Flip-Chip On Module Application

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Market-Driven WLCSP Development

- **The consumer and mobile markets are driving the need for wafer-level chip-scale packaging (WLCSP)**
  - Form factor
    - Smaller products require more memory in same or smaller space
- **The multichip package (MCP) market is driving the need for new high-volume wafer-level test methods**
  - Wafer-level burn-in (WLBI) or some equivalent stress
  - Speed and function that emulates back end

WLCSP Memory Module

- A secondary benefit of the WLCSP and WLBI development is flip-chip on module (FCOM)
- Today, package assembly and back-end tests make up a large percentage of the overall memory device cost
- In the future, package costs may become even higher to enable high-speed operation
- To keep the overall costs down, new packaging and testing methodologies must be developed

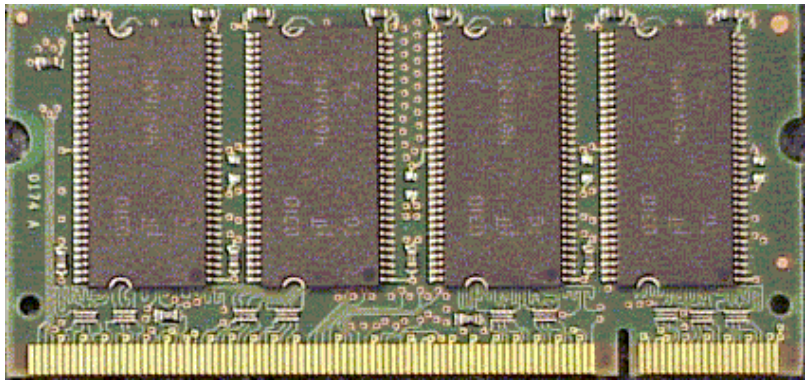
WLCSP Advantages

- **Cost**
  - Fewer back-end production steps
- **Form factor**
  - Higher densities in less space
- **Thermal**
  - Lower thermal impedance
- **Electrical**
  - Better electrical performance
- **Mechanical**
  - Greater solder joint reliability (SJR) with underfill

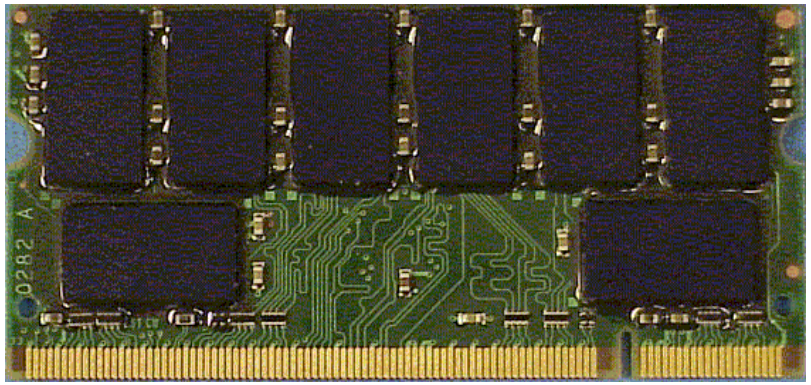
Production Flow Comparison

- **Standard module**
  - Fab
  - Probe
  - Package assembly
  - Back-end test
  - Module assembly
  - Module test
- **FCOM**
  - Fab and redistribution layer (RDL)
  - Probe and test
  - Module assembly
  - Module test

FCOM Form Factor Advantages

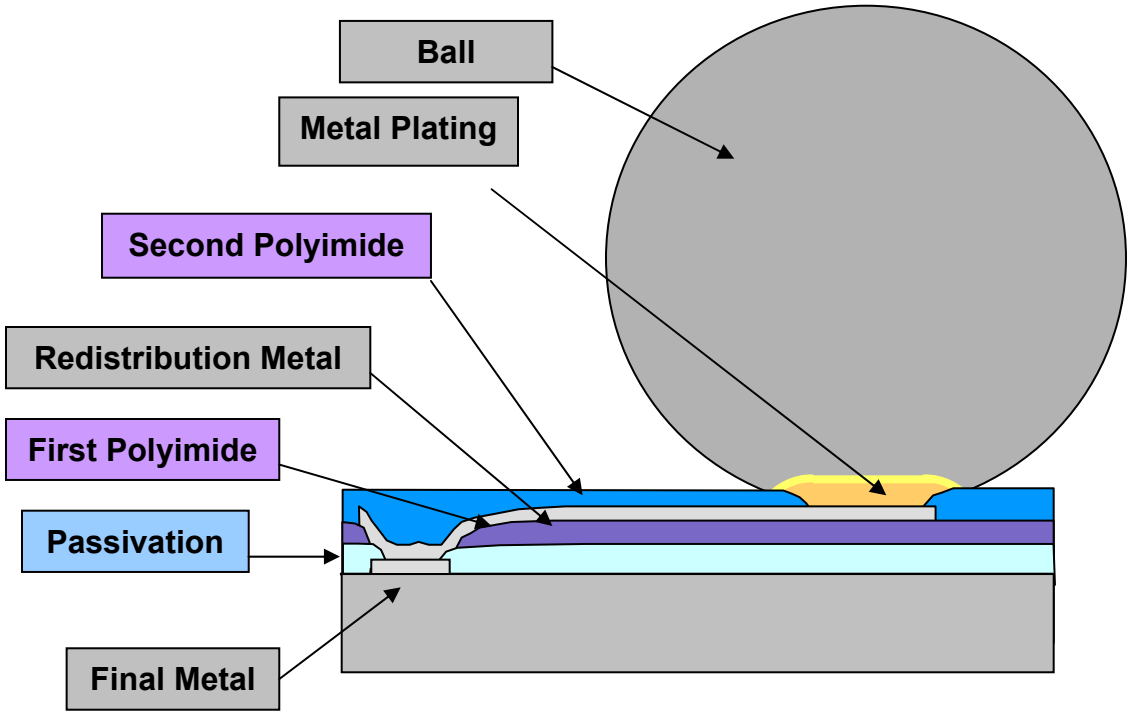


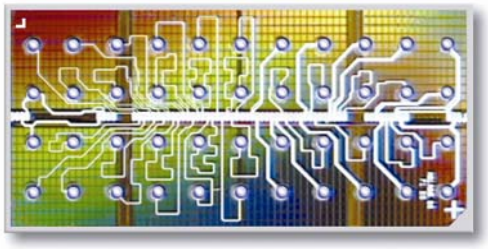
256MB SODIMM (TSOP – 8 die per module)



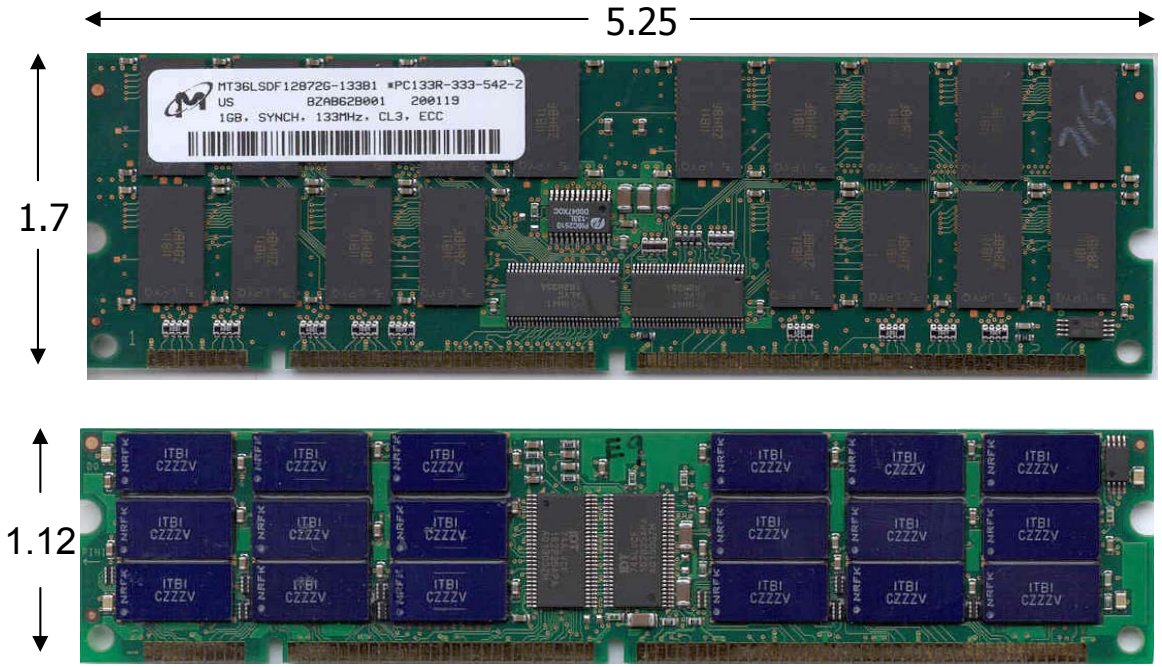
512MB SODIMM (flip-chip – 16 die per module)

Redistribution Layer

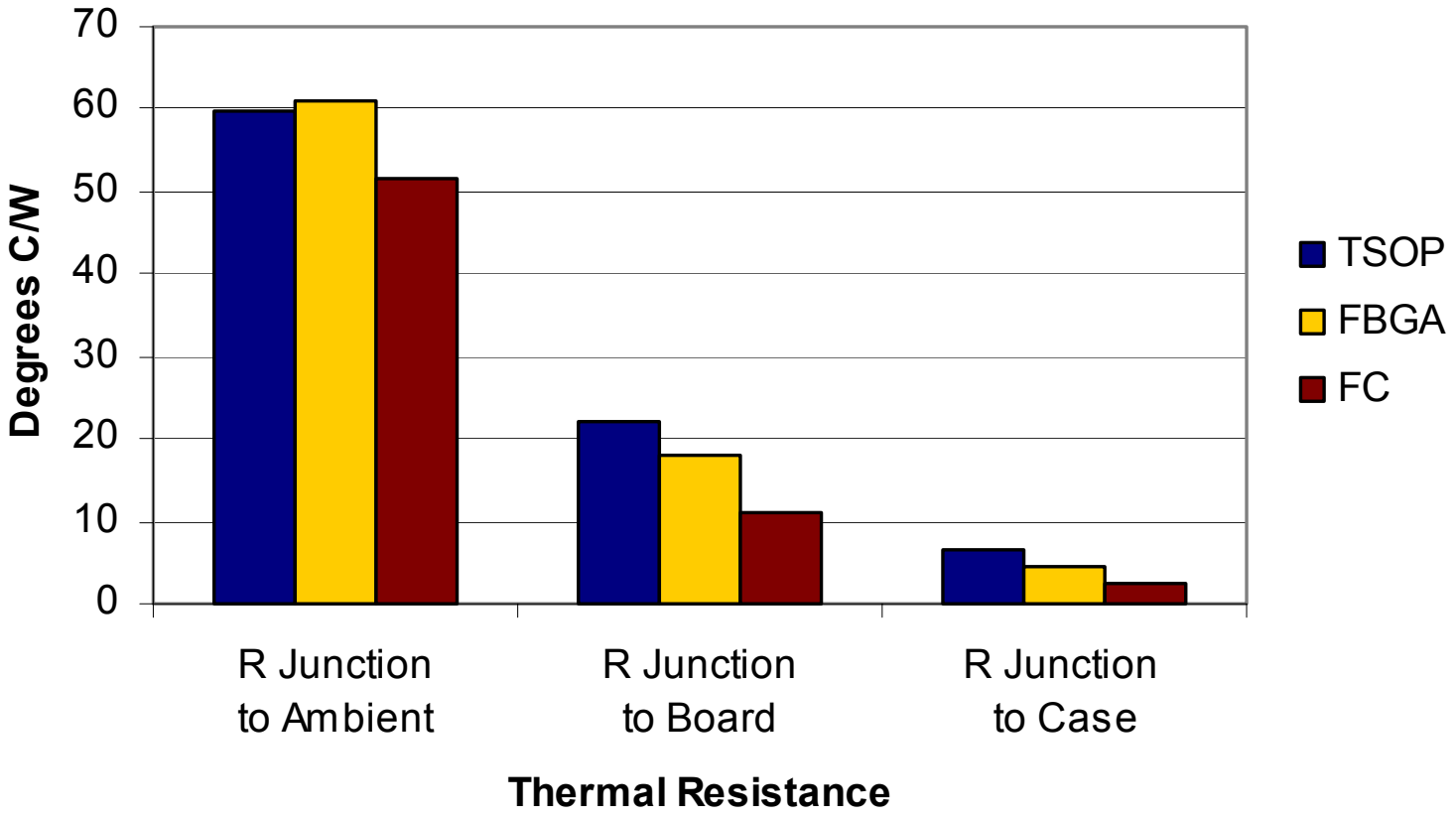




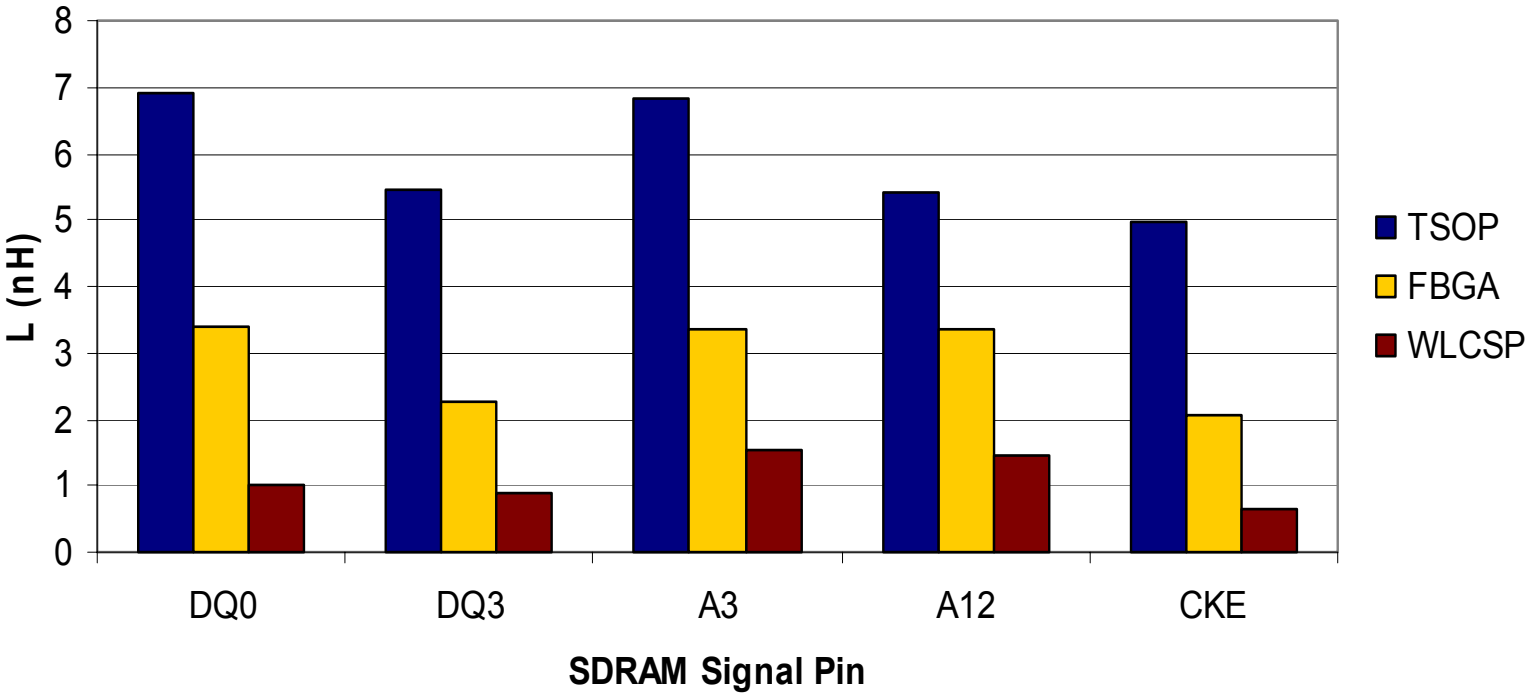
High-Density Modules



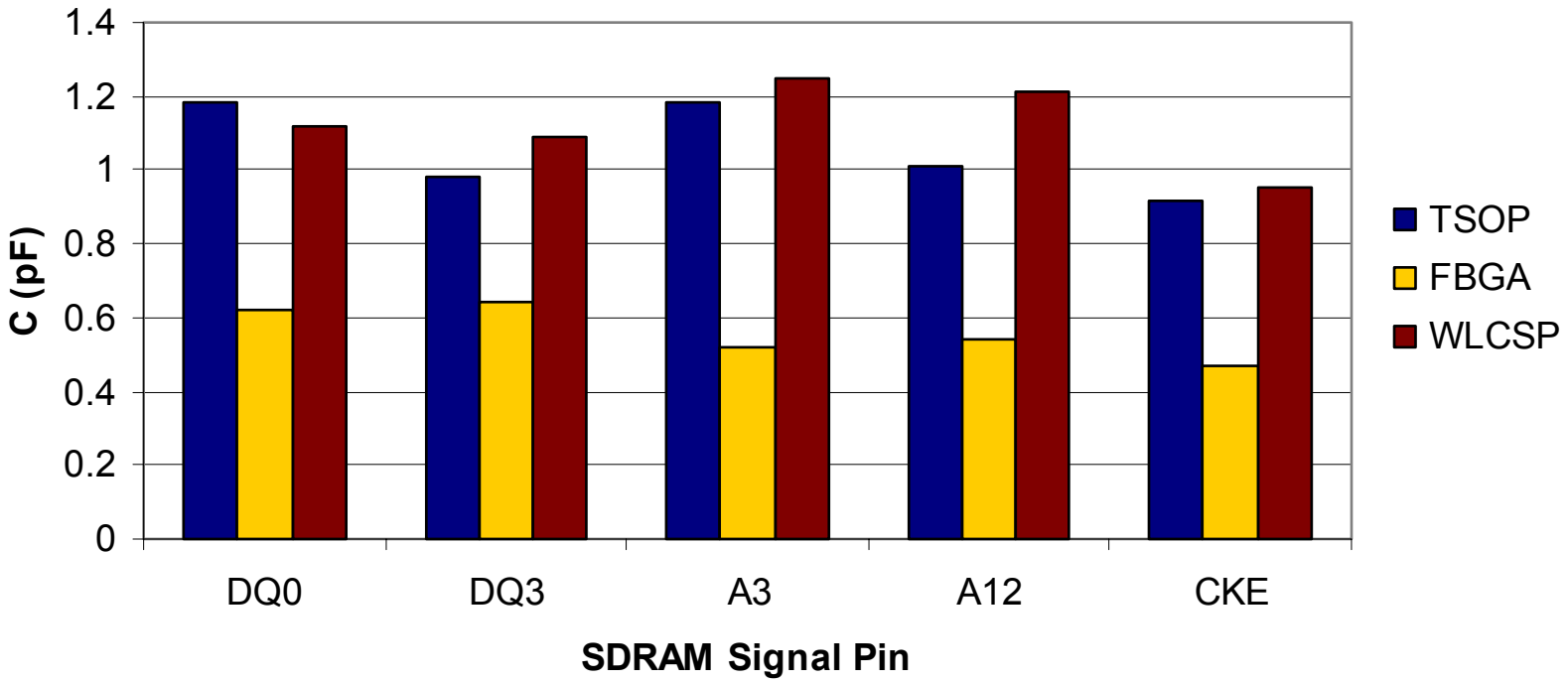
Thermal Resistance Comparison



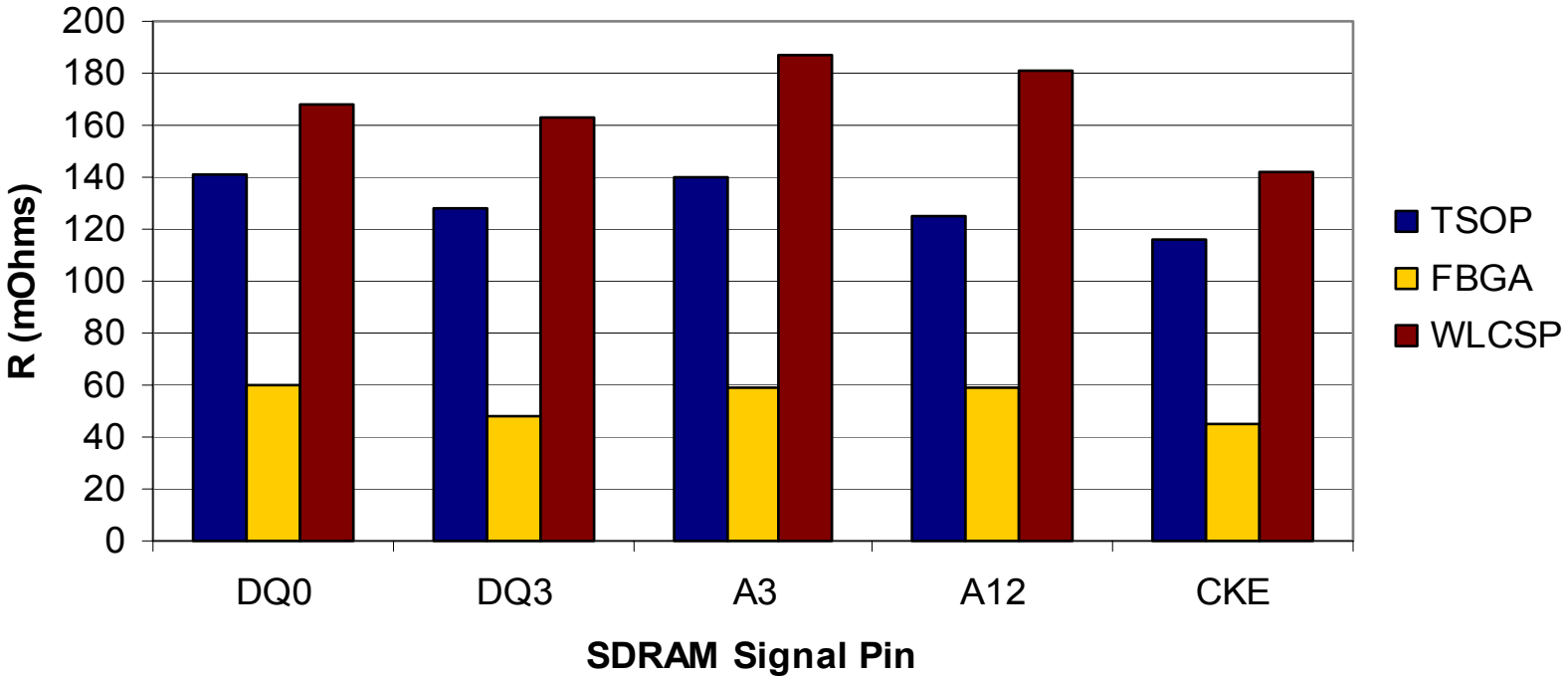
Electrical Inductance Comparison



Electrical Capacitance Comparison



Electrical Resistance Comparison



Solder Joint Reliability (SJR)

- **FCOM SJR with underfill**
  - 1,000 cycles -40°C to +85°C
  - Underfill has cost/process disadvantages
    - Added cost of material and equipment
    - Added cycle time for application and cure
    - No rework capability for production failures
- **FCOM SJR without underfill**
  - Large lead-free balls and no underfill
  - Optimized ball grid
  - New core materials being evaluated

FCOM Development

- Today, FCOM is not a high-volume process
- SJR needs to be optimized
- WLBI or probe/test process development challenges remain
- Grid and bond order need to be standardized
- Field quality/reliability data is needed before market will accept this solution