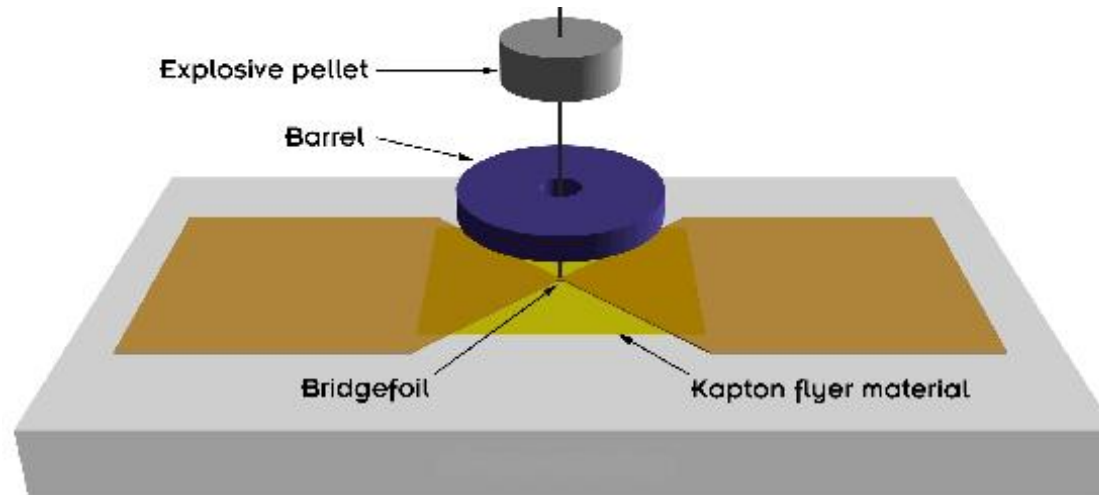


A Robust Planar Triggered Sparkgap Switch for High Power Pulse Applications

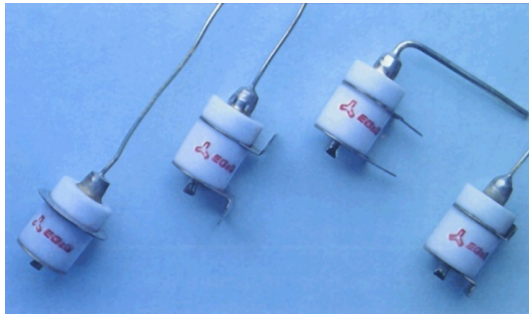
Thomas A. Baginski
Auburn University



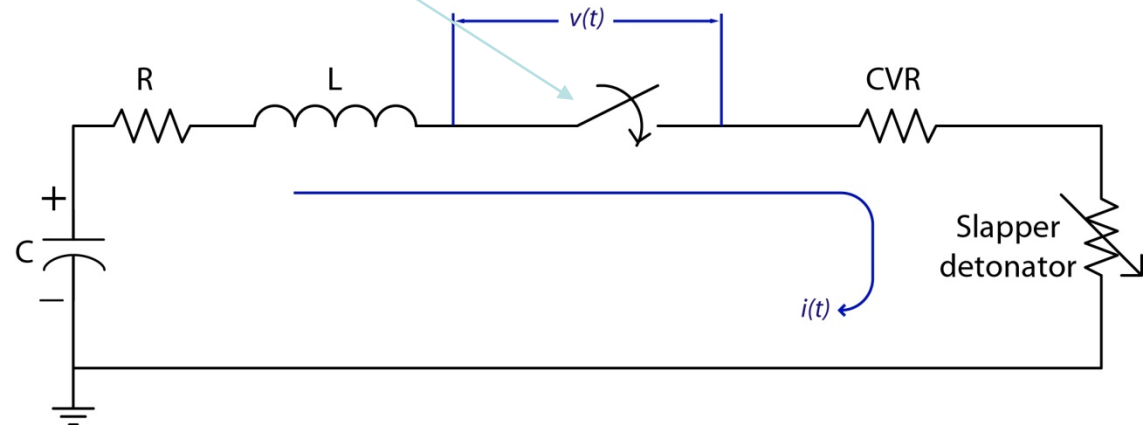
Chip Slapper Detonator



Typical Capacitor Discharge Unit (CDU)



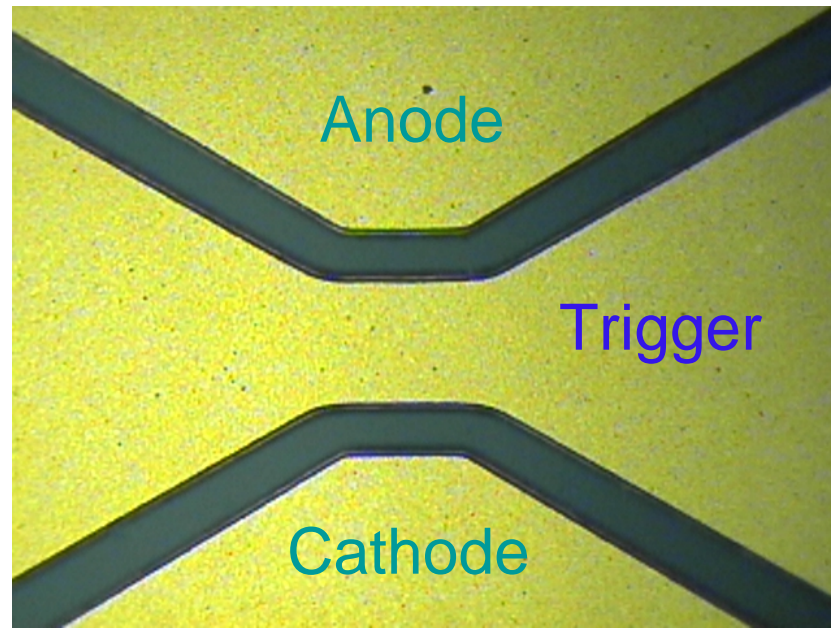
Triggered Spark-Gap



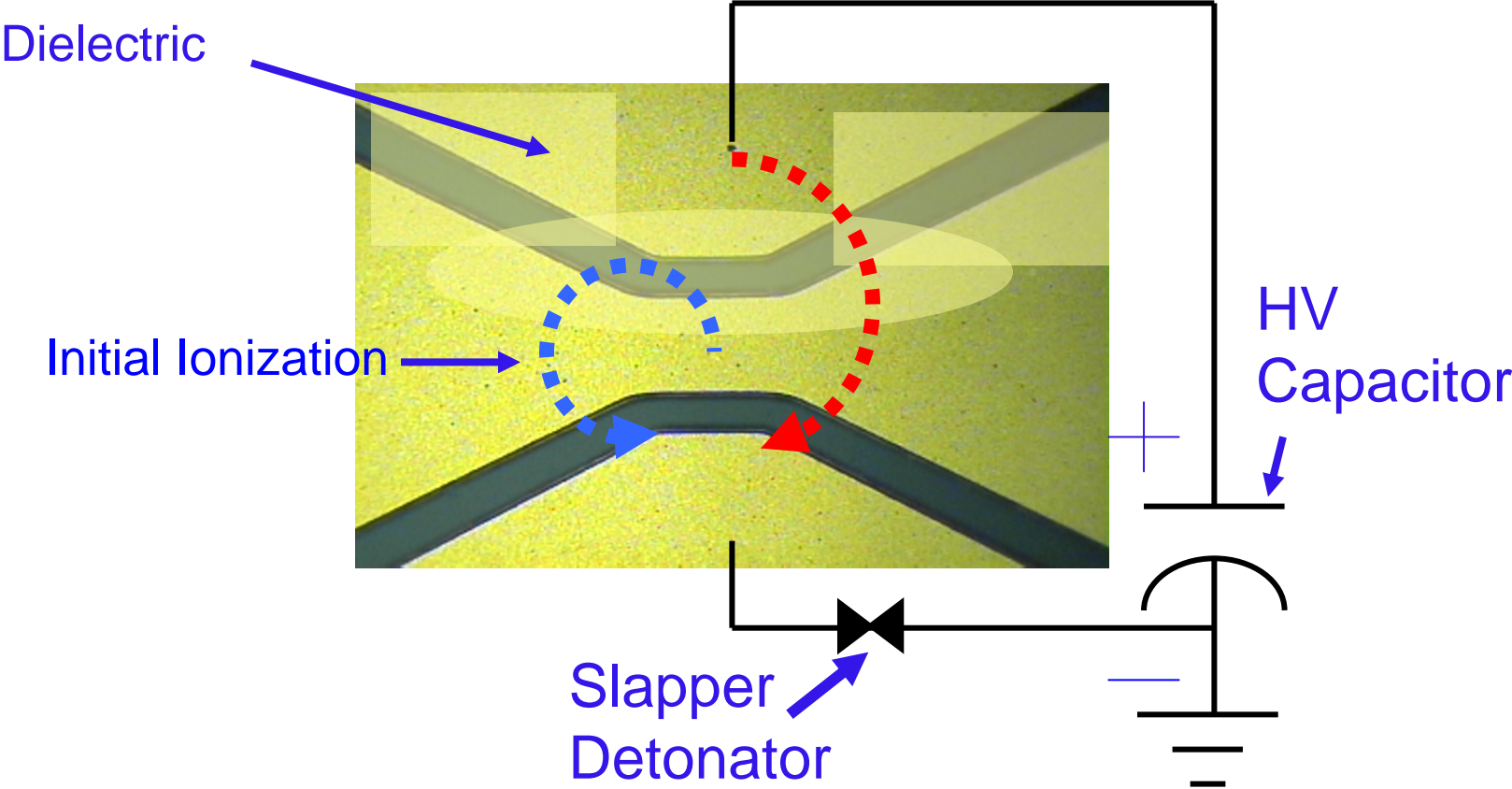
Switch Requirements

- Standoff voltage greater than 1500V
- Switch should allow fast discharge of a high voltage capacitor with a discharge time (τ) less than 100 ns.
- The switch should be capable of being actuated with a low voltage signal (i.e. <50V trigger pulse).
- Fabrication should employ a simple layout that allows direct integration into strip-line geometries (minimize parasitic impedances).
- Monolithic construction should be employed using conventional micro-electronic fabrication techniques to make the switch mechanically robust.
- No energetic compounds can be used in the construction of the switch.

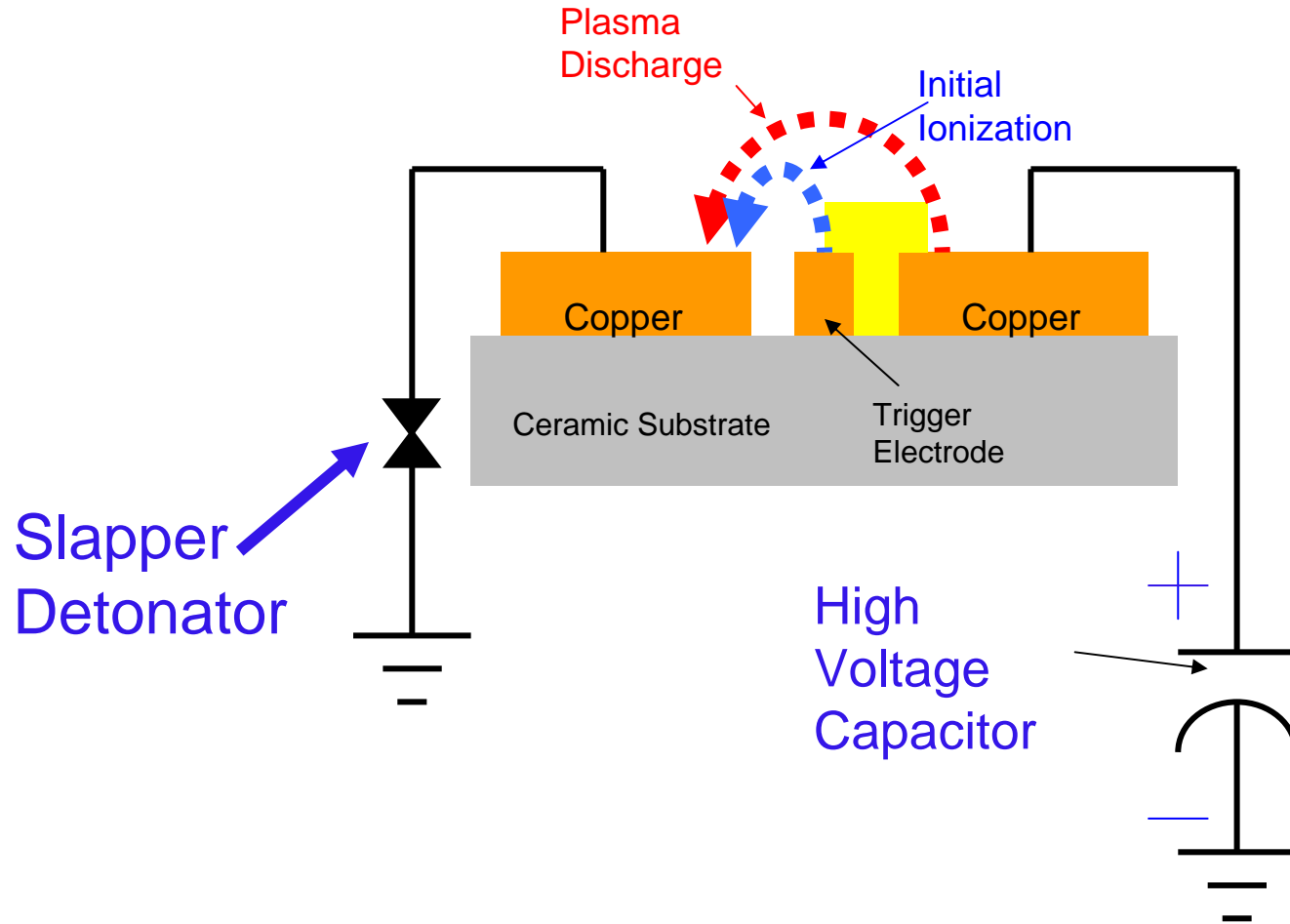
Planar Triggered Spark-Gap Switch



Switch Actuation

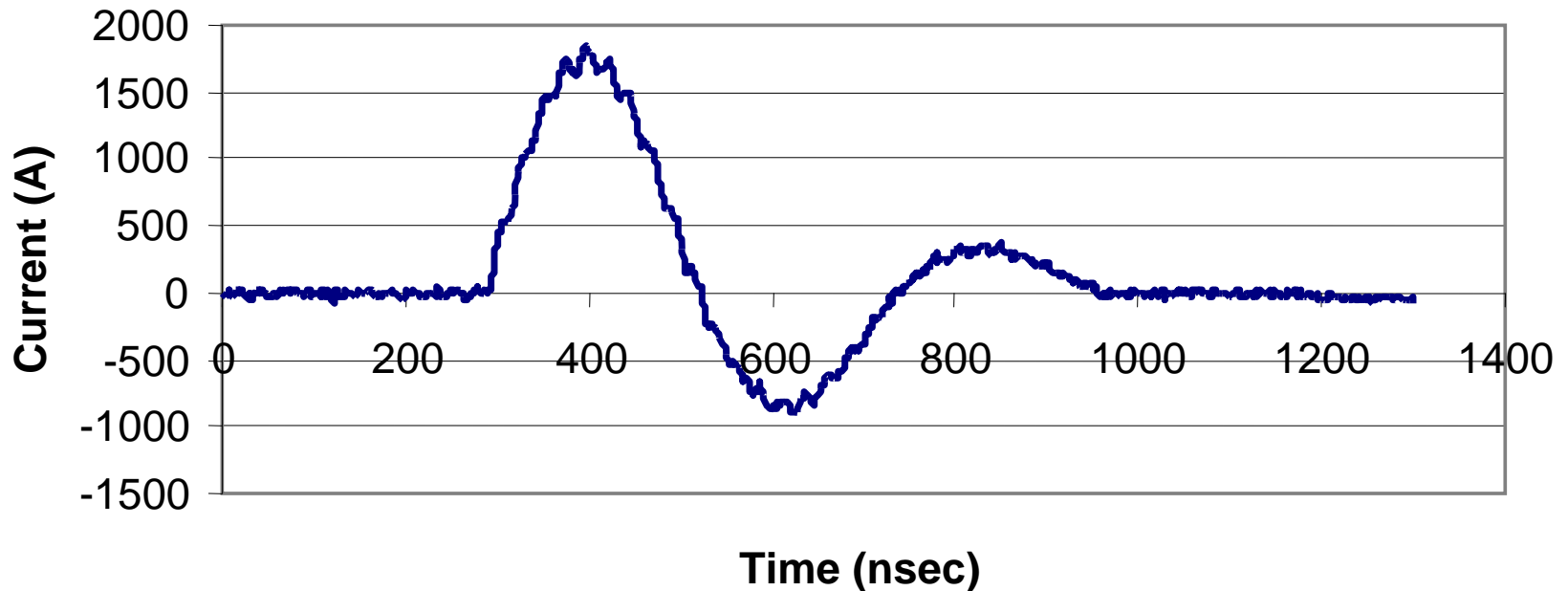


Switch Actuation

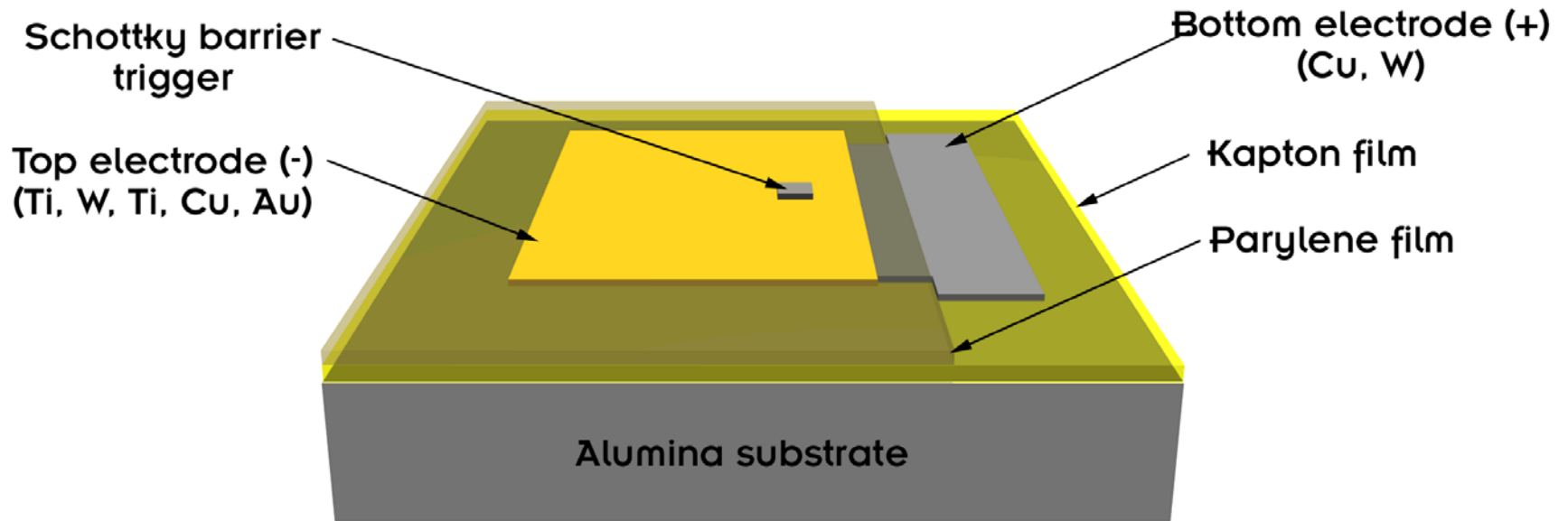


Ring Down (PTS Switch) $C=.17\mu\text{F}$, $V=1000\text{V}$,

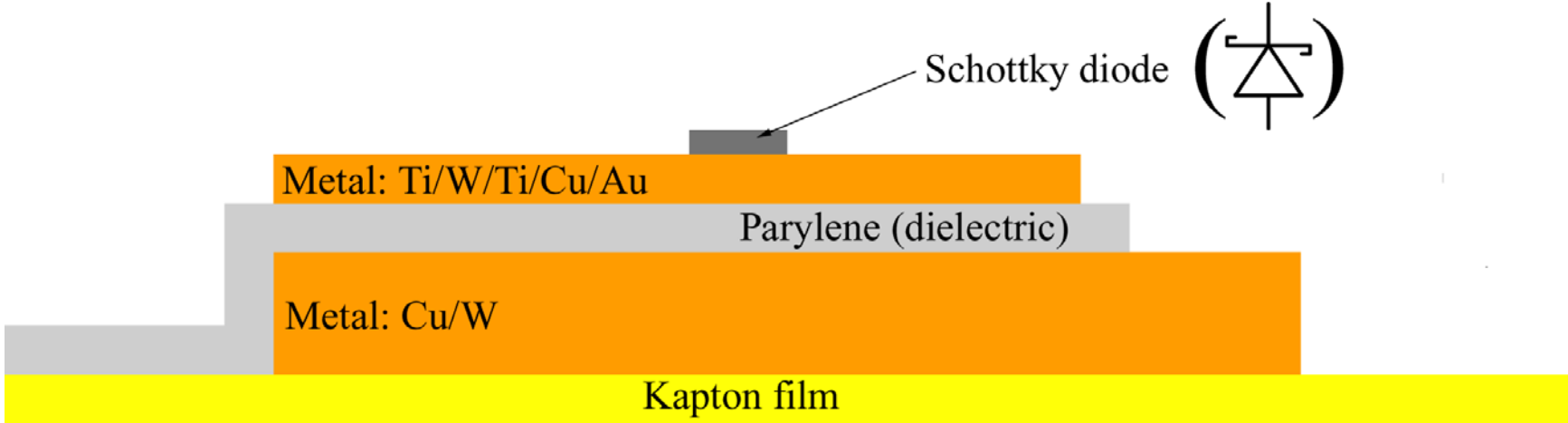
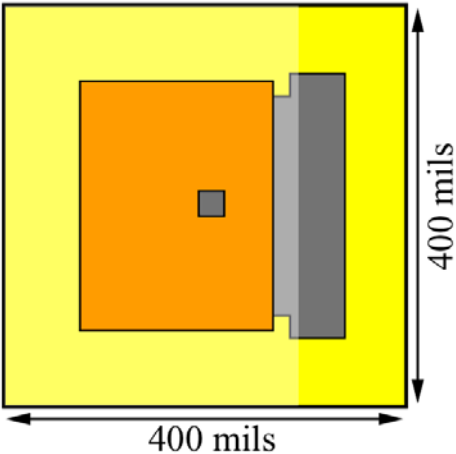
Test Load $=.004\text{ohm}$



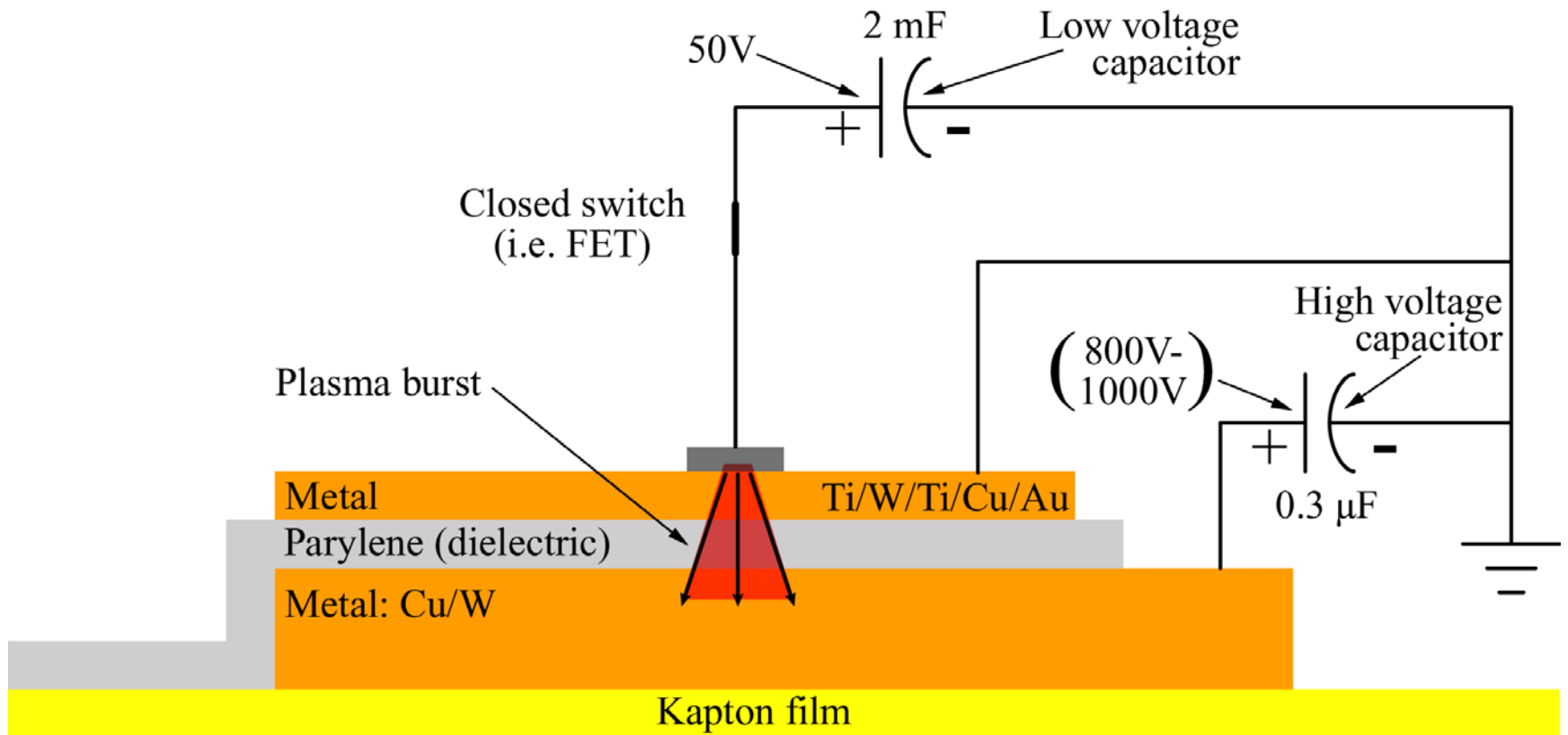
Parylene Shock Switch



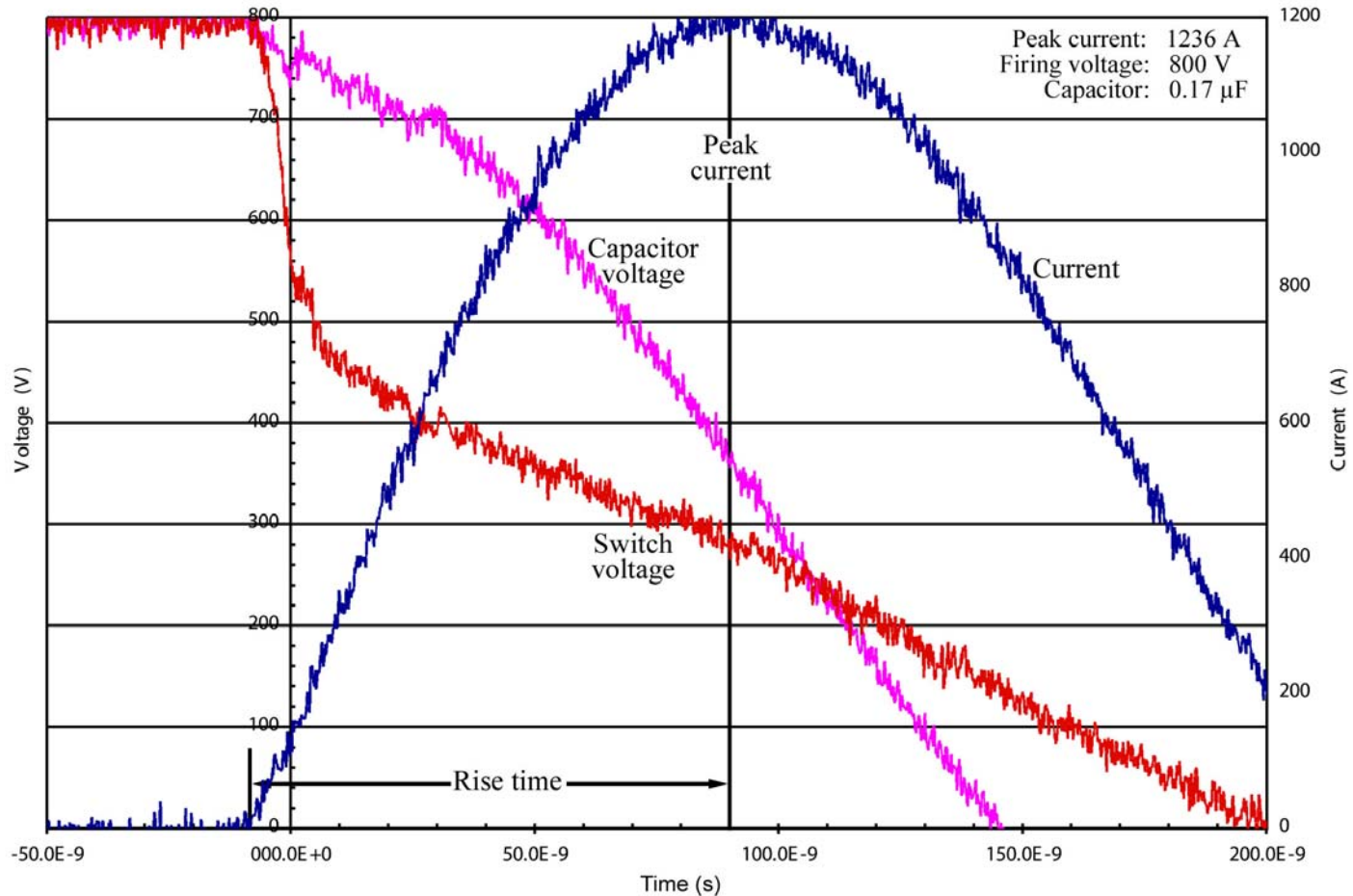
Schematic representation of shock switch.



Schematic representation of switch actuation.



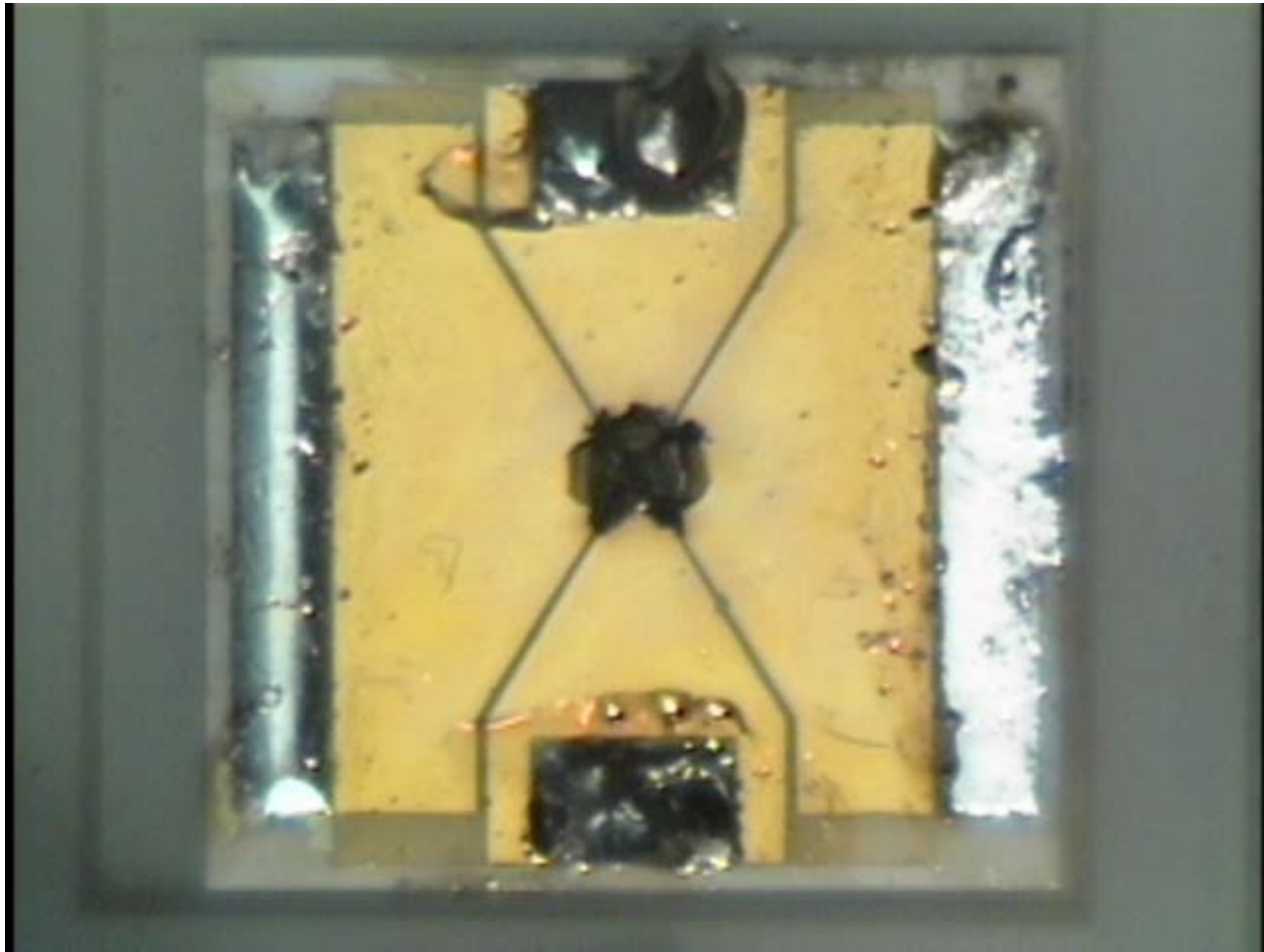
High voltage switch firing data obtained from a high speed digital oscilloscope. Traces are shown for the capacitor voltage, switch voltage, and switch current.



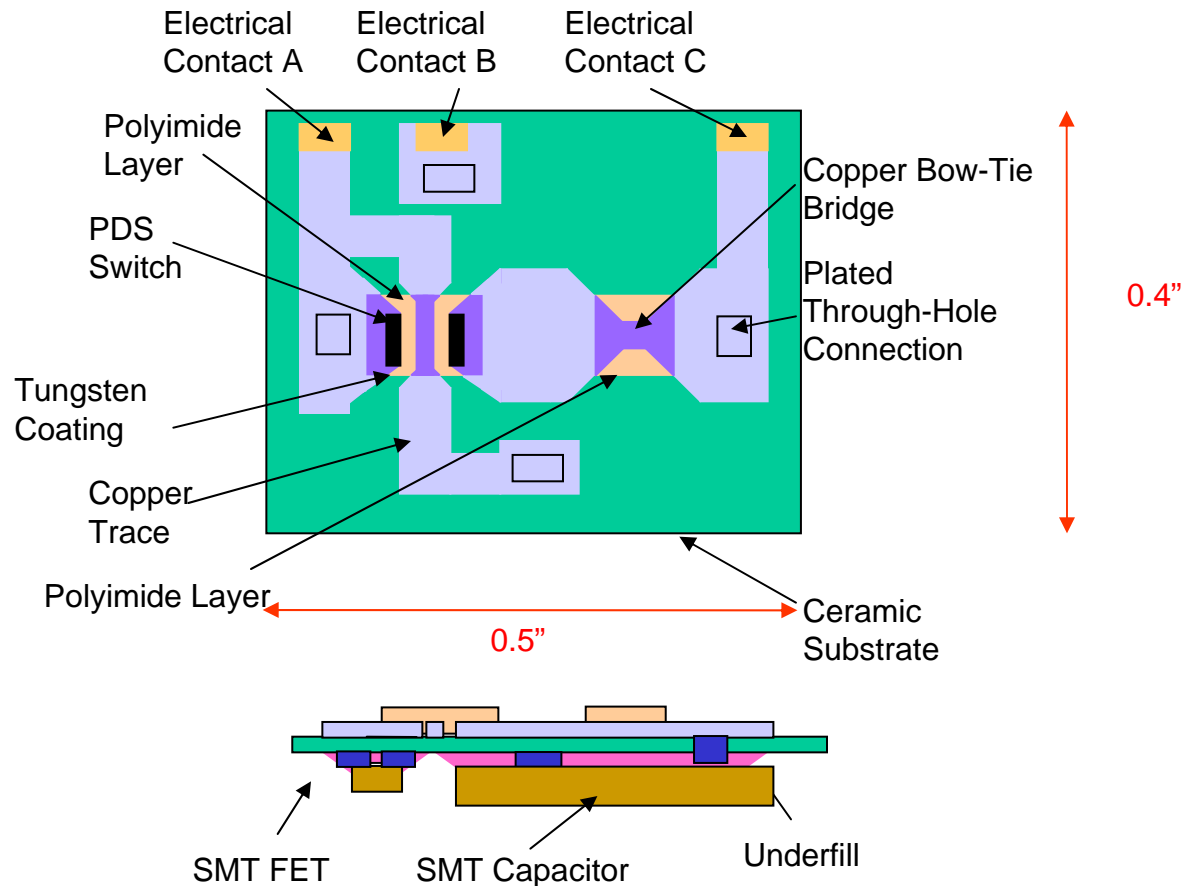
Planar Discharge Switch (PDS)



Fired Planar Discharge Switch

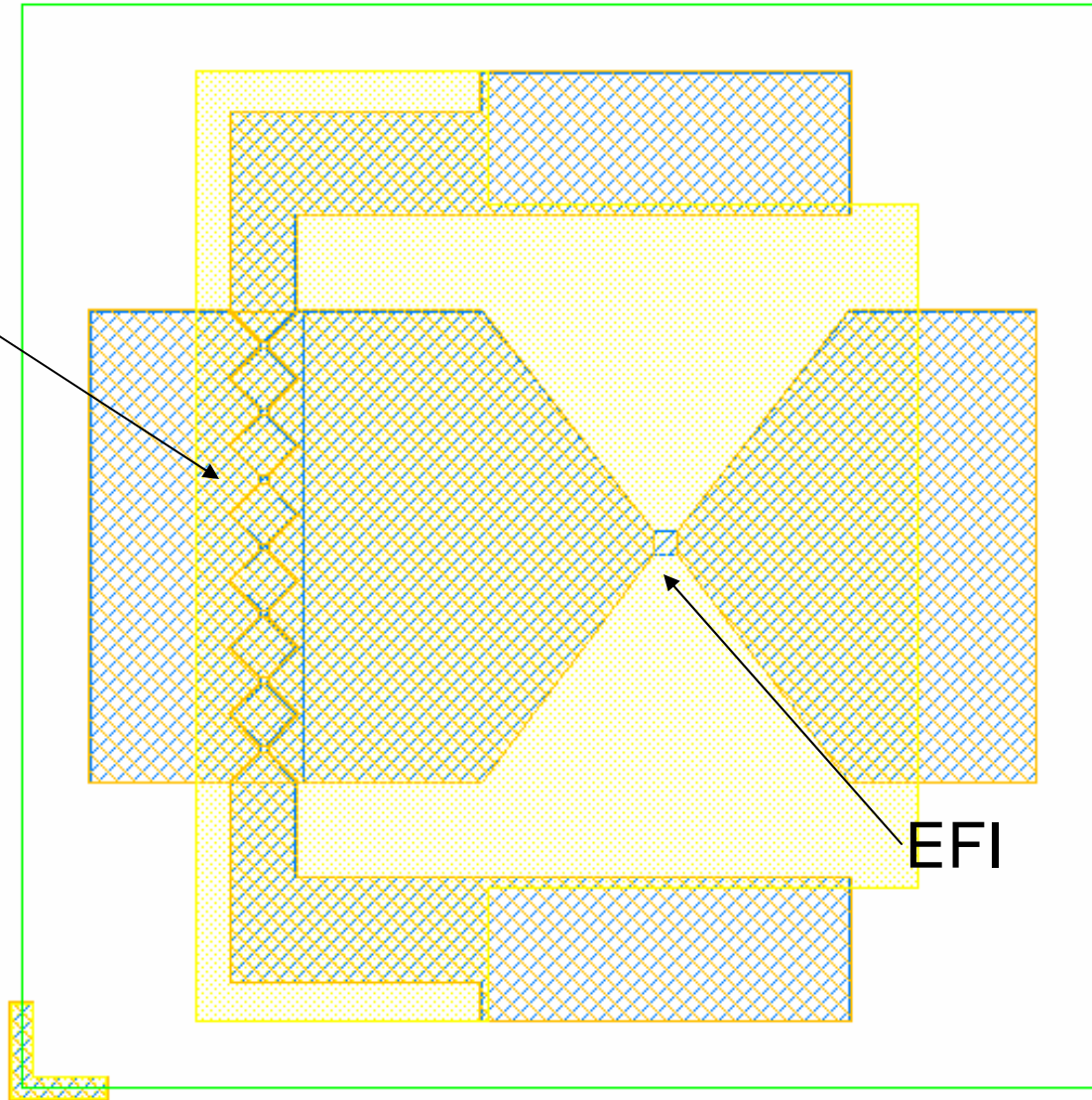


Miniature Fireset Concept with Planar Discharge Switch



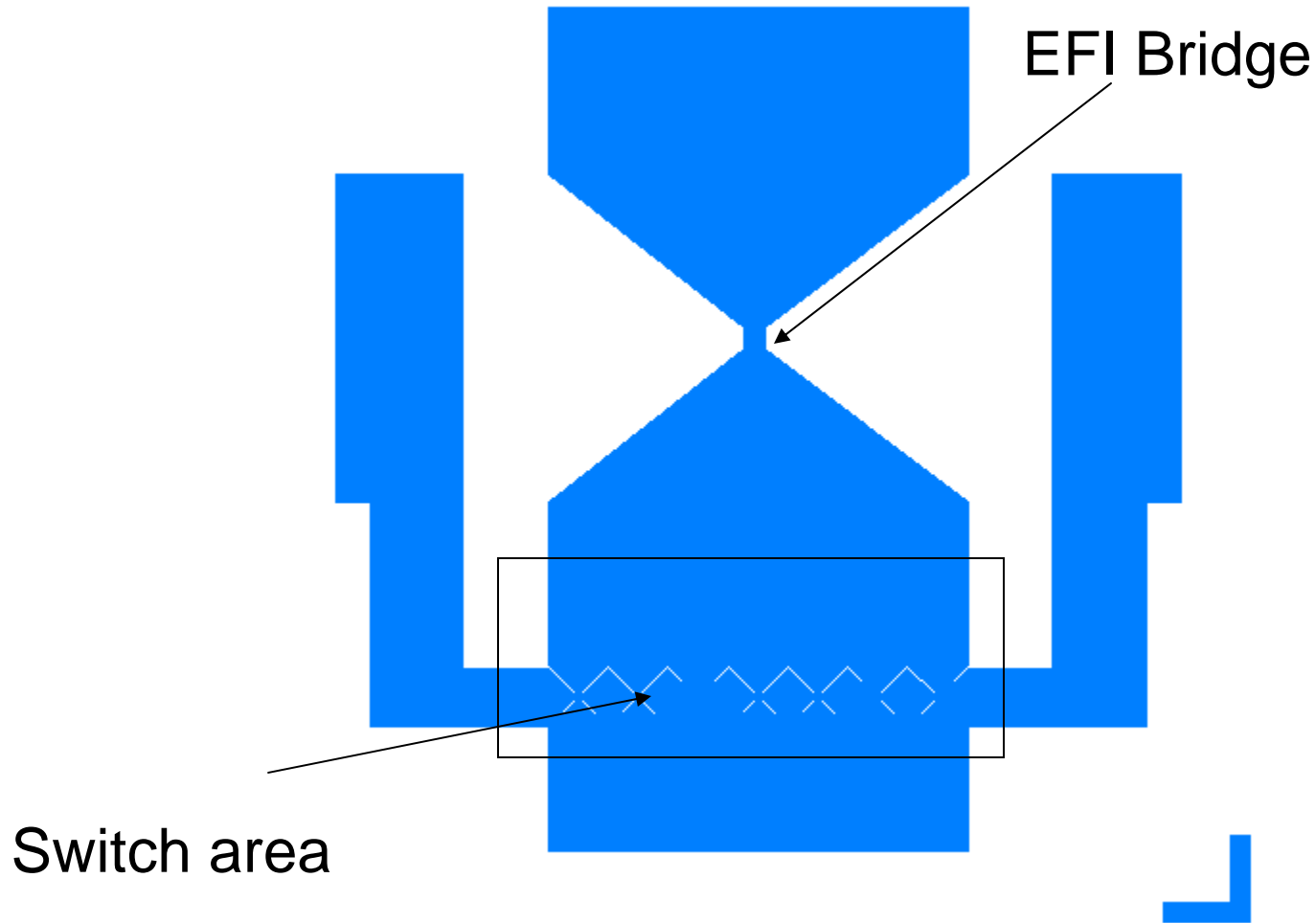
PDS plus EFI with Common Substrate

Switch area

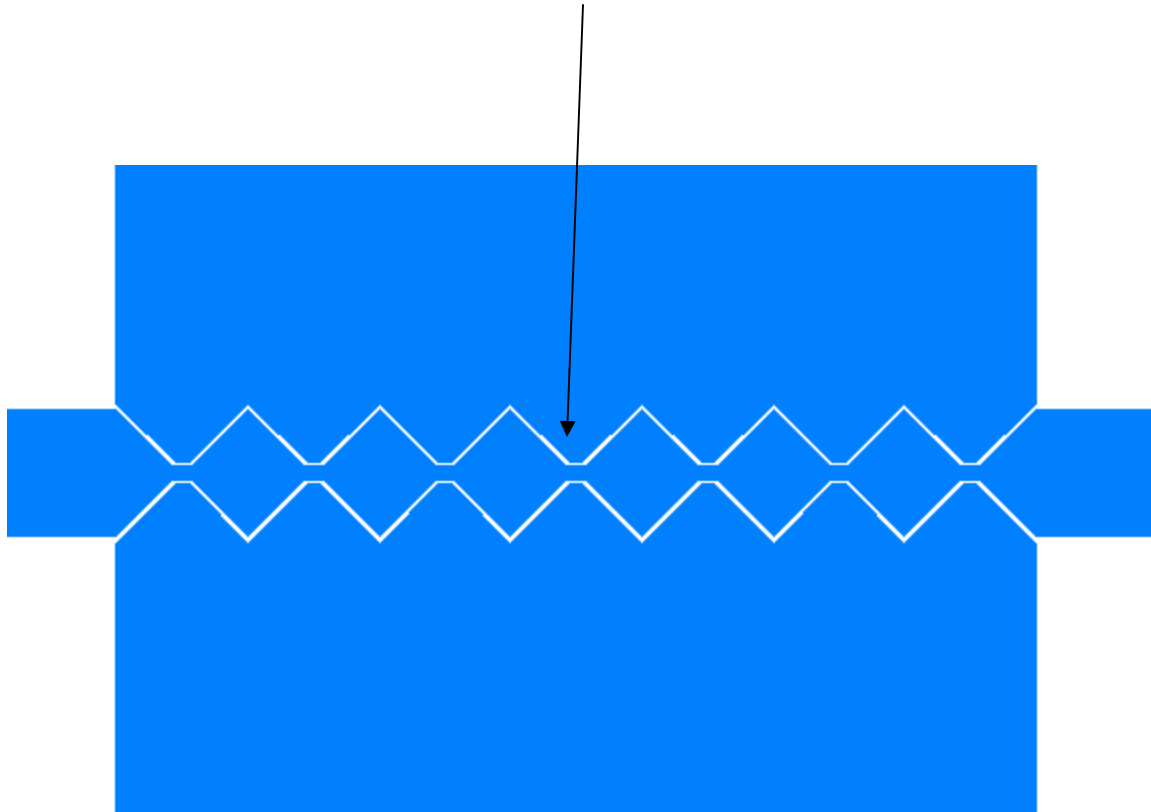


400 mils

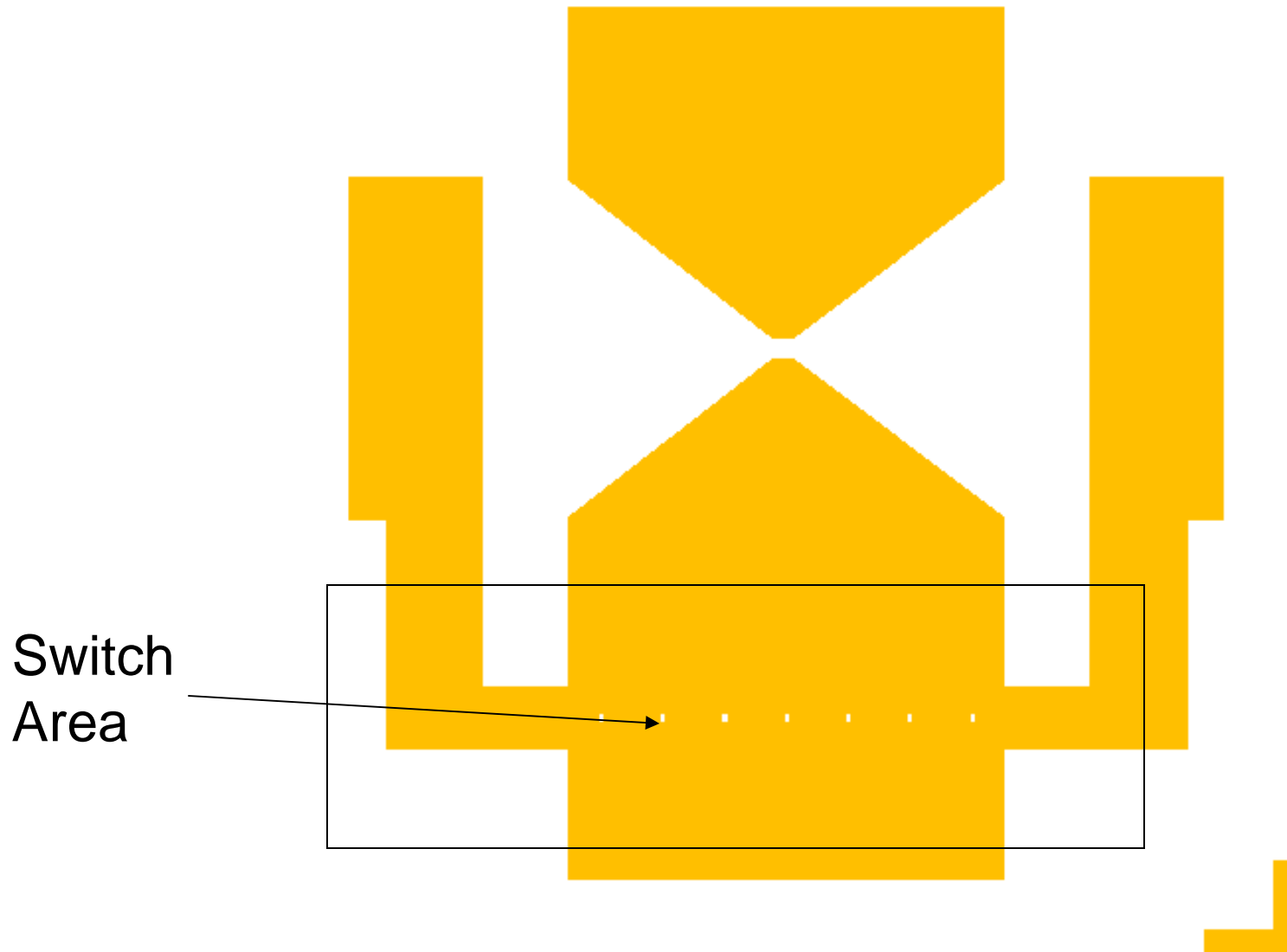
First level is patterned aluminum, bridge is standard size



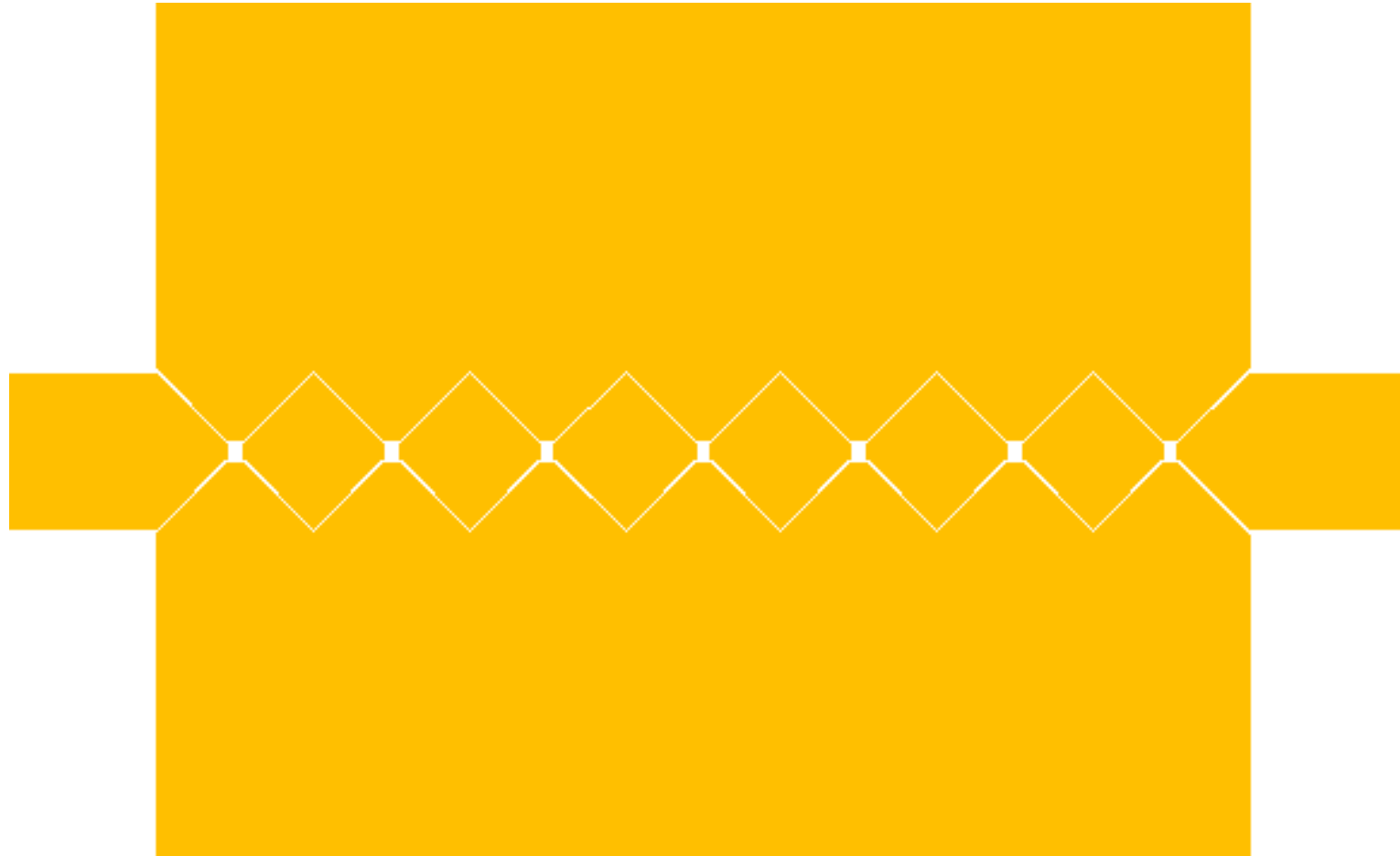
Zoomed view of “switch area”
small bridges are 2.5mil x 2.5mil



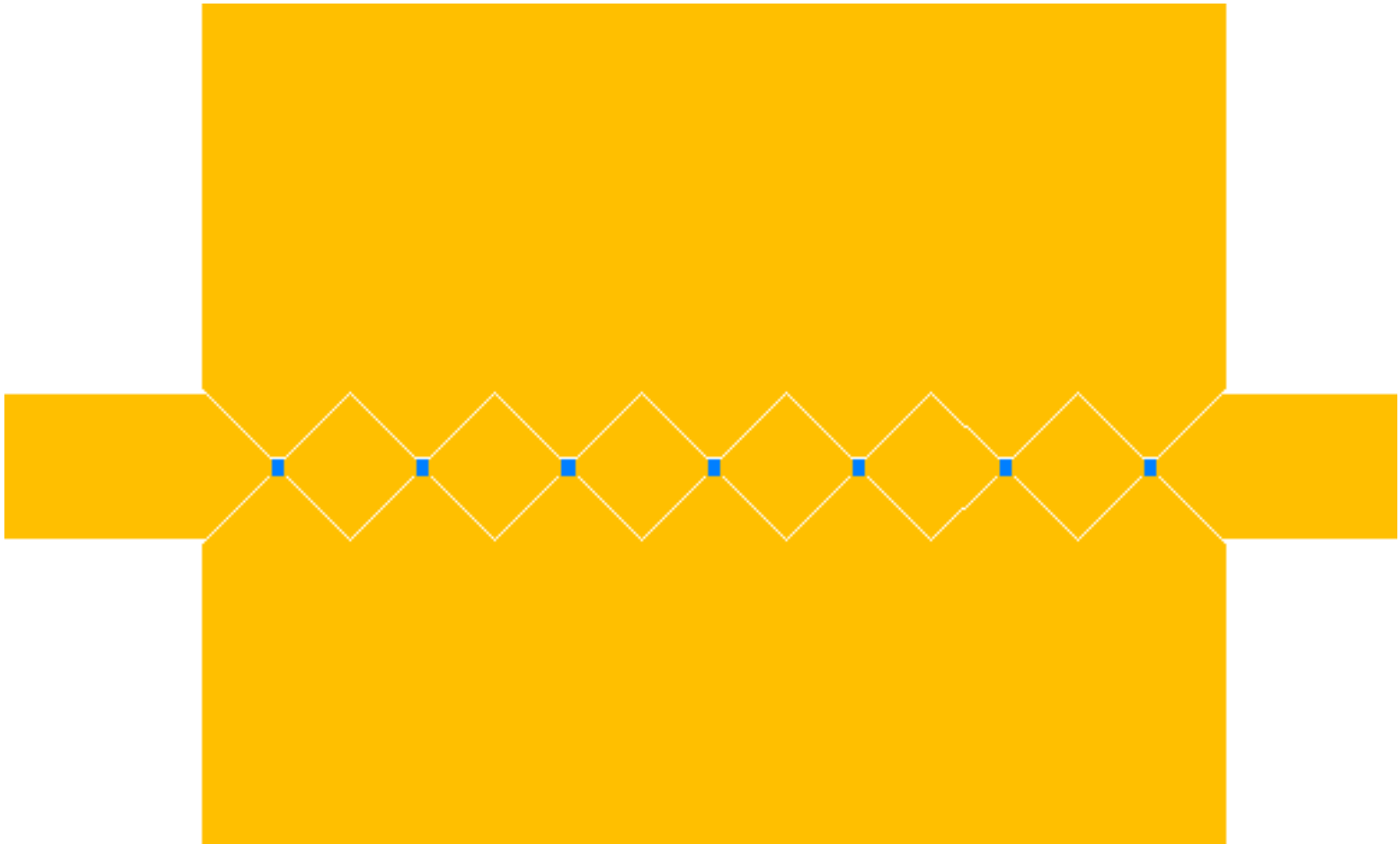
Liftoff layer for coating aluminum with Ti/Cu/Au



Expanded view of switch overcoat, gaps are
~ 15um, copper covers everything except
Al bridges



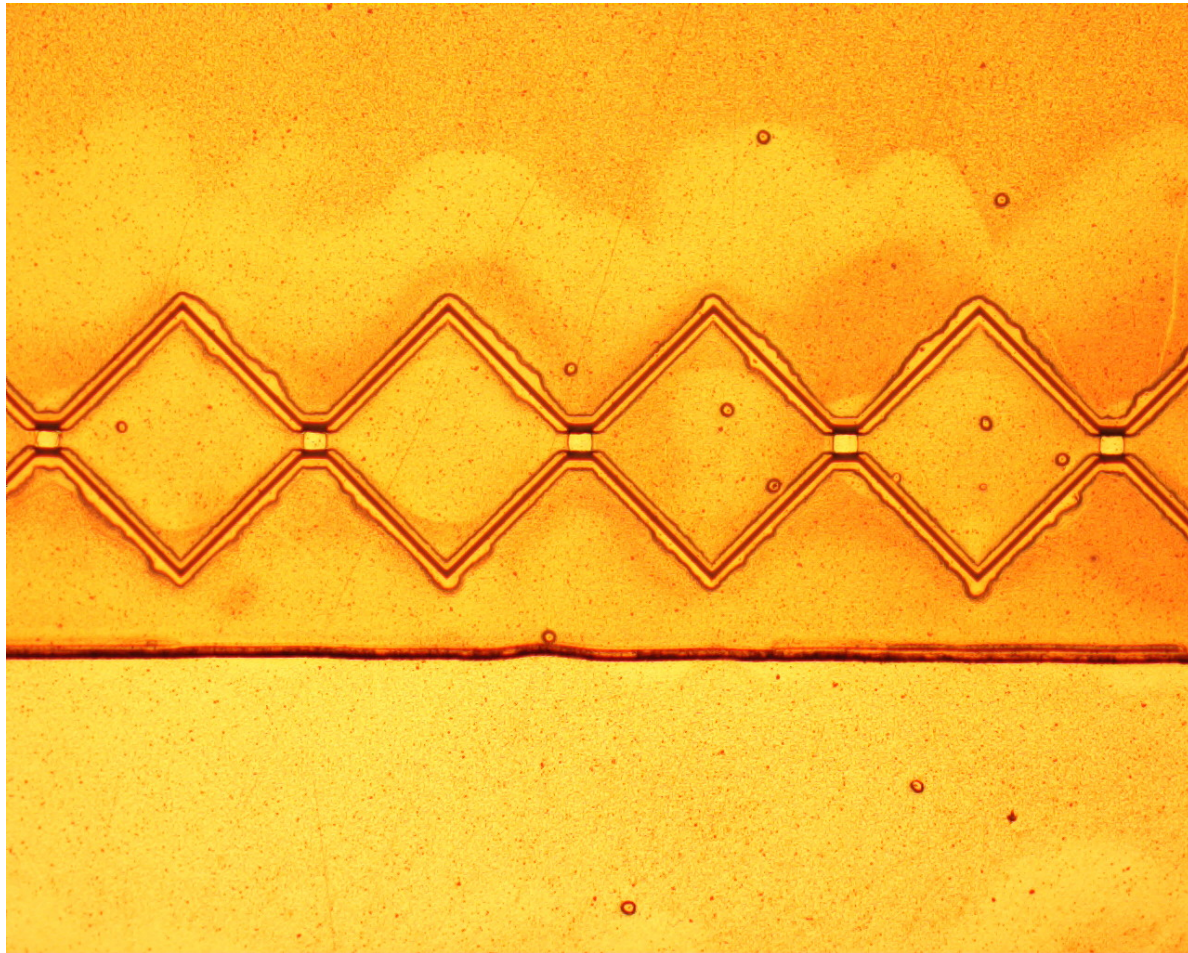
Blue is aluminum, orange is
aluminum coated with Ti/Cu/Au

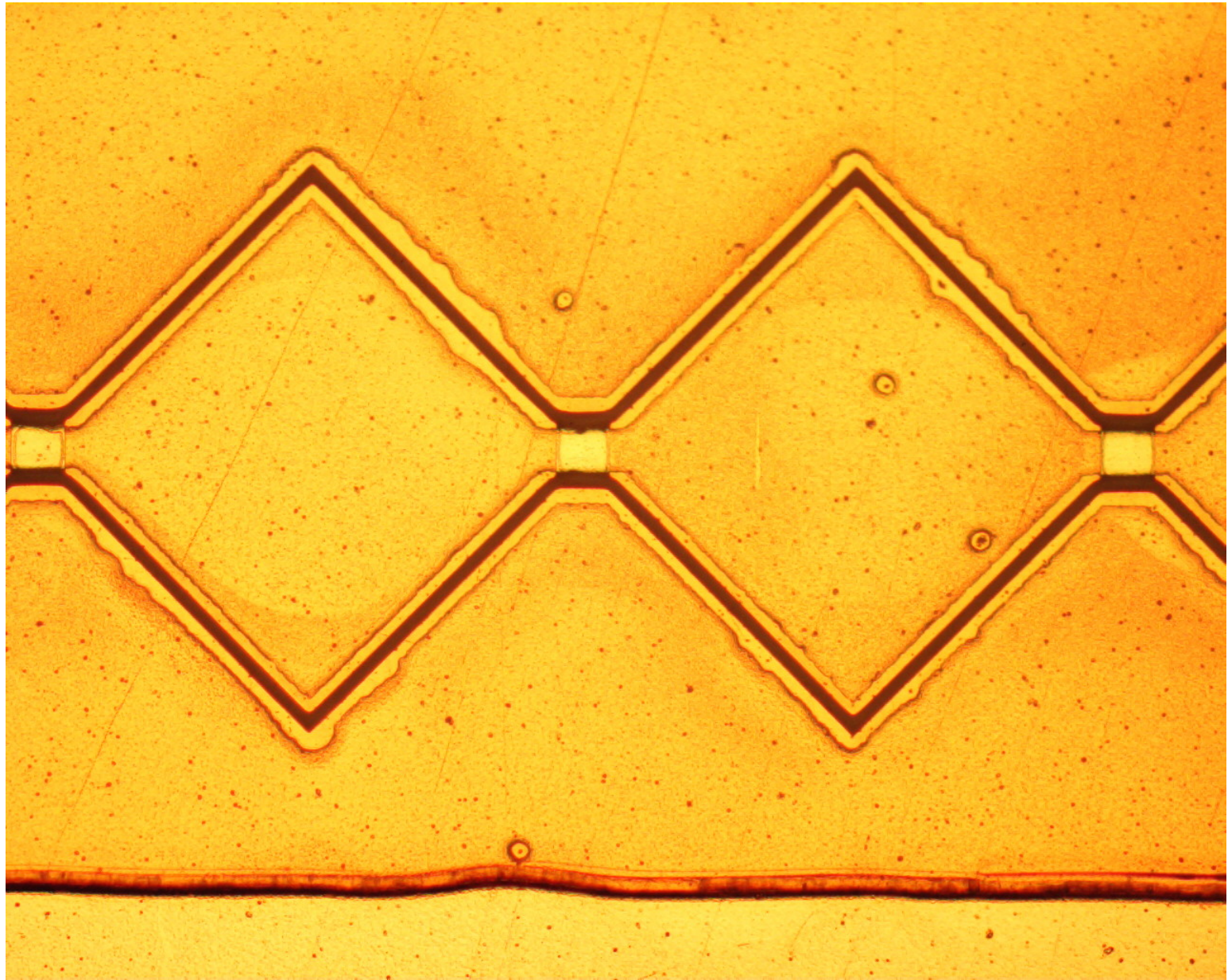


Polyimide layer

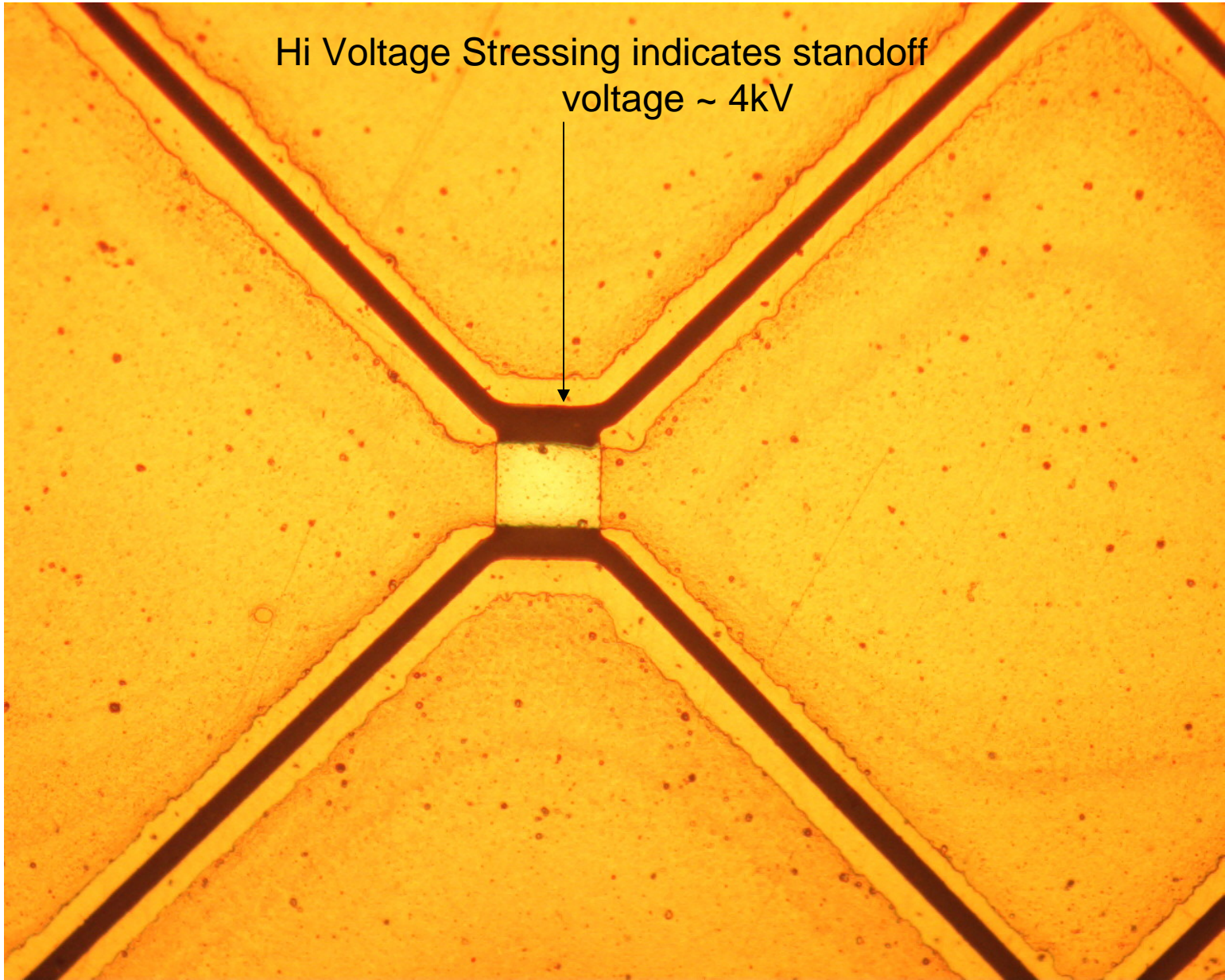


Switch after Ti/Cu/Au and Polyimide

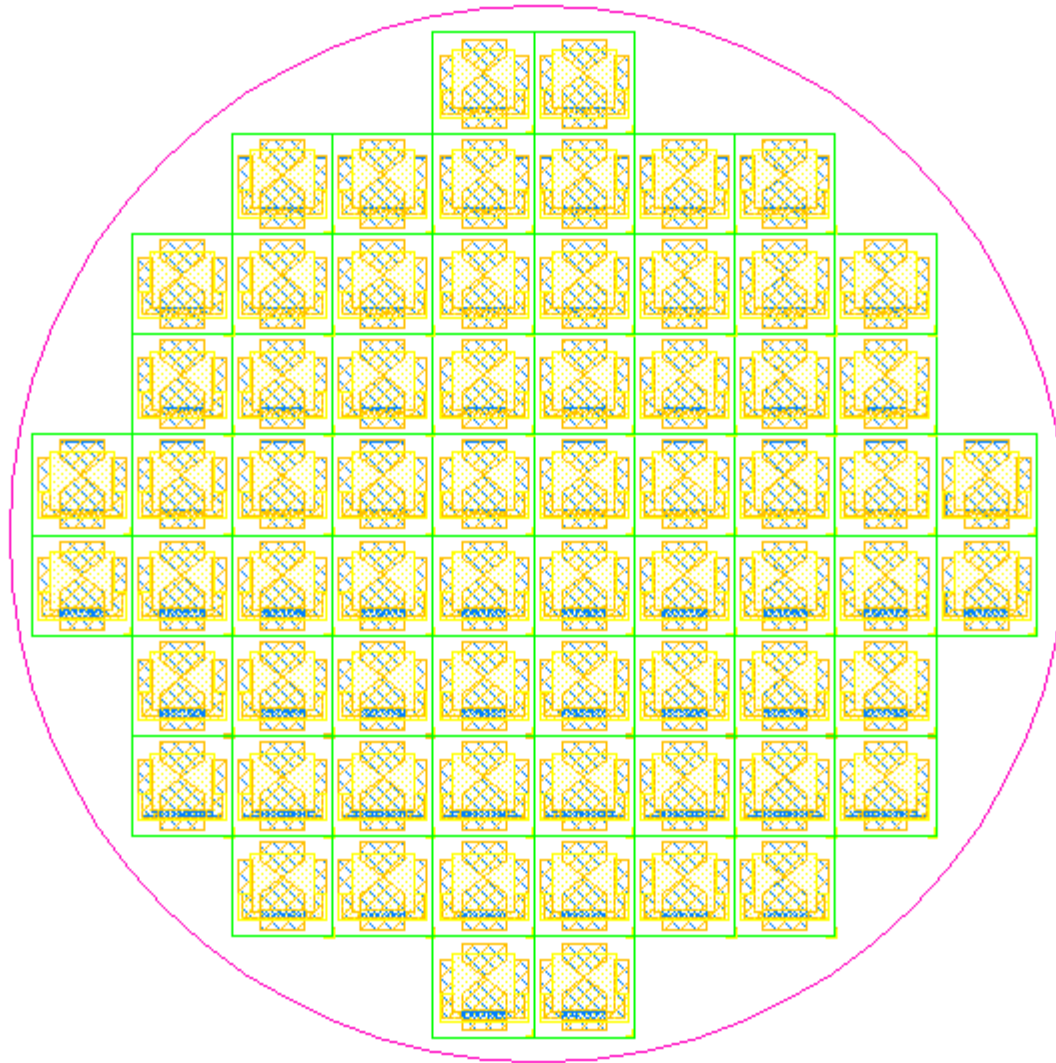




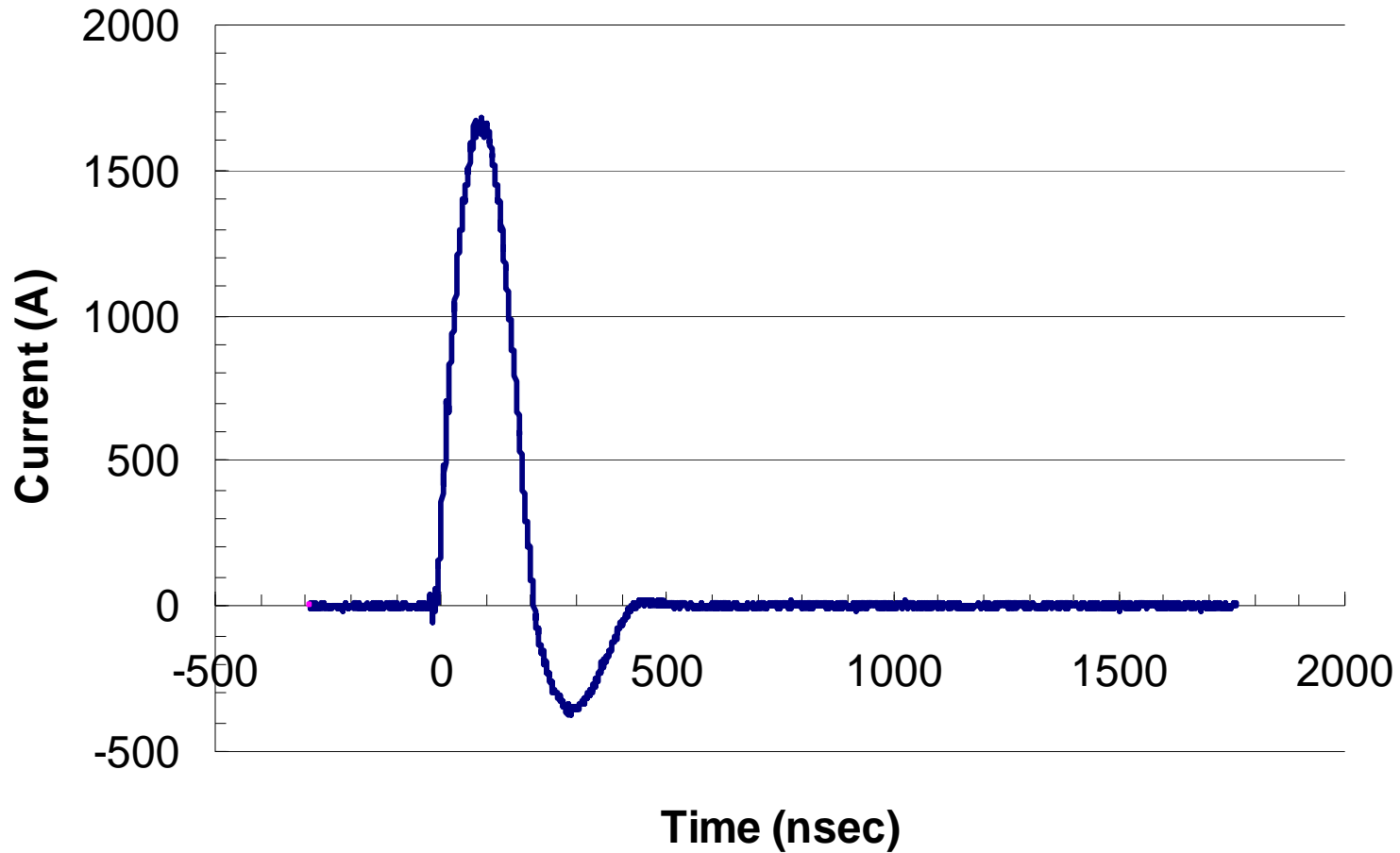
Hi Voltage Stressing indicates standoff
voltage ~ 4kV



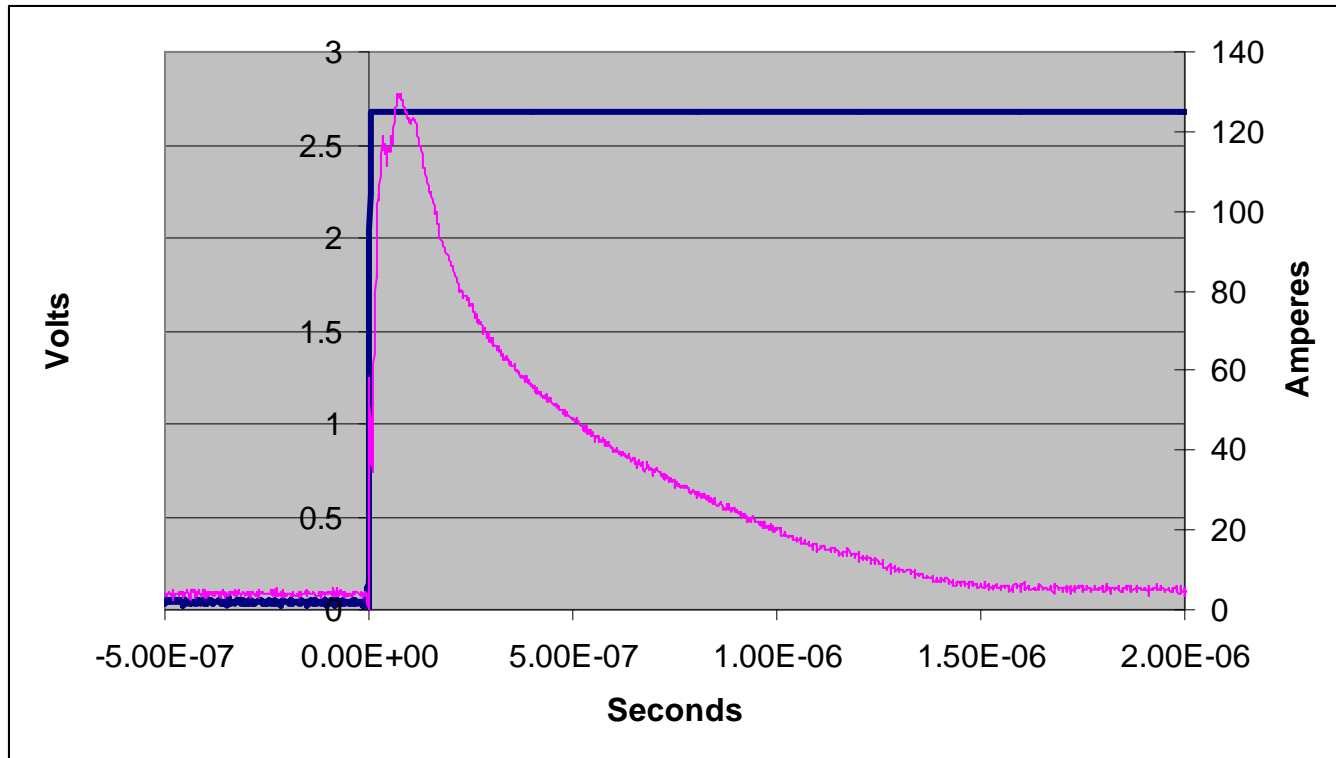
68 die on typical 4 inch substrate



Ring Down (PDS Switch)
C=0.2uF, Voltage=800, Test Load=0.004

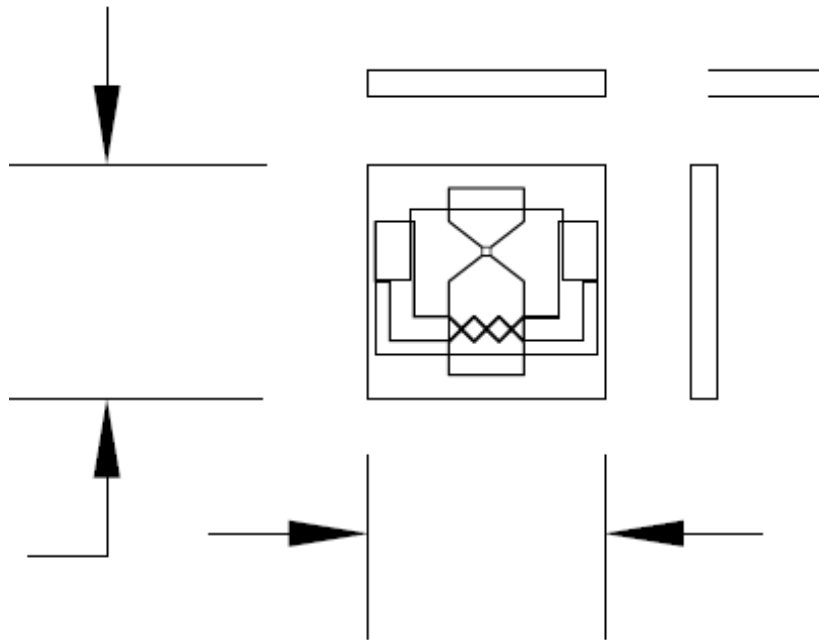


Jitter is repeatable and acceptable for typical EFI applications



Present Work

Reduce Size/Integrate on Standard Header



Conclusion

A novel one-shot switch has been introduced.

The structure is simple to construct using standard microelectronic processing techniques.

The device is easily integrated into flat stripline geometries

Device successfully functioned slapper with HNSIV