TELEDYNE
MICROELECTRONIC TECHNOLOGIES
A Teledyne Technologies Company

MEDICAL DEVICE TECHNOLOGY 30 YEARS TELEDYNE MICROELECTRONICS

Medical Devices

Packaging Capabilities & Engineering Services

Approved for Export

DMS 9/23/08

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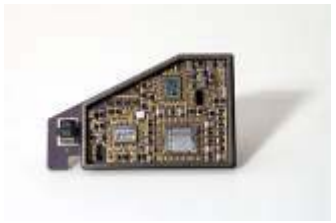
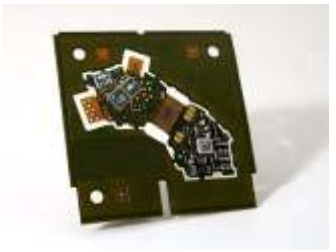
Over 2,000,000 Medical Devices Shipped

Prototype to full scale production of complex, mixed technology and miniaturized assemblies

- Implantable Devices
  - Cardiac Rhythm Management
  - Neural & Muscle Stimulators
  - Audiology Devices
  - Drug Infusion Pumps
- Diagnostic Devices
  - Gastrointestinal (GI) Sensors
- External Devices
  - Hearing Aids
  - Drug Pumps
  - Patient Monitors
  - Microprobes
- Medical Illumination Devices
  - LED Backlighting for Surgical Projection Systems
  - LED Illuminators for Photodynamic Therapy





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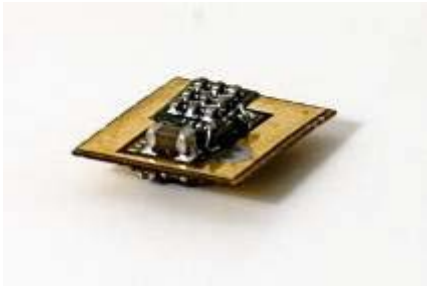
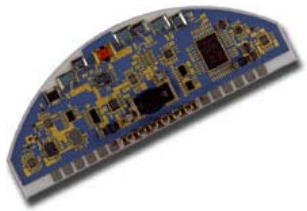
What we are good at

Prototype to full scale production of complex, mixed technology and miniaturized assemblies

- Designing packaging to miniaturize medical electronics
  - Miniature and micro-miniature subsystems
- Miniaturizing while maintaining
  - Signal integrity
  - Environmental stability
  - Long-term reliability
- Despite complexity
  - Tight designs
  - Complex flows
  - Mismatched materials and technologies
- Beyond the capabilities of others
  - Never seen before
  - This will never fit





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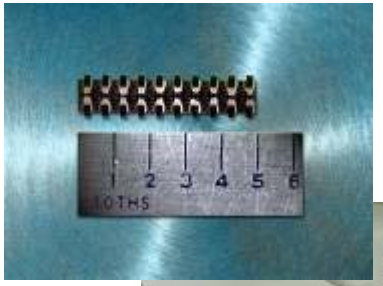
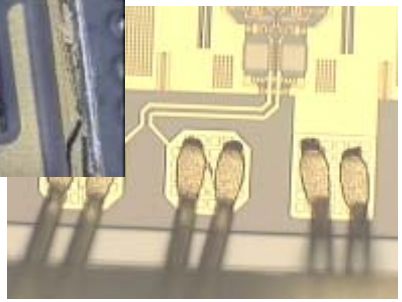
How we do it...

Prototype to full scale production of complex, mixed technology and miniaturized assemblies

- Creating the Backbone
  - 2D and 3D Arrangements
  - Ceramics and Laminates
  - Rigid <-> Flexible
- Assembling the Core
  - Ultra-fine SMT
  - Ultra-fine Chip & Wire
  - Ultra-fine, Mixed Mode Flip-chip
- Integrating Peripherals
  - Sensors
  - RF Components
  - Power Supplies
- Stuffing the Shell
  - Plastics
  - Ceramics
  - Metals





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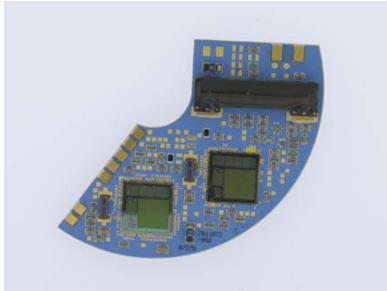
Packaging for Implantable Devices

Prototype to full scale production of complex, mixed technology and miniaturized assemblies

- Implantable Insulin Pumps
  - Multilayer thick film technology
  - Encapsulated bare die assembly
  - Unusual shape and aspect ratio for substrate
- Cardiac Pacemakers & Defibrillators
  - High temperature cofired ceramic (HTCC) substrate
  - Mixed mode assembly-SMT & Chip On Board
  - Diffusion Patterning
  - High Density packaging
  - 4x4 mil traces, spaces & vias
- Neuromodulation
  - Fine-line ceramic multilayer substrate
  - Combination of conventional chip & wire technology with SMT



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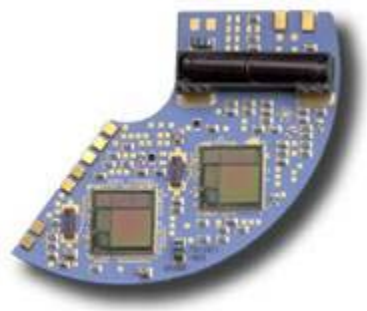
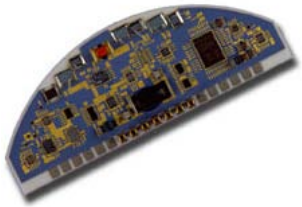
Odd Shapes

Prototype to full scale production of complex, mixed technology and miniaturized assemblies

- Substrate Technologies
  - Ceramic
  - Laminate
  - FR4
  - Flex
  - Rigid-Flex
  - HTCC
  - LTCC



- Manufacturing Technologies
  - SMT
  - Chip & Wire
  - BGA
  - Flipchip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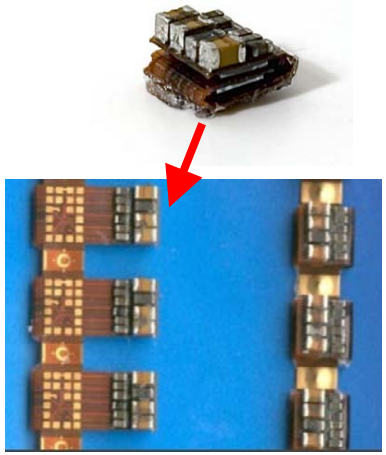
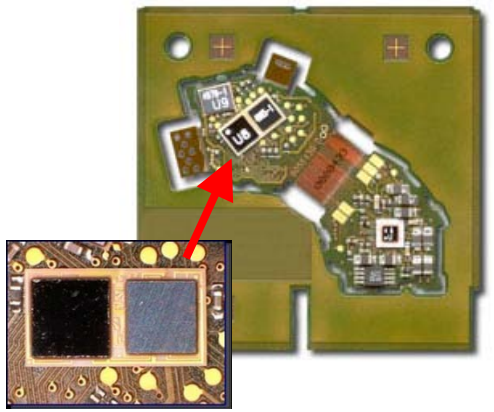
Innovative Packaging for Medical Applications

Prototype to full scale production of complex, mixed technology and miniaturized assemblies

- Hearing Aid
  - Multilayer flex substrate
  - Flip chip attached active components
  - SMT assembled passives
  - 3D integration through flex folding
  - Multi-up production process and methodology



- Behind the Ear (BTE) Sound Processor
  - Multilayer rigid-flex substrate
  - SMT assembly with Chip Scale Packaging (CSP) active components
  - Flip chip on flex circuit for maximum density
  - Highest density packaging/least peripheral space required for connectivity, usually no more than 10% beyond the die size



Production Volume Capability

Prototype to full scale production of complex, mixed technology and miniaturized assemblies

- Current Capacity - Utilization rate: 40%
- Approximately 250,000 MCPs of varying types per year
  - Plastic DIP Packages: 135,000 units/year
  - SMT: 60,000 units/year
  - High Density Flip Chip/BGA: 30,000 units/year
  - Mixed Technology (SMT and Chip & Wire): 20,000 units/year
  - High Complexity Aero/Mil: 5,000 units/year
- Our capability ranges
  - from very complex, low volume jobs
  - to high volume items such as medical implantable devices and solid state relays

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High Run Rate Manufacturing Cell

Prototype to full scale production of complex, mixed technology and miniaturized assemblies

- For high volume programs
  - Increased efficiency
  - Decreased cycle time
  - Continuous supply of material via point-of-use KanBan systems
  - Reduced material handing and travel
  - Process optimization through operator feedback
  - Near real time SPC tracking and display of key processes
  - Increased yields and reduced rework
  - On-time deliveries
  - Provides for customer IP security
  - Provides a localized support staff

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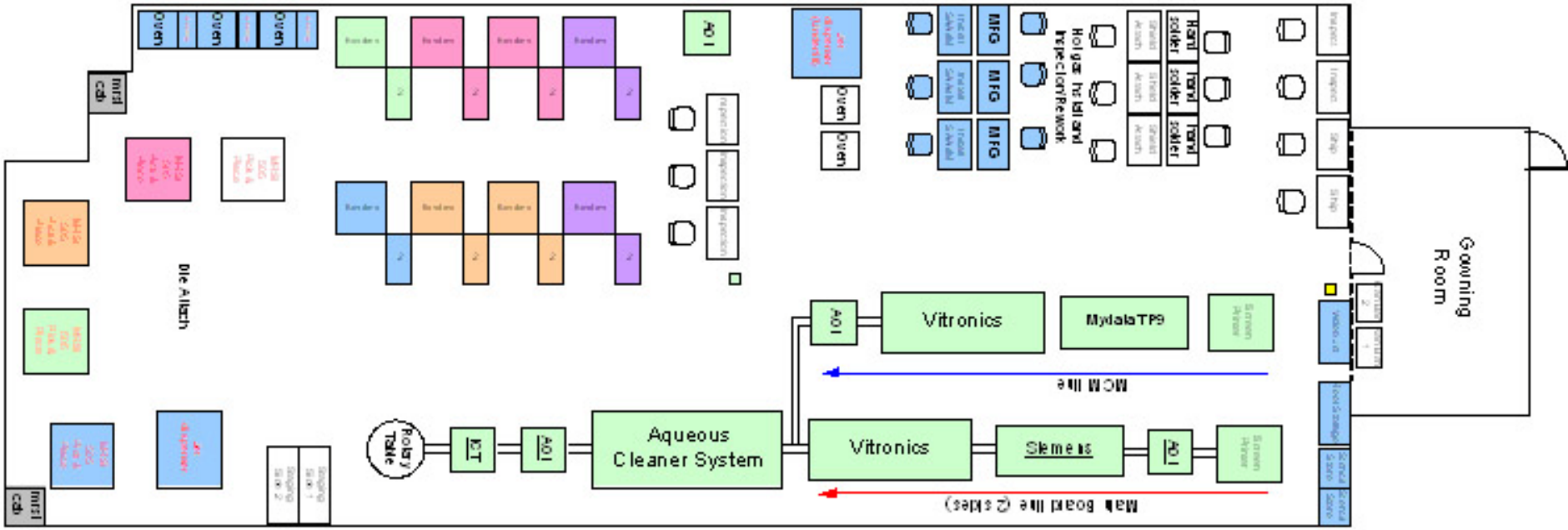
Typical Layout of High Run Rate Manufacturing Cell

Prototype to full scale production of complex, mixed technology and miniaturized assemblies



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Equipment used in High Run Rate Manufacturing Cell

Prototype to full scale production of complex, mixed technology and miniaturized assemblies

- Current High Run Rate Manufacturing Cells employ independent lines of equipment, including:
  - Asymtek Jet Dispenser/GPD Auto Dispenser
  - MRSI Pick & Place Systems
  - Stencil Printers
  - Vitronics Reflow Ovens
  - AOI Systems
  - K&S/Delvotek High Speed Wire Bonders
  - Aqueous Batch Cleaning Systems
  - Automatic Test Equipment/Systems