

Light Bulb

- Power: 40 W
- Area: 120 cm^2
- Flux: 0.33 W/cm^2

Silicon

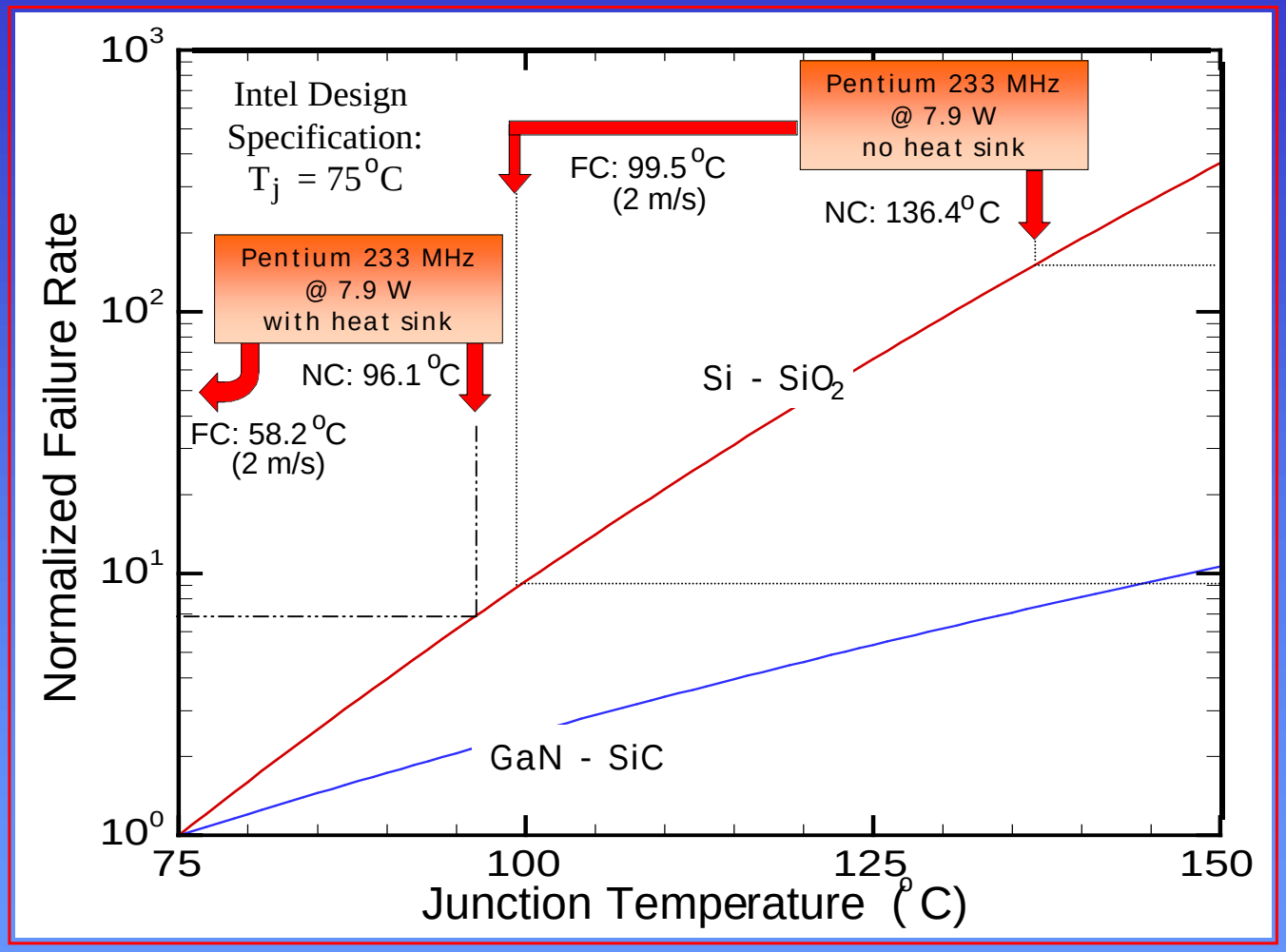
- Power: 40 W
- Area: 1.5 cm^2
- Flux: 26.7 W/cm^2

80 x

Package

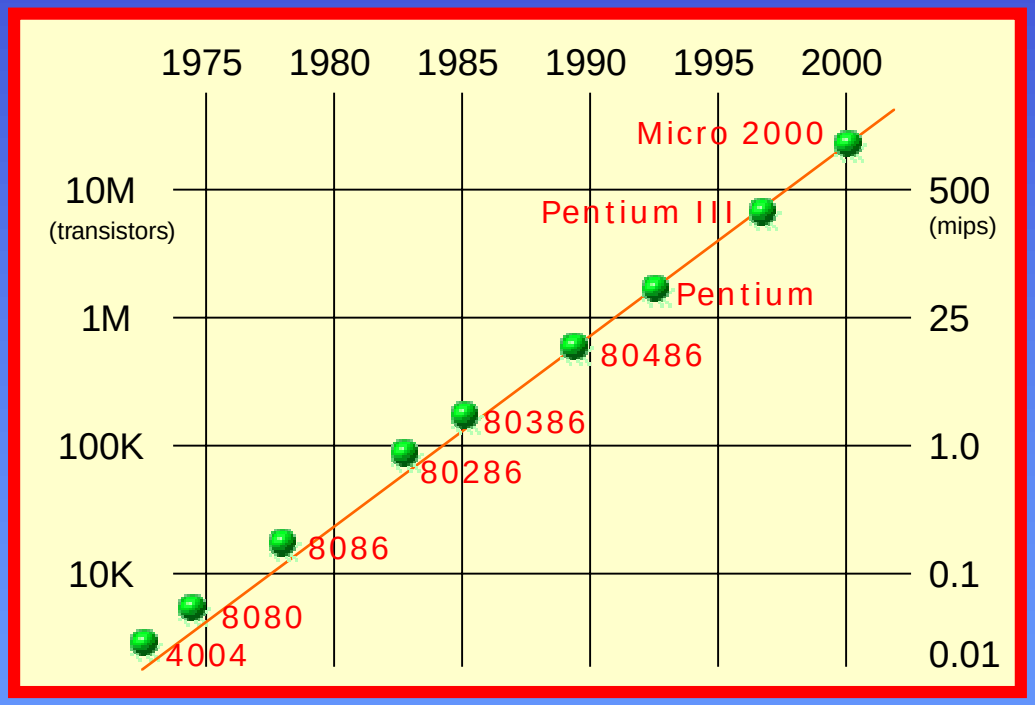
- Rj-c: 0.94 C/W
- Rj-a: 6.8 C/W (no heat sink)
- Rj-a: 2.5 C/W (heat sink)

Component Failure Rate



Moore's Law (1965)

- each new chip contains roughly twice as much capacity as its predecessor
- a new generation of chips is released every18 - 24 months



From: www.intel.com

- *in 26 years, the population of transistors per chip has increased by 3,200 times*

IC Trends: Past, Present & Future

	1980	1999	2003	2006	2012
Comp. Per Chip	0.2 M	6.2 M	18 M	39 M	100 M
Frequency (MHz)	5	1250	1500	3500	10000
Chip Area (sq. cm)	0.4	4.45	5.60	7.90	15.80
Max. Power (W)	5	90	130	160	175
Junction Temp. (C)	125	125	125	125	125

From: David L. Blackburn, NIST

What Does The Future Hold?

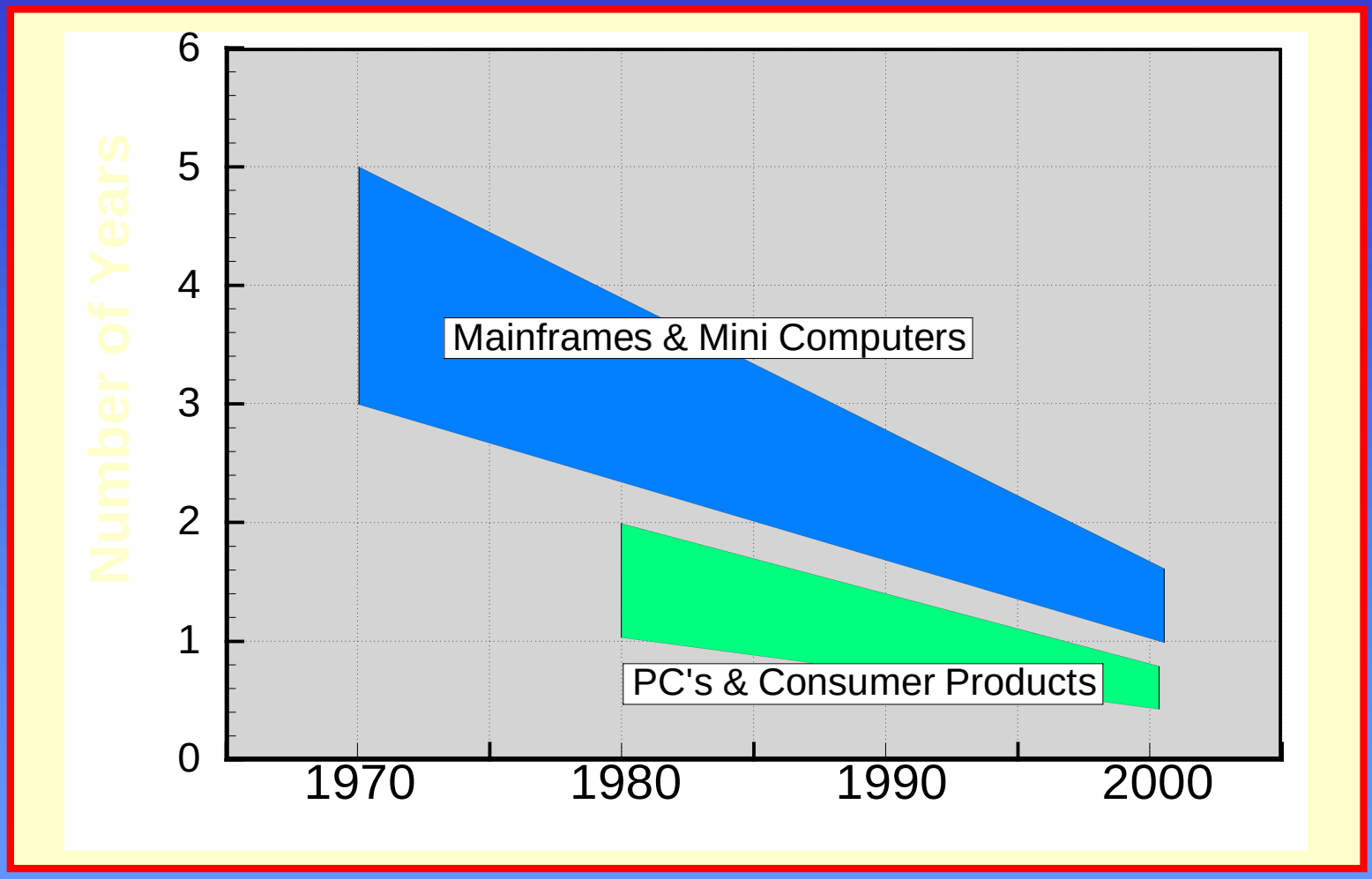
- More of the same?
  - higher packaging densities
  - higher heat fluxes
- Can we rely on a technology break through?
  ie. Bipolar ➪ CMOS ➪ ?
- Thermal design tools must become part of a fully integrated design tool set

Design Challenges

- Reduce design cycle times to a minimum
  - numerical simulation and prototype testing are becoming less viable
    - especially during preliminary design cycles
  - optimization tools

- Concurrent design
  - requires multidisciplinary skills
  - simplicity is imperative

Product Design Cycle



Future Considerations

- Optimization tools
  - faster models
  - I/O portability for concurrent designs

- Improved access to design tools
  - web tools
  - extranets
  - machine portability
  - standardized test methods