The Global Electronic Packaging Roadmap: The Drive to Lower Cost

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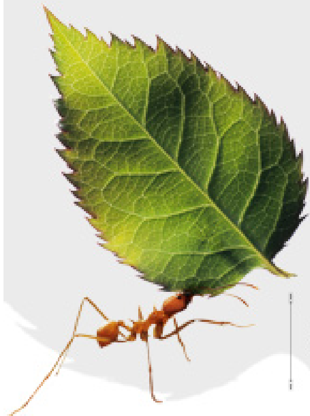

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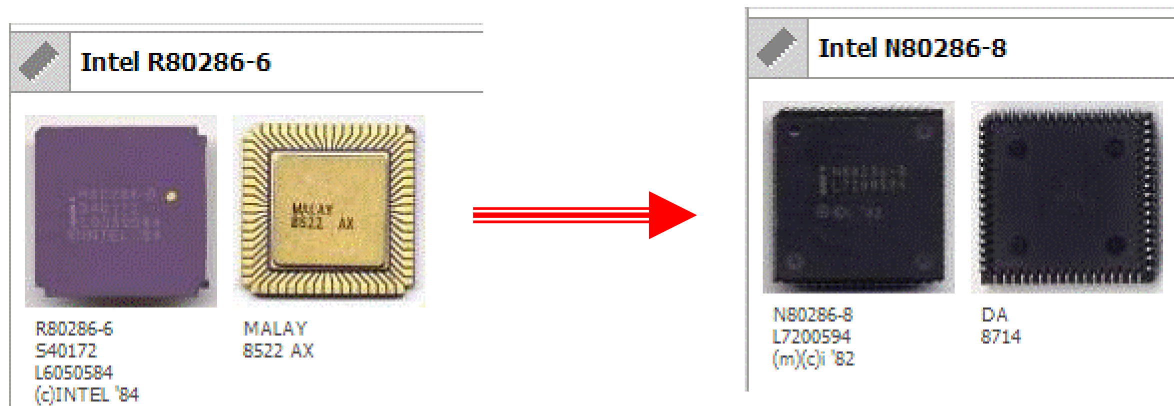
Semicon West July 2006

The Over-riding Drive to Lower Cost

1987
Intel 80286 Processor
Conversion from ceramic LCC to PLASTIC



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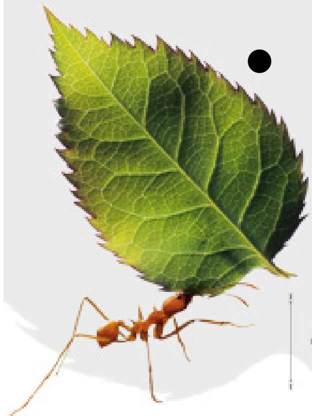
From 1987 to 2006…

- The drive to lower packaging and assembly cost is accelerating….
  - Infrastructure applications
  - High thermal demand applications
  - High Voltage, High Current applications
- Replace ceramic with plastic solutions
- Driven by advances in design and materials

Outline of Presentation

- The drivers for ceramic replacement
- Key examples: high power semiconductors
  - Motor control (IR/Sanyo)
  - Cellular Infrastructure (Freescale)
  - Optoelectronics (Nortel)
- A review of new organic technologies and solutions
- Impact on the packaging industry over the next decade

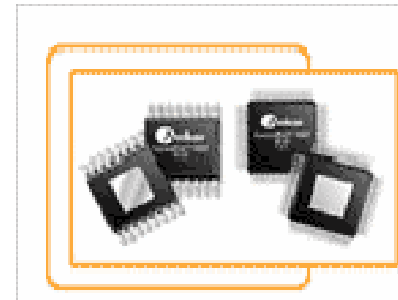


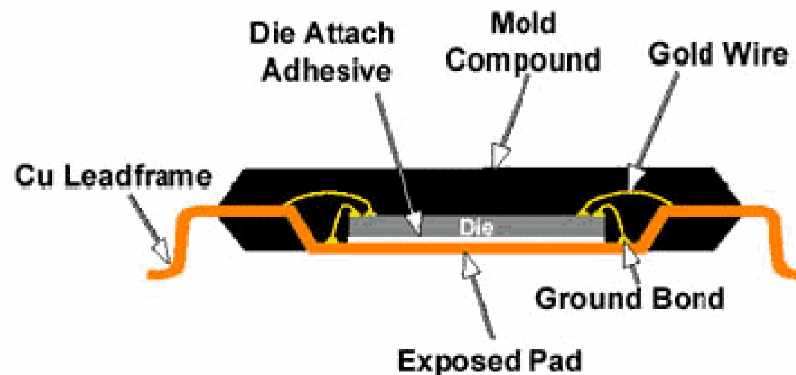
The Drivers to Replace Ceramic with Plastic

- Lower material costs
- Larger format size fabrication
- Higher manufacturing throughput
- Tighter dimensional control- lowers assembly costs
- Well established and competitive supplier base

Thermal Management in Plastic Packages: Amkor

- Amkor: 1991
- Overmold with exposed copper paddle
- 4 Watt Devices
- Cell phones, PDA





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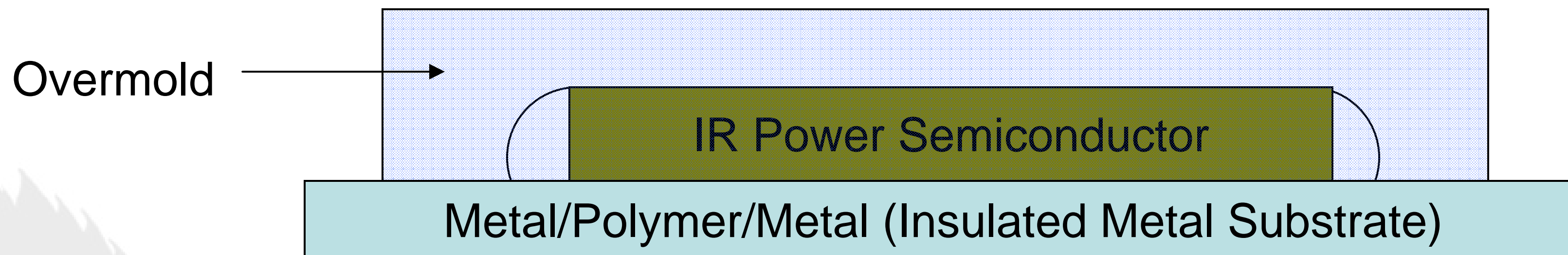
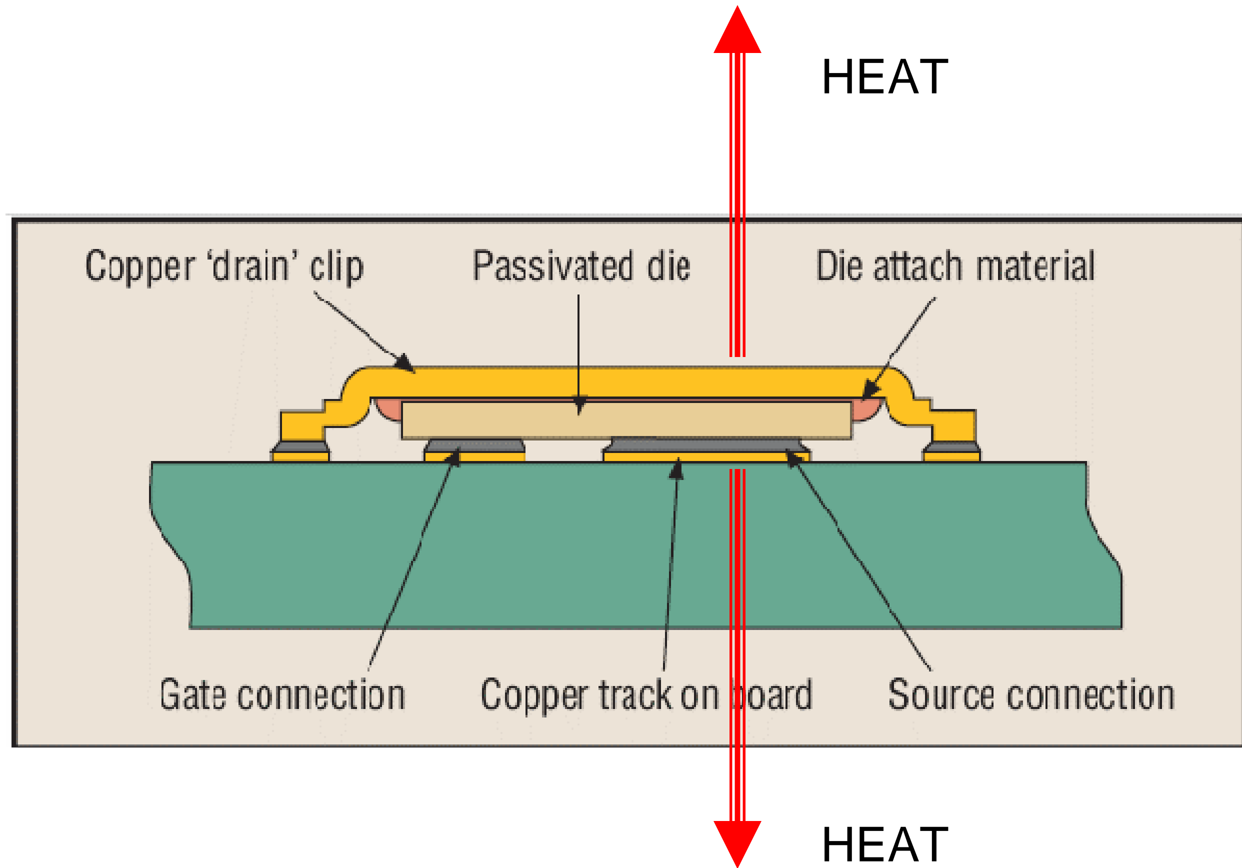
Power Semiconductor Applications: IR and Sanyo Technology

- IR and Sanyo: 2003
- Current levels > 15 Amps
- Motor Control Modules
- Replacement for DBC

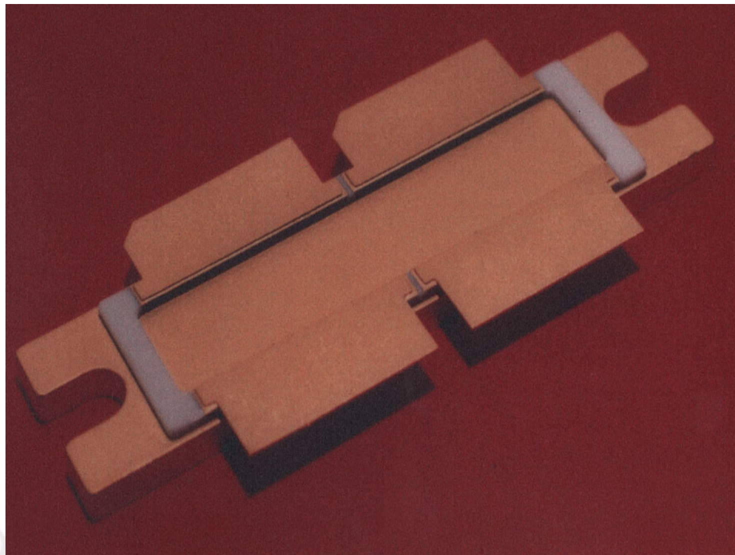


Power Semiconductor Applications: IR DirectFET

IR's DirectFET MOSFETs set industry standard for Intel Itanium 2 processor power.



RF Power Applications: Plastic Overmold



- Freescale Semiconductor
- Overmold Plastic Package
- Cellular Basestation Power Amplifier
- Up to 2.7 GHz
- Power levels > 100 Watts
- Continuous device operation 200C

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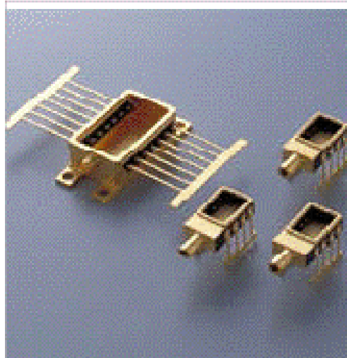
Optoelectronic Applications



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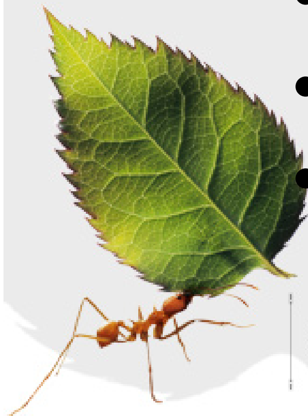
News Release

February 23, 1999

Nortel Networks and Hitachi Technical Collaboration Produces Plastic Packaging Technology for MiniDIL Laser Products

- Nortel/ Hitachi
- Injection molded plastic and metal
- Replaces ALN ceramic
- Semiconductor laser and fiber housing
- Long haul telecommunications
- GR-486-CORE reliability



LCP is the New “Ceramic Solution”

- Liquid Crystal Polymer
- Moisture impervious
- Metallization is reliable and robust
- Can be laminated and injection molded
- Low dielectric loss up to 80 GHz
- Stable up to 400C (Quantum Leap)
- Broad Supply Base: Quantum Leap Packaging, Rogers, Sumitomo, 3M, RJR Polymer, Handy and Harman

Quantum Leap LCP Data

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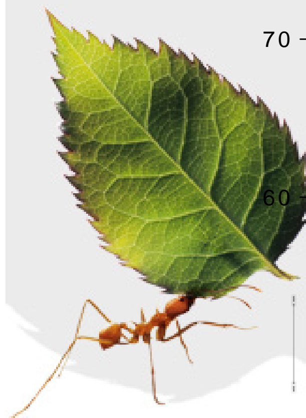
110
100
90
80
70
60
0
200
400
600
800
1000
Weight (%)
Temperature (°C)
30-1 TGA.001
30-2 TGA.001
102
100
98
96
100
200
300
400
Universal V3.9A TA Instruments

QLP LCP stability to 400C



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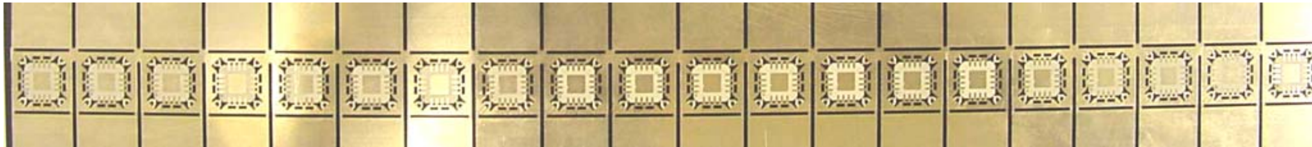
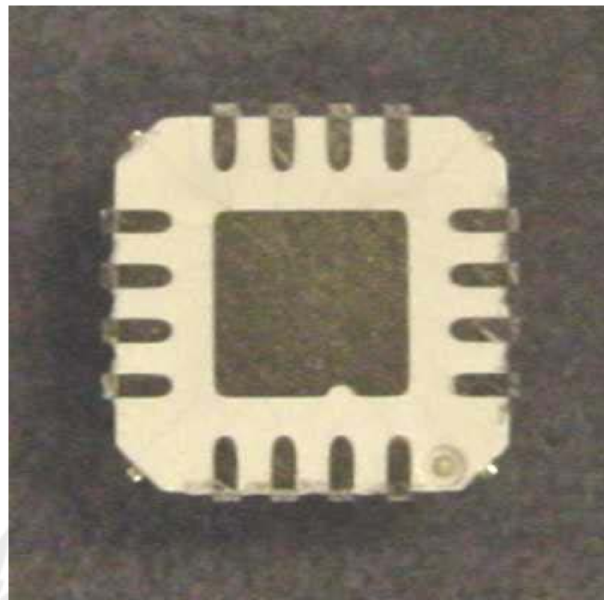
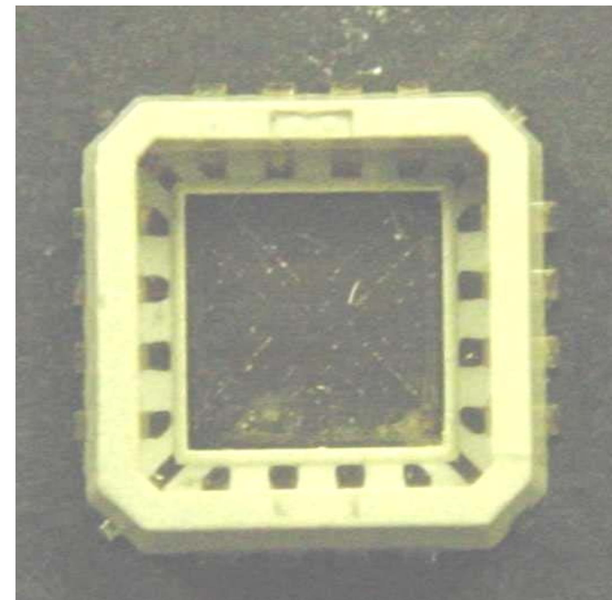
Injection Molded LCP QFN Cavity Packages

Quantum Leap Technology





BOTTOM VIEW OF THE SINGLE UNIT



TOP VIEW OF THE SINGLE UNIT

Electronic Packaging Industry Impact

- Continued attrition of ceramic supply base
  - Alcoa, National (LTCC), CTS (ceramic)
  - Focus on niche military applications
  - Ceramic margins will be under intense pressure (CMOS Image Sensor, SAW Filter)
- ***Increasing focus of suppliers <u>with polymer core strength</u> into packaging: 3M, GE Polymer, Ibiden, Isola, Sumitomo, DuPont..***

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Electronic Packaging Industry Impact

- Growth and expansion of innovative polymer-solutions companies worldwide
  - Specialty polymers for high performance applications
  - Licensing of polymer IP to volume manufacturers
  - Commodity production in Asia
- Many opportunities for new “low cost enabling” technologies