# Electronic Packaging Challenges in the Medical Device Industry

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Donald Banks, Alvin Weinberg and Gabriel Mouchawar

# Introduction

- Implantable medical device challenges
- Device architecture concepts
- Implantable cardioverter defibrillator downsizing
- Device packaging evolution at SJM
- Ongoing opportunities
- Future solutions

# Implantable Medical Device Challenges

- High quality and reliability
- Strict regulatory environment
- Validation and traceability requirements
- Small sales volumes
- Reduced size and thickness in a physiologic shape
- Increased functionality
- Increased service life
- In line with healthcare economics

# Device Architecture Concepts

| Concept | Pros | Cons |
|---|---|---|
| Folded/Stacked Flex Hybrid<br>battery \| capacitor \| hybrid | • Thinnest product | • Largest product footprint<br>• Complex hybrid (multiple component surfaces) |
| Single-Sided Rigid Hybrid<br>battery \| capacitor<br>hybrid | • Balanced thinness/footprint<br>• Simplest electronics assembly (one side) | • Requires thinner battery and capacitor |
| Double-Sided Rigid Hybrid<br>capacitor \| battery<br>hybrid | • Smallest footprint<br>• Thickest Capacitors | • Thickest product<br>• Two component surfaces |

# ICD Volume Downsize Progression

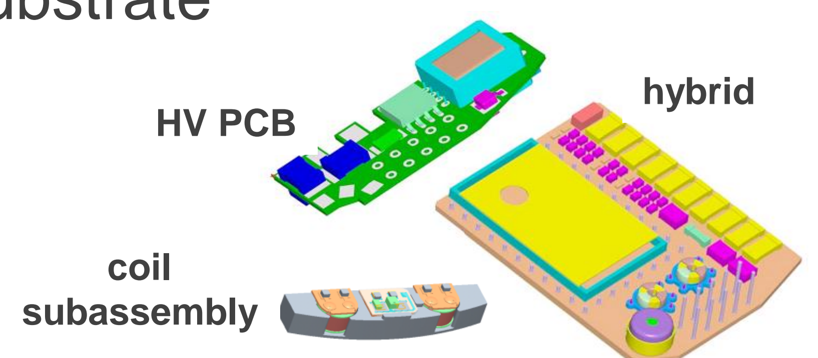
- Advances in batteries, HV capacitors, electronics, packaging have allowed more capability in smaller and thinner devices

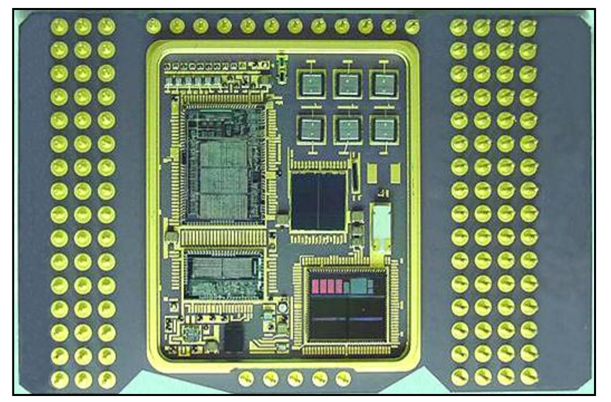
1992 → year → 2015

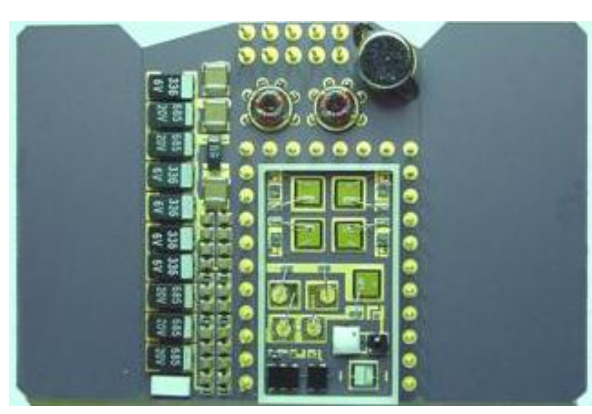
~120 cc → volume → 30 cc

# Device Packaging Evolution at SJM (1990's)

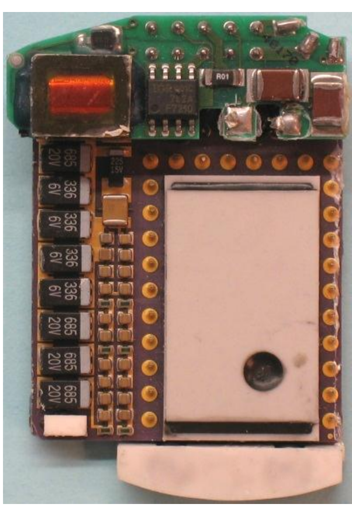
- Double sided HTCC hybrid substrate
- Additional modules required
  - Charging HV PCB
  - Telemetry and RF
  - Activity sensor





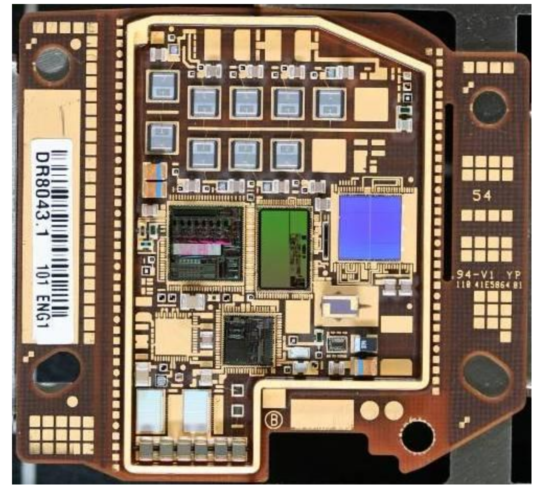
High voltage side



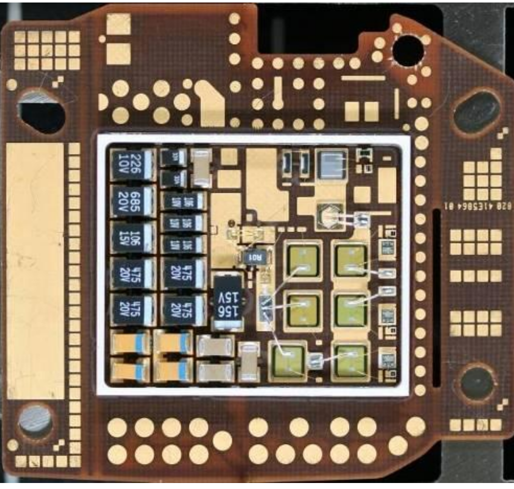
Assembly

# Device Packaging Evolution at SJM (2000's)

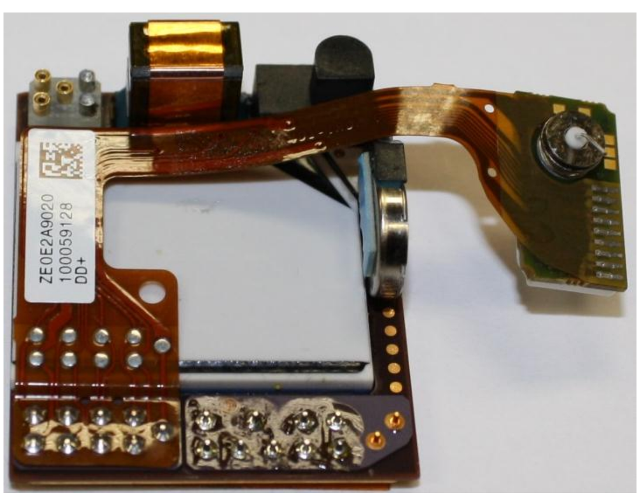
- Organic high density interconnect (HDI)
  - Optimized shape
  - Integration of charging/inductive modules
- Component integration (IC, Ta caps, MEMS, GMR)
- Use of connectors




**Low voltage side**



**High voltage side**



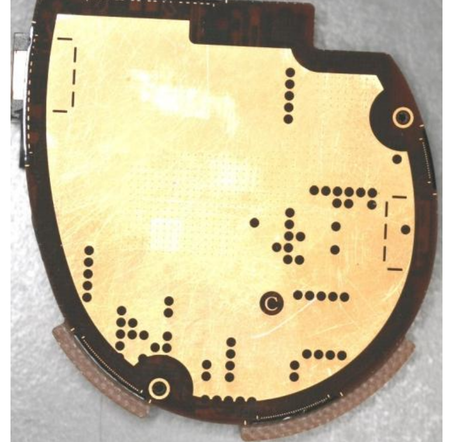

**Completed hybrid w/RF module**

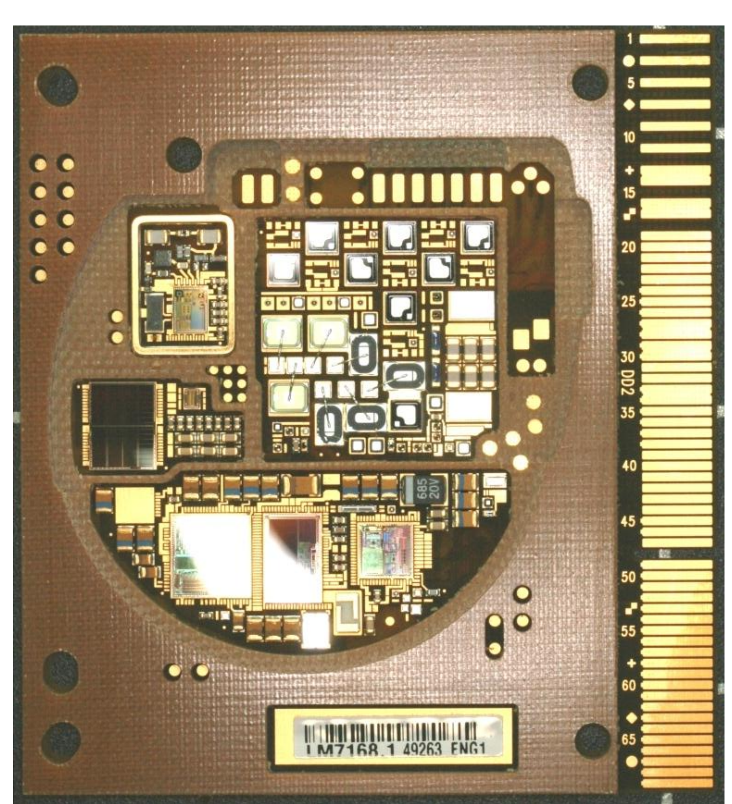
# Device Packaging Evolution at SJM (2010's)

- Single sided organic substrate for ease of assembly
- Edge connector for test and burn-in
- Integrated RF

**Encapsulated hybrid after routing**

**Non-populated side of the hybrid**





**Active side of the hybrid pre-encapsulation**

# Ongoing Opportunities

- ENEPIG for universal substrate finish
- BGA, LGA, WLCSP
- Embedded structures
- IC integration
- Cost reduction
- Manufacturability and testability
- Alternate energy sources

# Future Solutions

Conventional pacemaker and lead

Leadless pacemaker