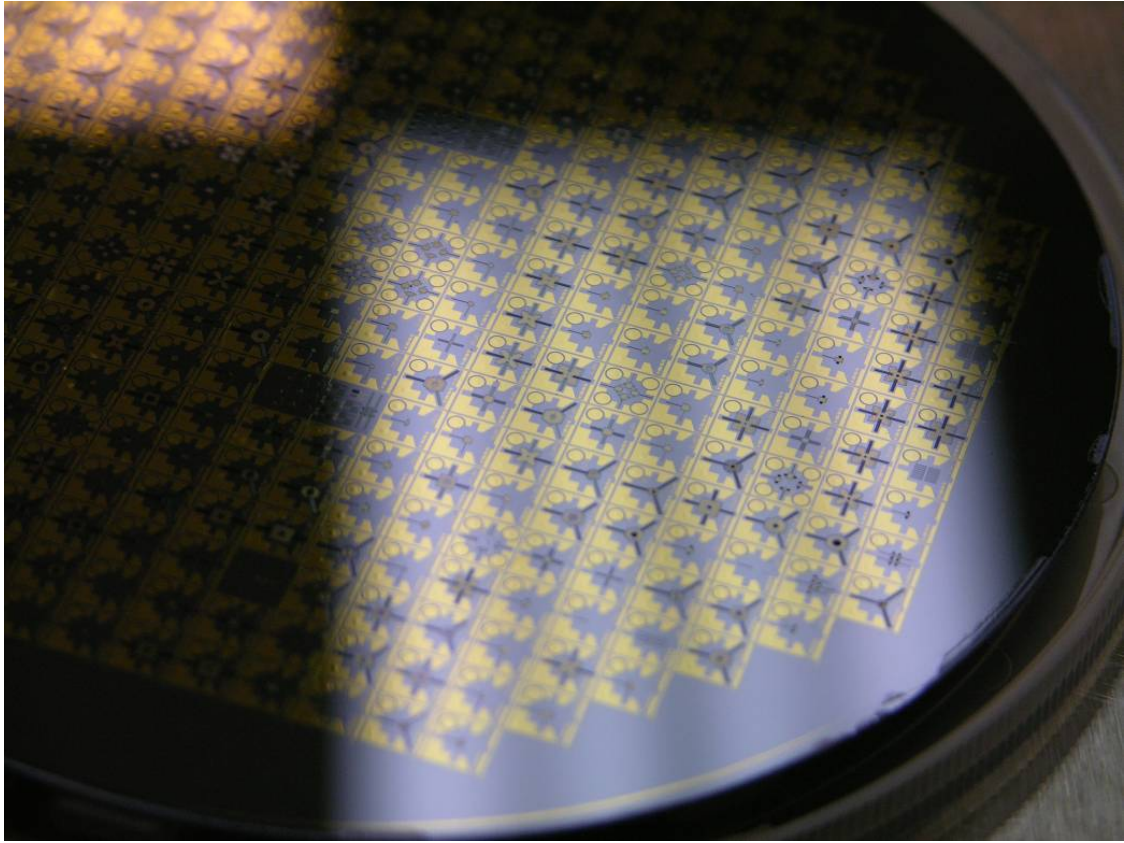


MEMS Impact Sensor



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21 May 2009

Contact Switch for Point Detonation

- Purpose: impact sensor for air burst round
- Trigger between 90 and 150 G
- Current snap dome sensor too large and inaccurate
- New contact switch must be low profile: less than 900 μm tall
- 2 rounds of design and fabrication completed in 2007
 - 60 sensors delivered
- 1 round of design and fab in 2008, 15 sensors delivered

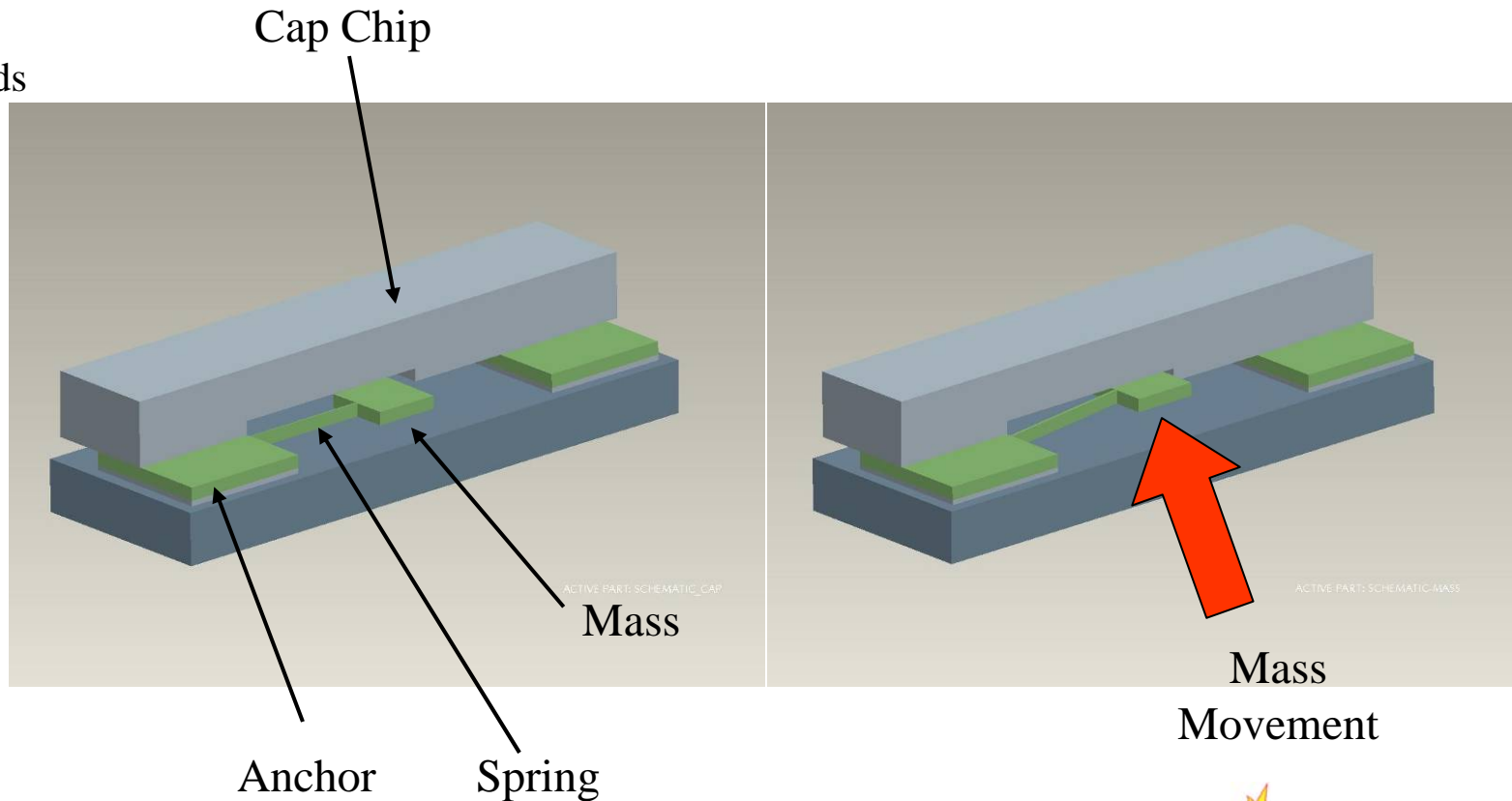


Contact Switch Schematic

Out-of-Plane Configuration

Threshold Sensor:

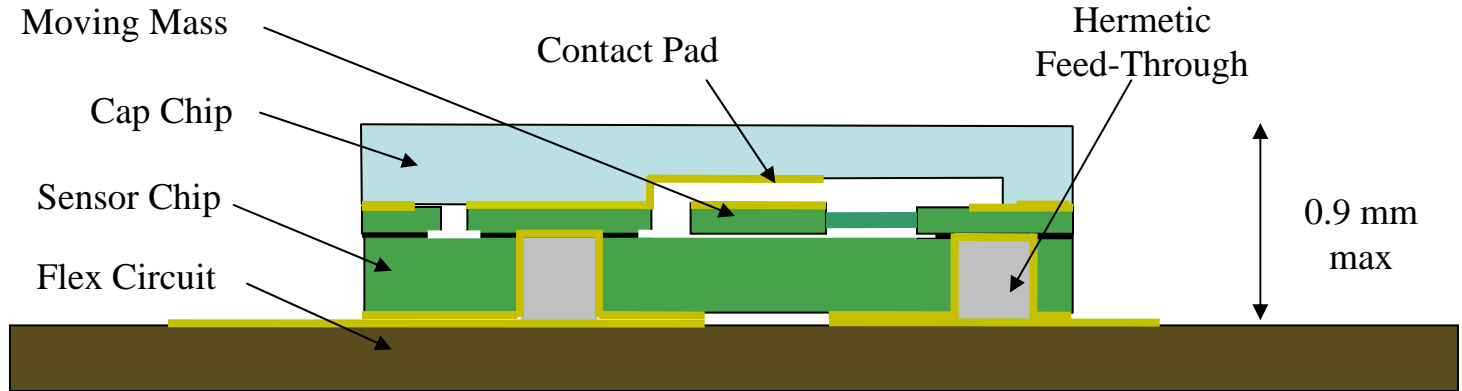
- Impact and shock
- Mass moves
- Switch closes
- Shock event ends
- Switch opens



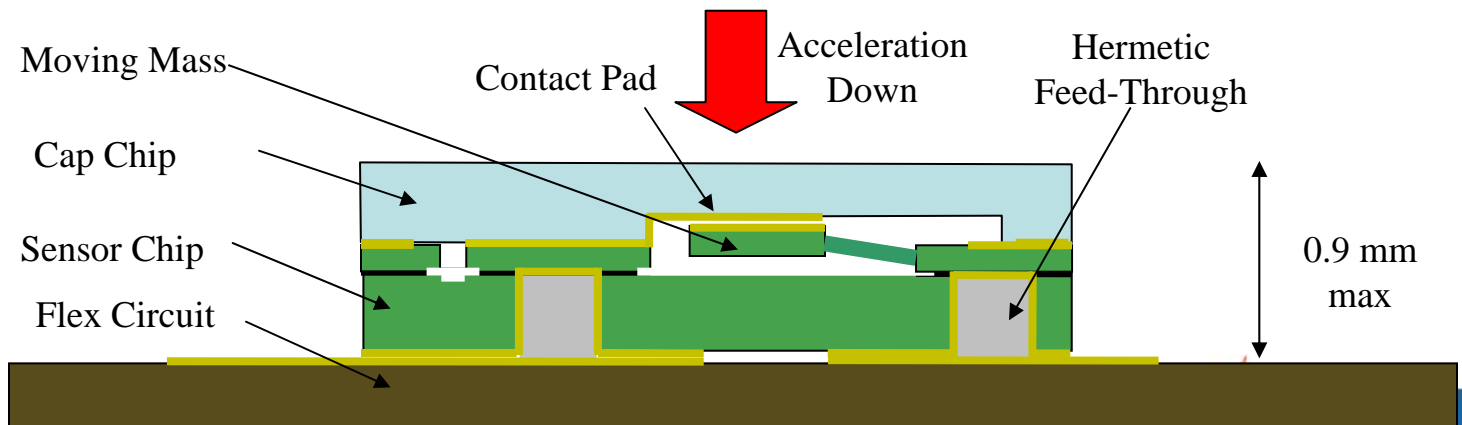
Contact Switch Schematic

Packaging and Signal Routing

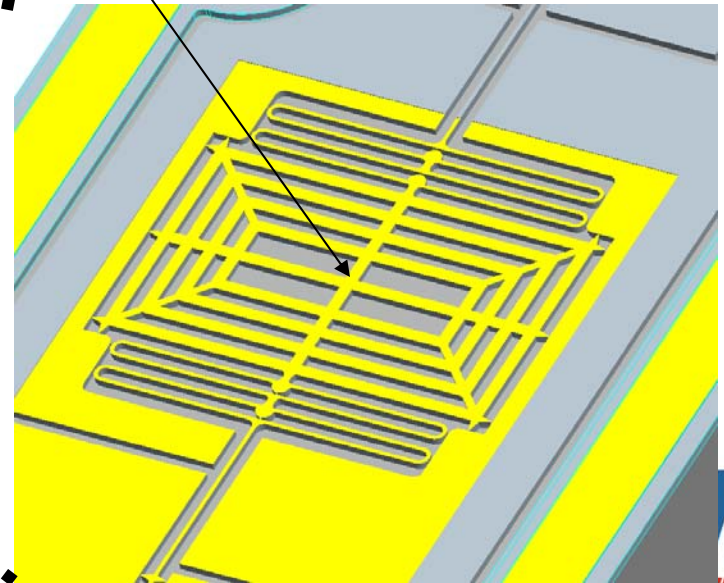
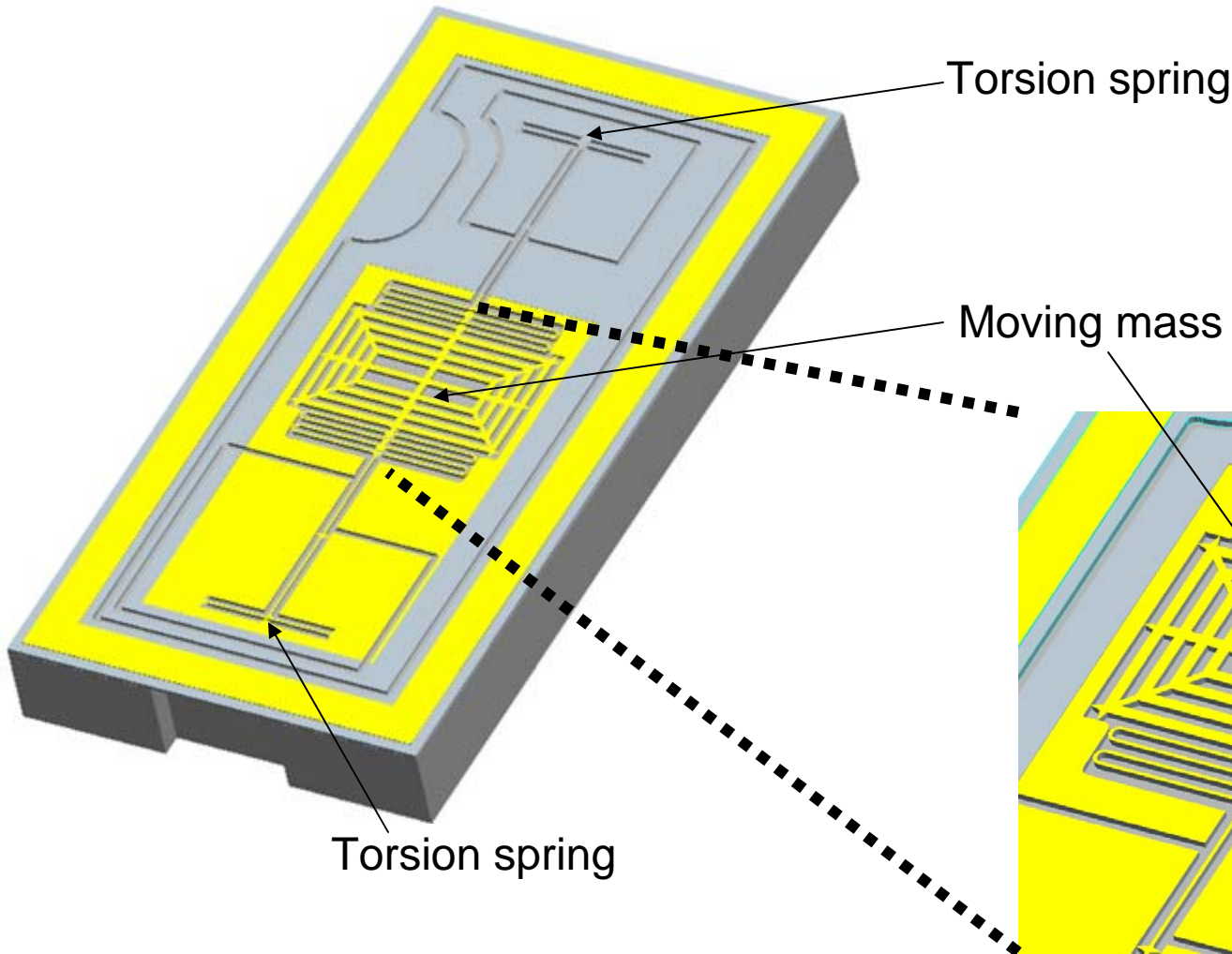
Switch
Open



Switch
Closed



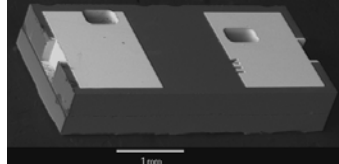
2-Spring Design



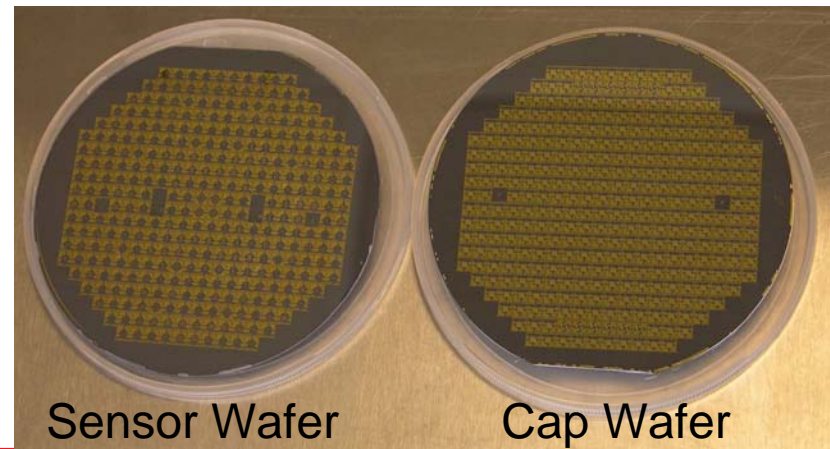
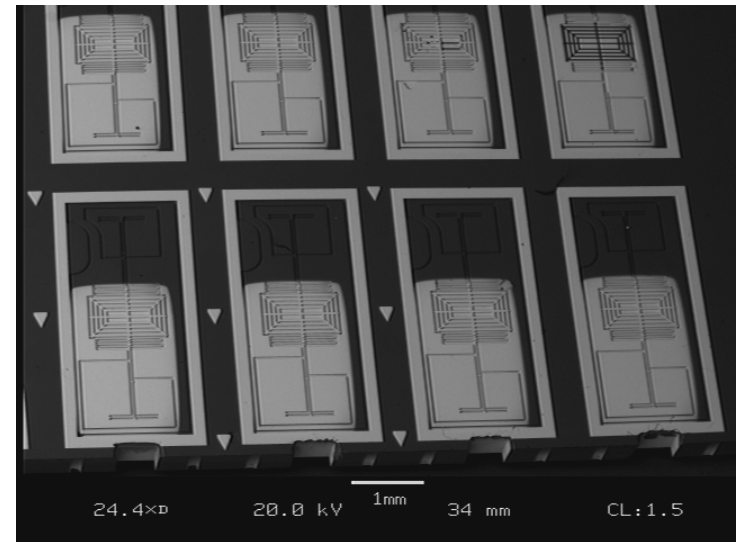
Switch Sealing

Requires MEMS Chip to Cap Chip Bond

- Option 1:
 - Seal arrays of 12, then sub-dice into individual sensors

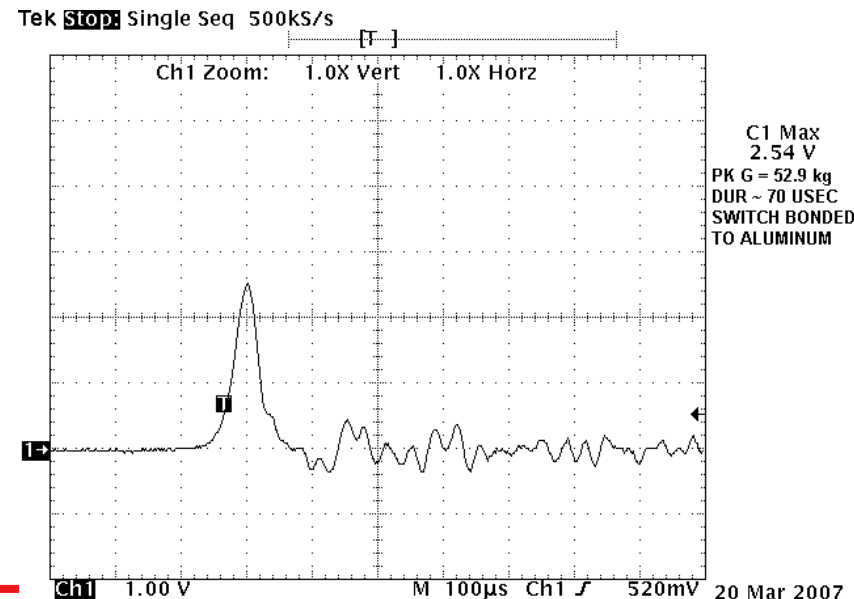


- Option 2:
 - Use wafer bonding to seal over 600 sensors simultaneously, then dice into individual sensors



Contact Switch Status

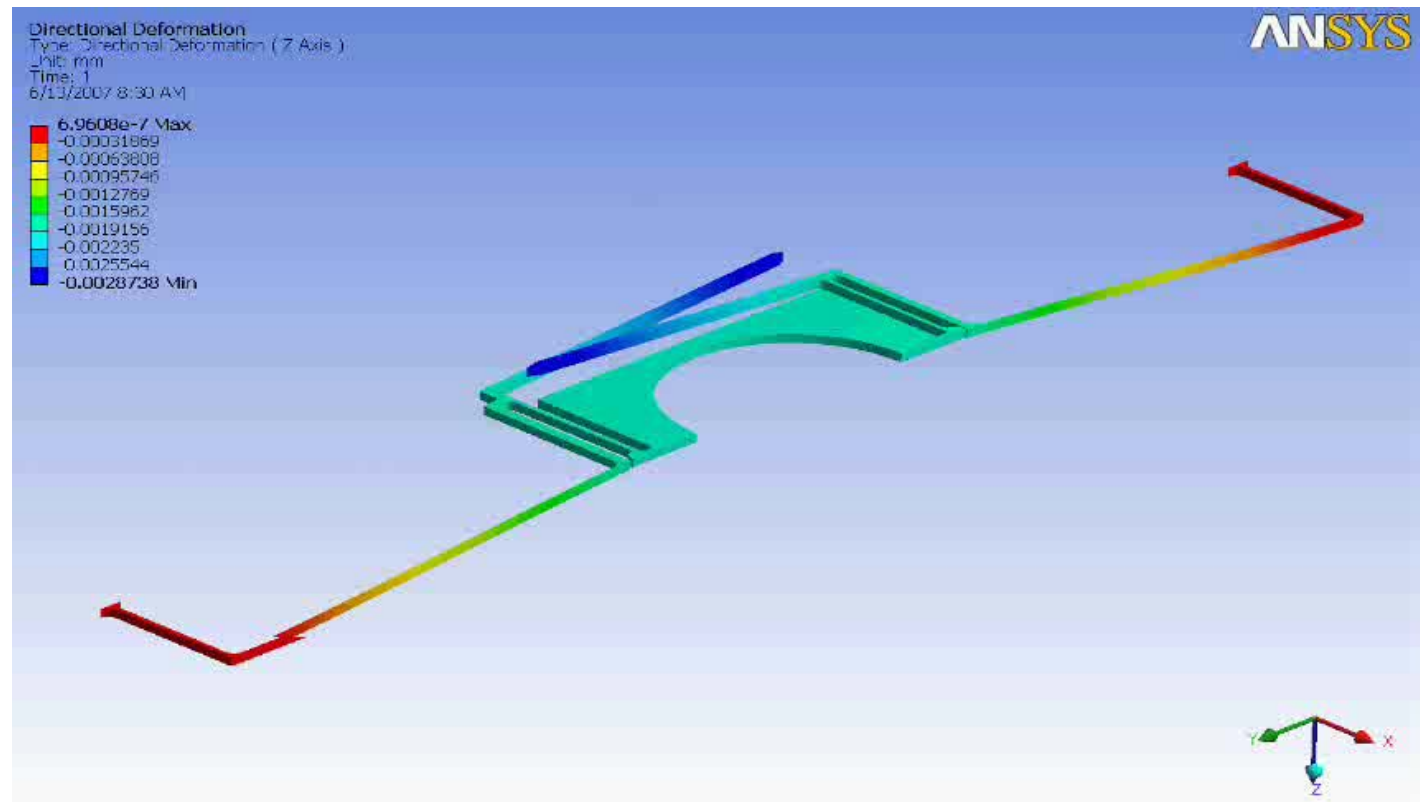
- Switch testing to date:
 - Passed 50,000 g shock, operation successful before and after
 - Contact level approximately 150 g
 - Gun launch successful
- Improvements for next round
 - Switch contacts
 - Wafer level packaging



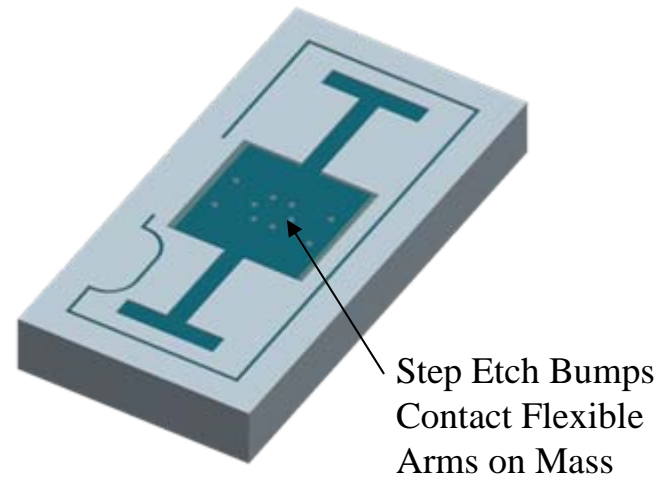
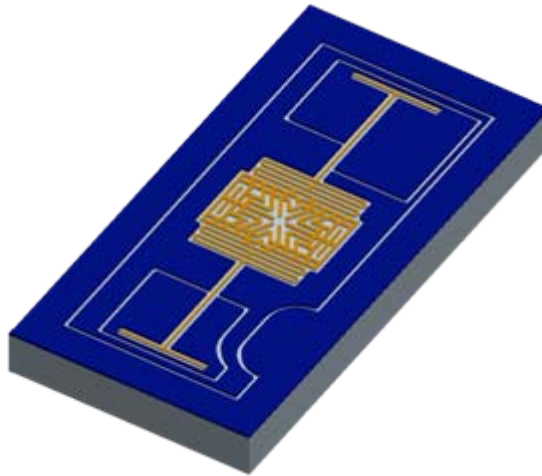
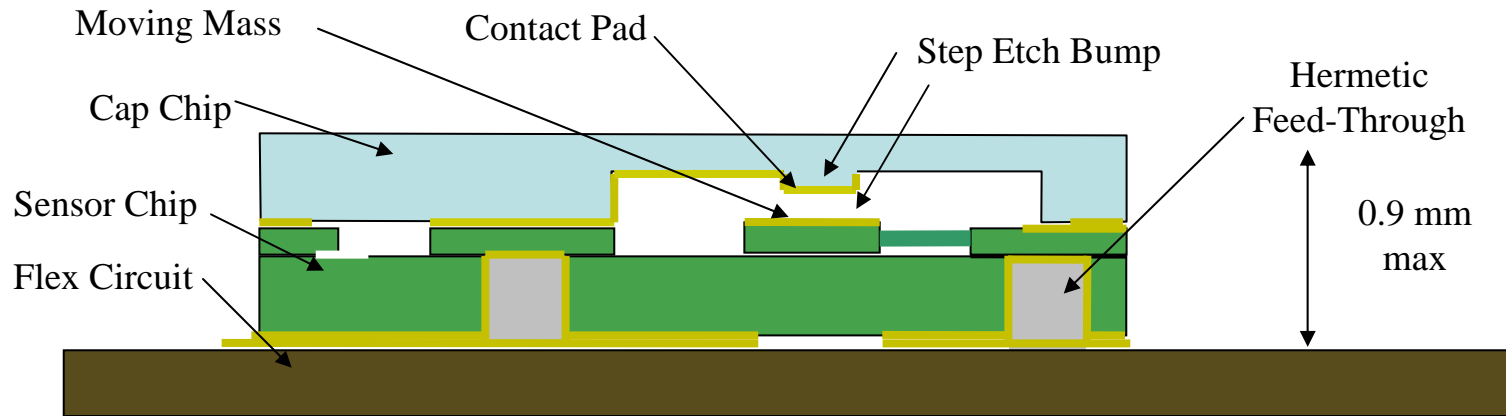
Two Spring Switch

Contact Arm Variation

- Contact points move ahead of the mass
 - Increased contact duration
 - Reduced switch bounce



Next Generation Contact Switch

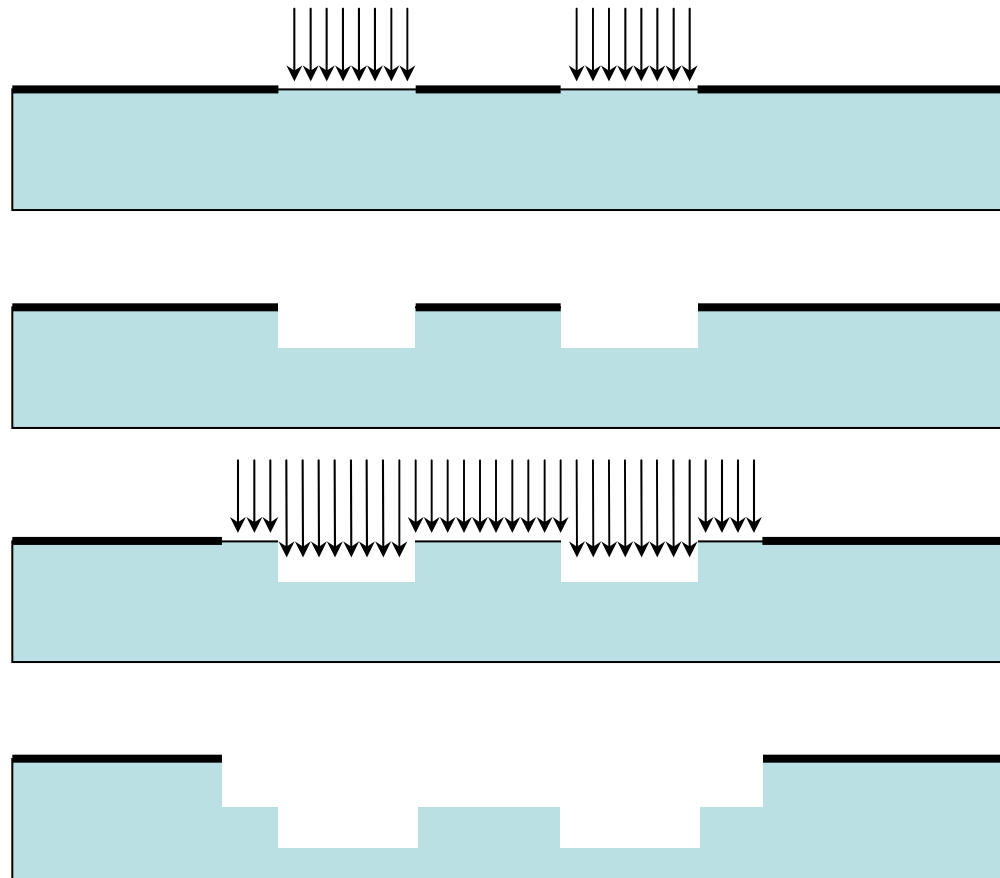


Step Etch Advantages

- Increased contact pressure
- Increased signal duration
- Resistance to residue on contact area
- Reduced squeeze film damping

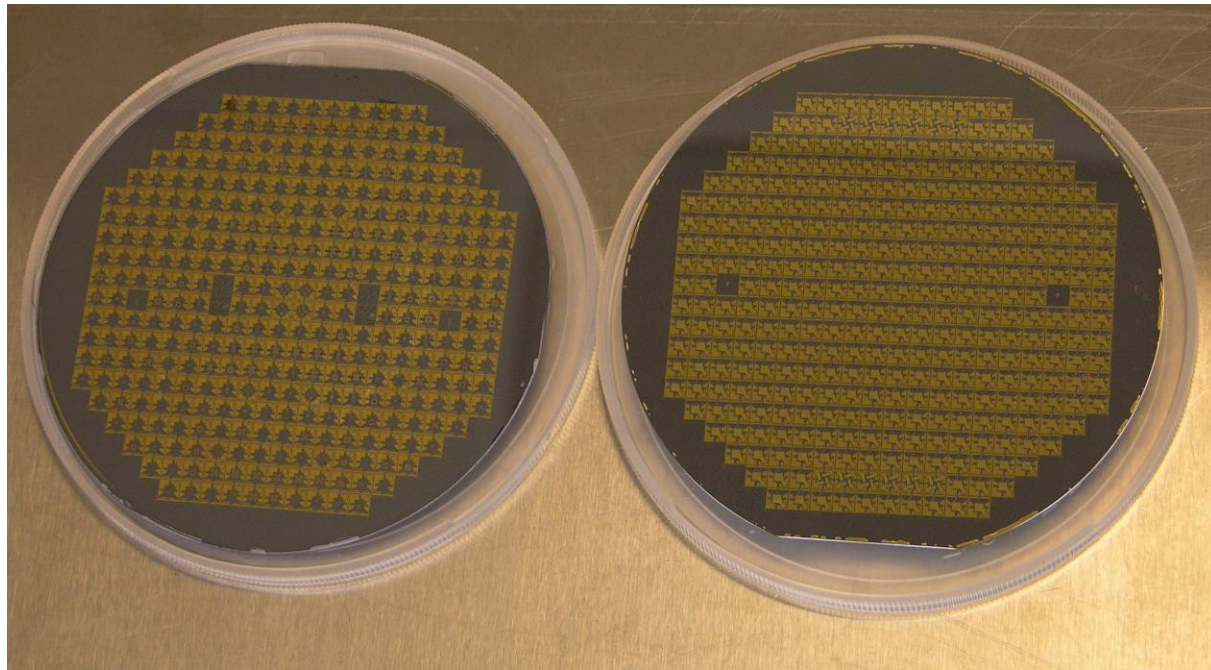
Step Etch Process: Cap Fabrication

Deep Reactive Ion Etching of Silicon



Contact Switch Summary

- Small, surface mount
 - Prototypes are 2 x 4 mm, and 0.8 mm tall
- Hermetically sealed using array level packaging
- Provides a closed switch during the shock event



Sensor wafer (left), and cap wafer (right)