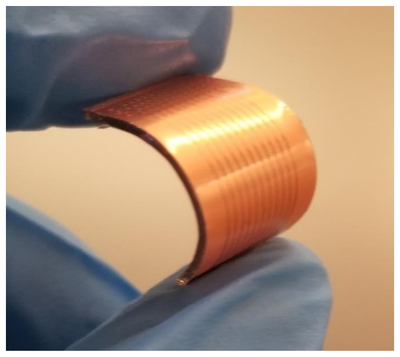
Active Flexible Connector for Long-reach Signaling in Wafer-scale Systems

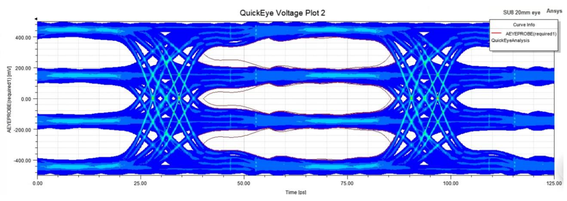
Randall Irwin, Subramanian S. Iyer | UCLA CHIPS

Introduction and Motivation

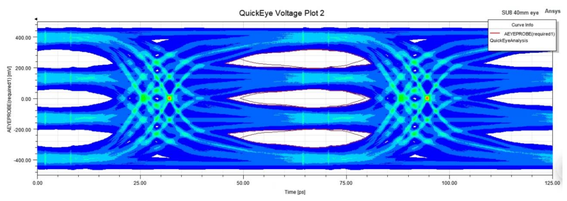
- FlexCon is a high bandwidth (>240 Gbps/mm) flexible connector cable platform for I/O signaling on wafer-scale systems
- Losses in passive FlexCon channels limit reach to ~2-3cm
- Active FlexCon:
  - Signal buffering to extend reach
  - I/O components (e.g. Serdes) can be integrated to minimize wafer area overhead



FlexCon



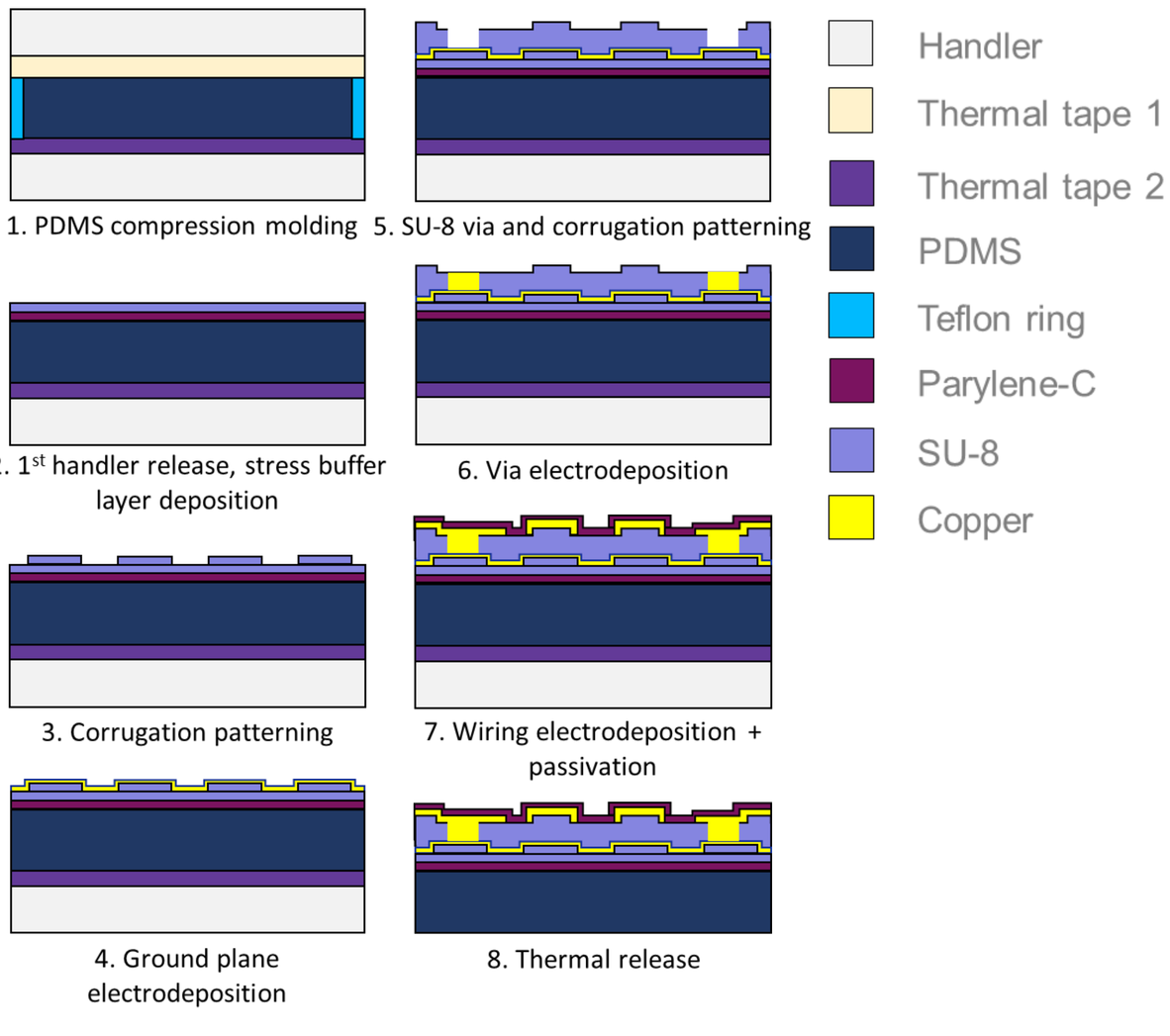
Simulated eye characteristics (20mm channel)



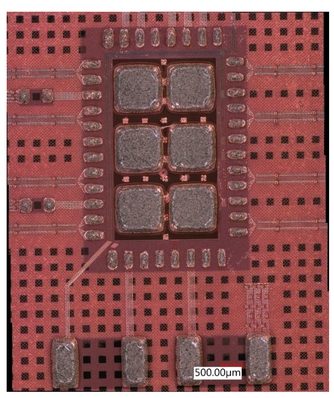
Simulated eye characteristics (40mm channel)

- Commercial chips are too thick (> 0.5mm) to integrate in FlexCon substrate
- Initial proof-of-concept demonstration possible with a flip-chip assembly
- Commercially available buffer with equalization: TI SN75LVPE4410
  - Quad-channel linear redriver, 124mW/channel
  - Up to 16Gbps

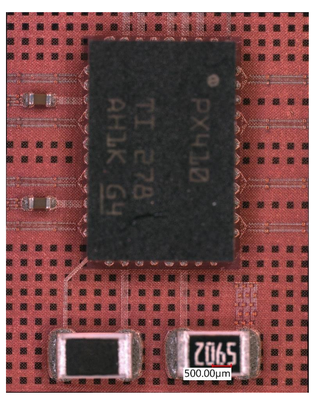
Process Flow



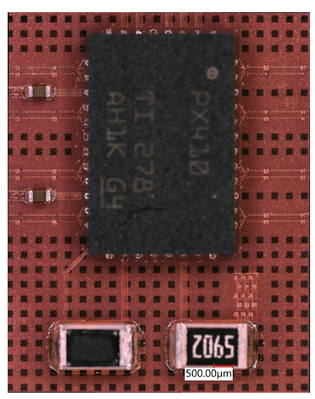
1. PDMS compression molding
2. 1st handler release, stress buffer layer deposition
3. Corrugation patterning
4. Ground plane electrodeposition
5. SU-8 via and corrugation patterning
6. Via electrodeposition
7. Wiring electrodeposition + passivation
8. Thermal release



9. SnBiAg solder paste stencil printing



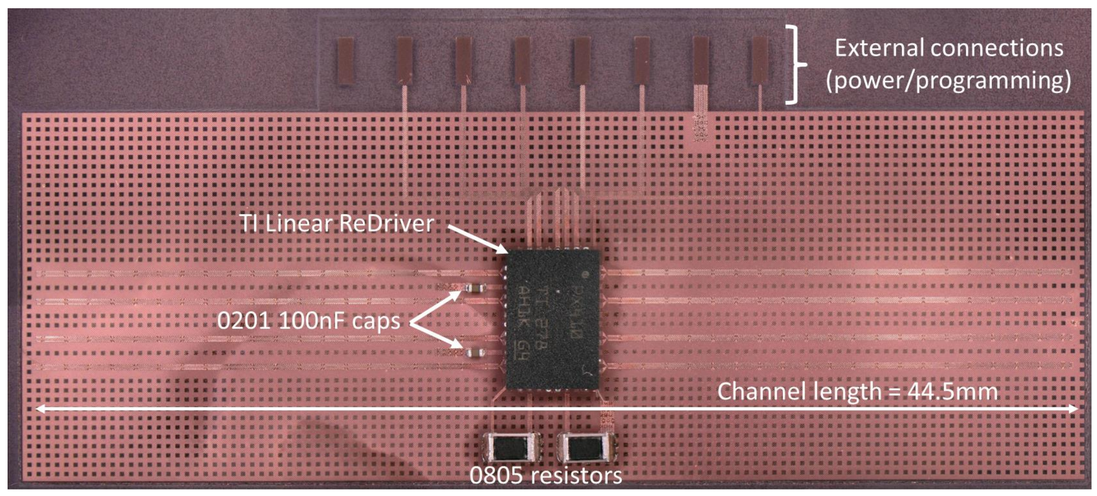
10. Component placement



11. Reflow

Experimental Results

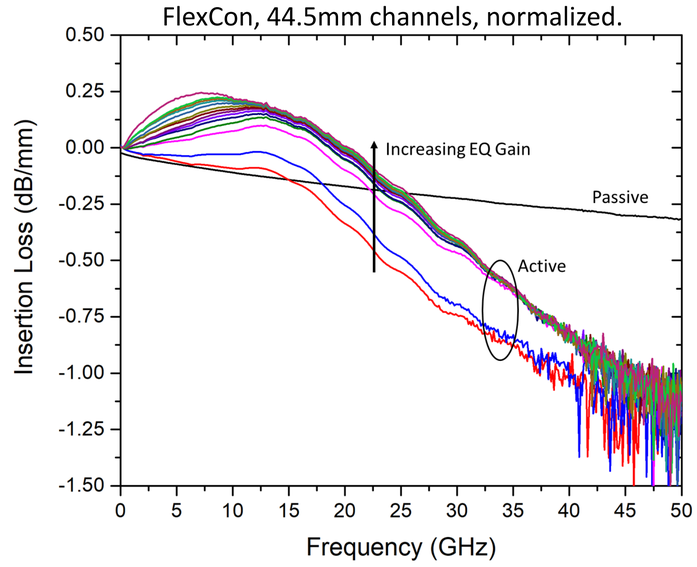
- Components successfully integrated with 44.5mm FlexCon channels



Active FlexCon flip-chip assembly

- Buffer chip placed at the midpoint along a 44.5mm channel
- Passive and active channels measured
- Normalized insertion loss (right) demonstrates FlexCon reach extension via integration of active buffer

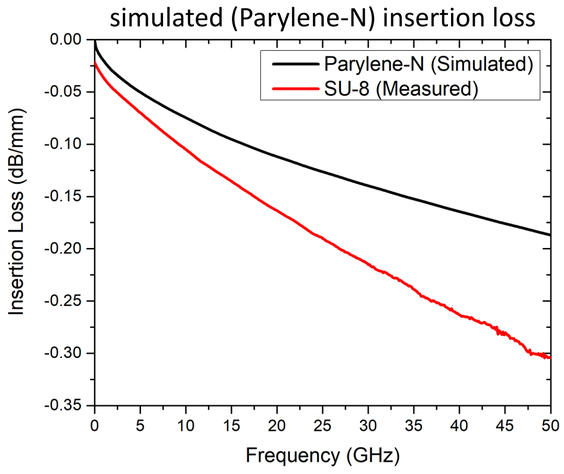
Measured insertion loss of active and passive FlexCon, 44.5mm channels, normalized.

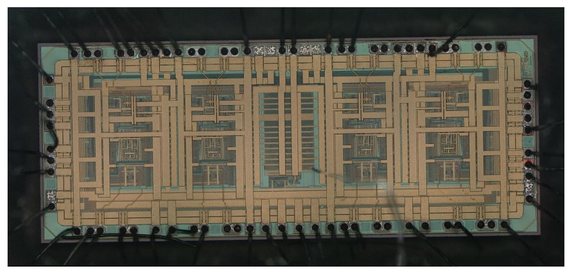


Future Work

- Further improvement of FlexCon reach by reducing dielectric losses
  - SU-8: Df = ~0.015
  - Parylene-N: Df = < 0.002

FlexCon measured (SU-8) and simulated (Parylene-N) insertion loss





Depackaged TI SN75LVPE4410

- Bare die integration of depackaged commercial buffer chip
  - Heated sulfuric acid epoxy removal
  - Wirebonds sheared/lapped
- Eliminates need for external connector
- Solderless integration
- Improved reliability

Conclusion and Acknowledgements

- Successfully integrated active components into FlexCon using screen-printed SnBiAg solder paste and conventional reflow oven process
- FlexCon reach extension demonstrated using commercially available buffer with equalization: TI SN75LVPE4410 linear redriver
- Further improvement to be demonstrated via replacement of lossy SU-8 dielectric with low-loss Parylene-N and integration of depackaged linear redriver

We would like to thank SEMI-Flextech, SEMI-NBMC, UC-MPRI, and the UCLA CHIPS consortium for supporting this work

2023 UCLA CHIPS Workshop
Poster Session

UCLA CHIPS CENTER FOR HETEROGENEOUS INTEGRATION AND PERFORMANCE SCALING