

Low Crosstalk Differential Transmission Line Interconnect on Si ULSI

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1. Background

- Si ULSI: Global Interconnect Freq. > GHz, Length = cm-order
- 1, Signal wavelengths \approx Global interconnect length
- 2, The inductance (ωL): Cannot be neglected

Interconnect must be designed as **transmission line**.
(= RLC distribution constant circuit model)

Using the inductance positively
→ High-speed signal transmission can be achieved.

2. Purpose

Employment of Differential Transmission Line to Interconnect Structures on Si ULSI

Differential Transmission Line vs. Single-ended Transmission Line

- Ground planes or ground lines are not required
- Superior common-mode noise robustness

- Differential Transmission Line Structure for Long Interconnects
- Robustness to Crosstalk Noise

3. Differential Transmission Line Structure for Long Interconnects

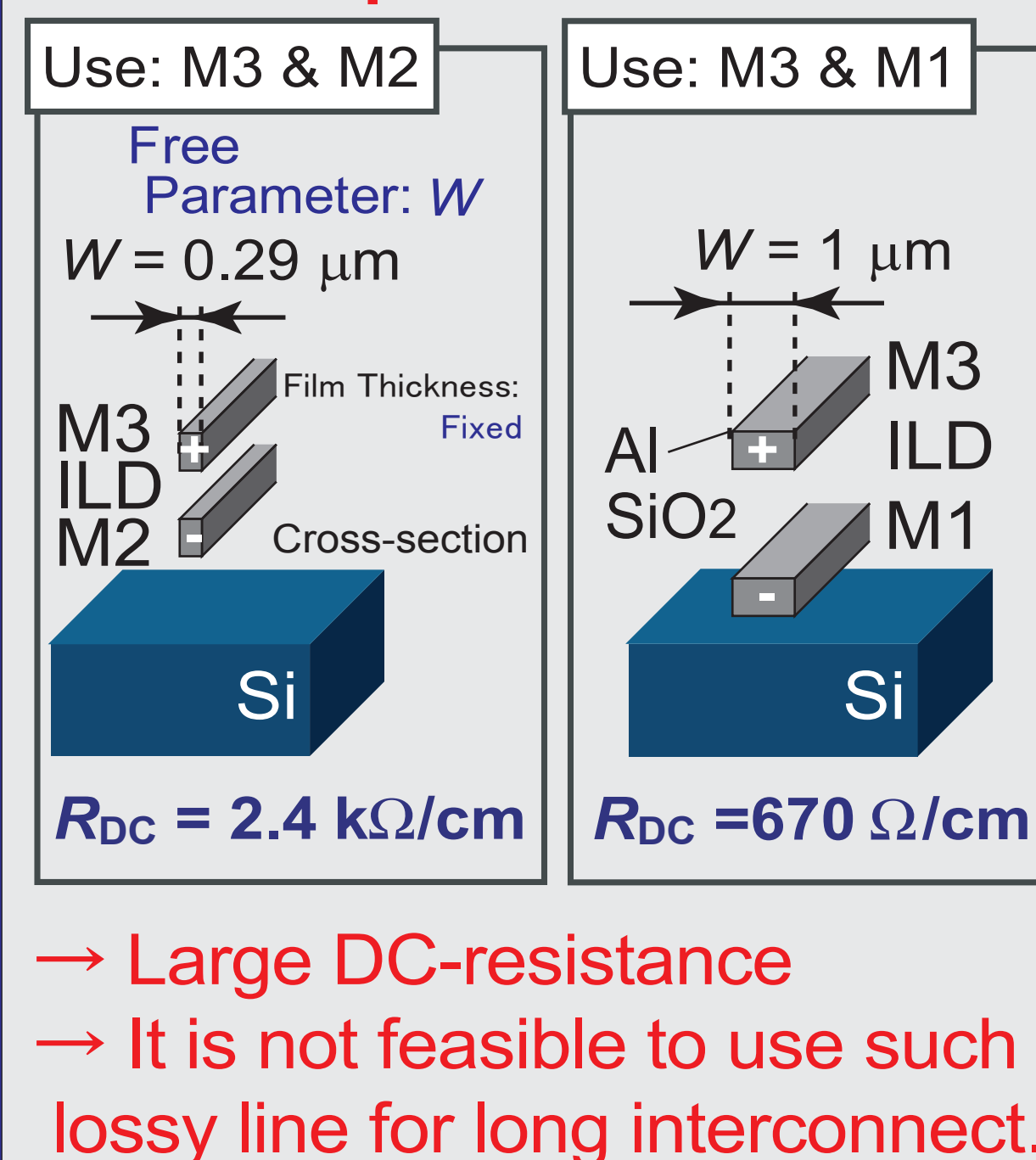
Required characteristic of differential transmission lines

- Low losses (Large bandwidth)
- $Z_{diff} = 100\Omega$
- Low interconnect-resource
- No GND-plane

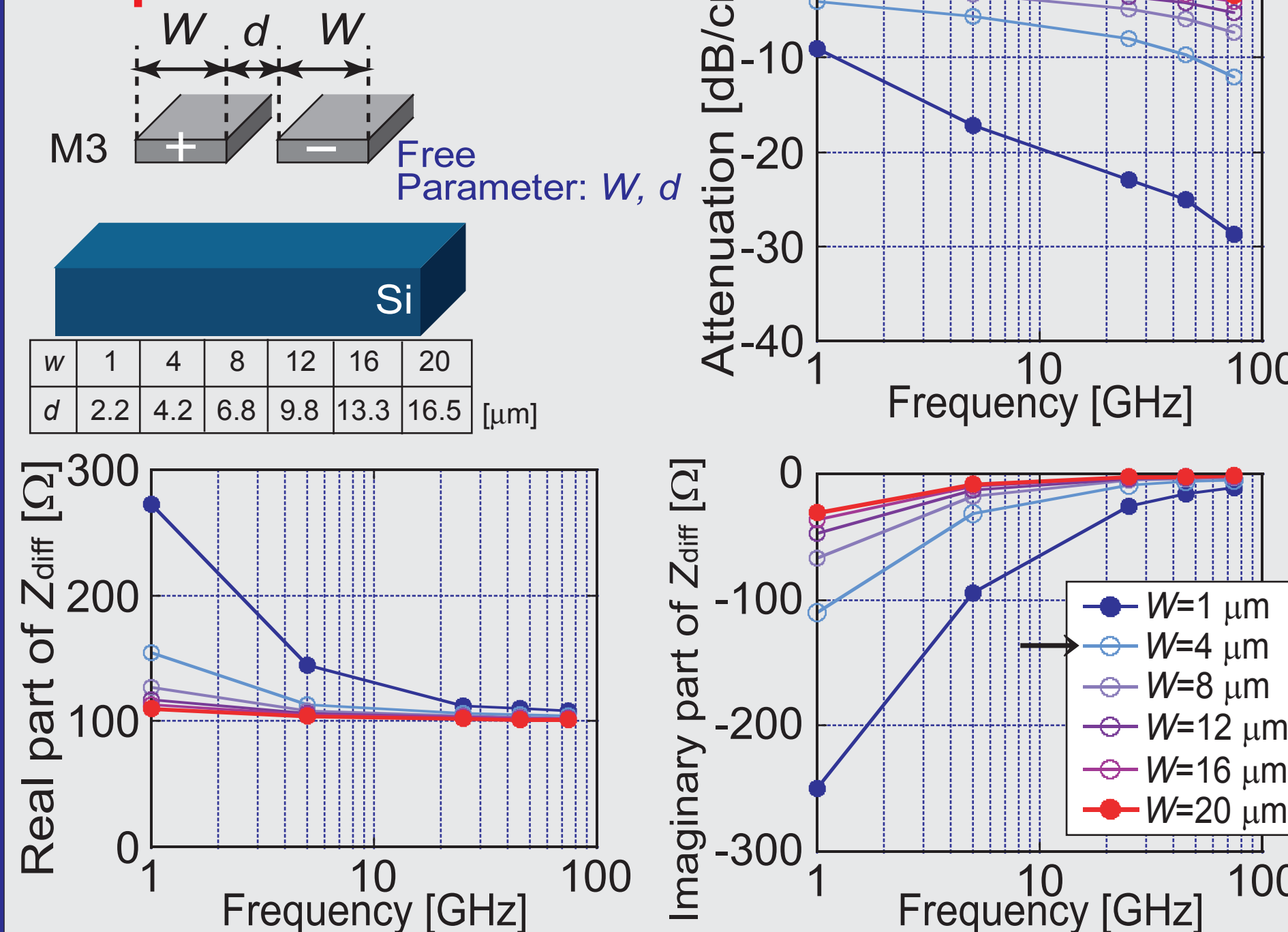
- Line Parameter: AMS 0.35 μm CMOS (M3: 0.9 μm , M2&M1: 0.6 μm , ILD: 1 μm)
- EM Simulation Ansoft 2D Extractor

Consideration of transmission line structures

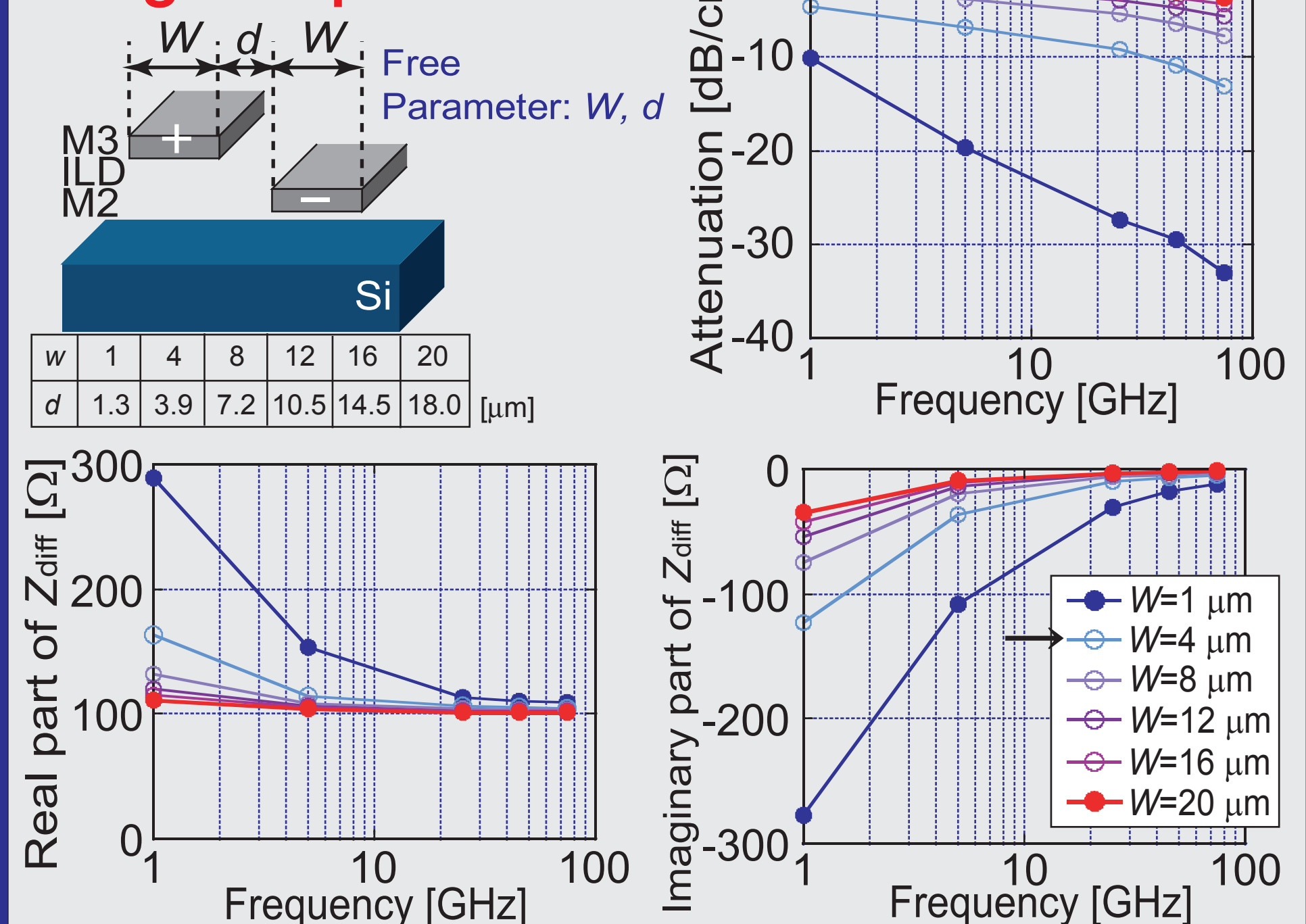
Stacked-pair Line



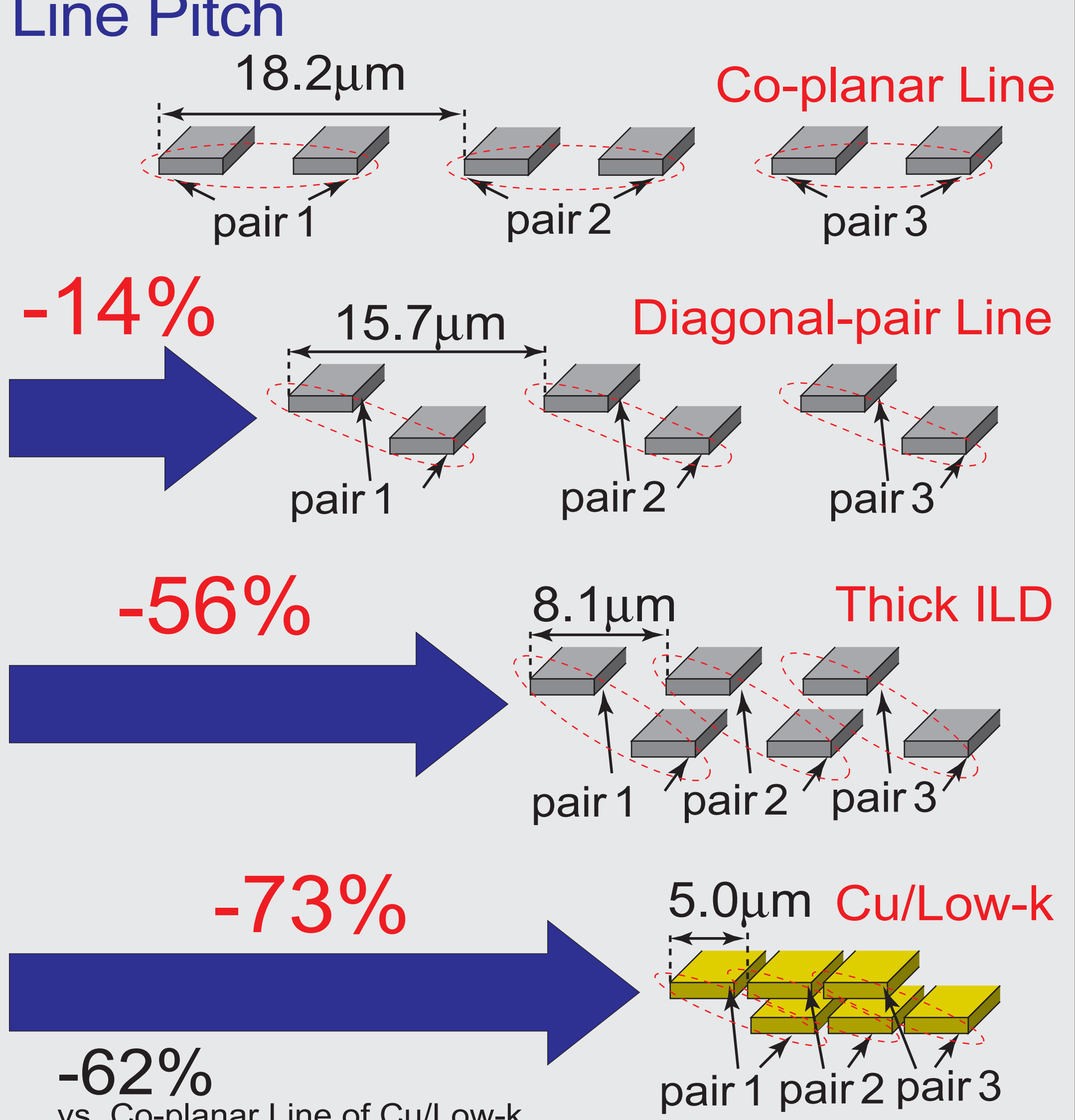
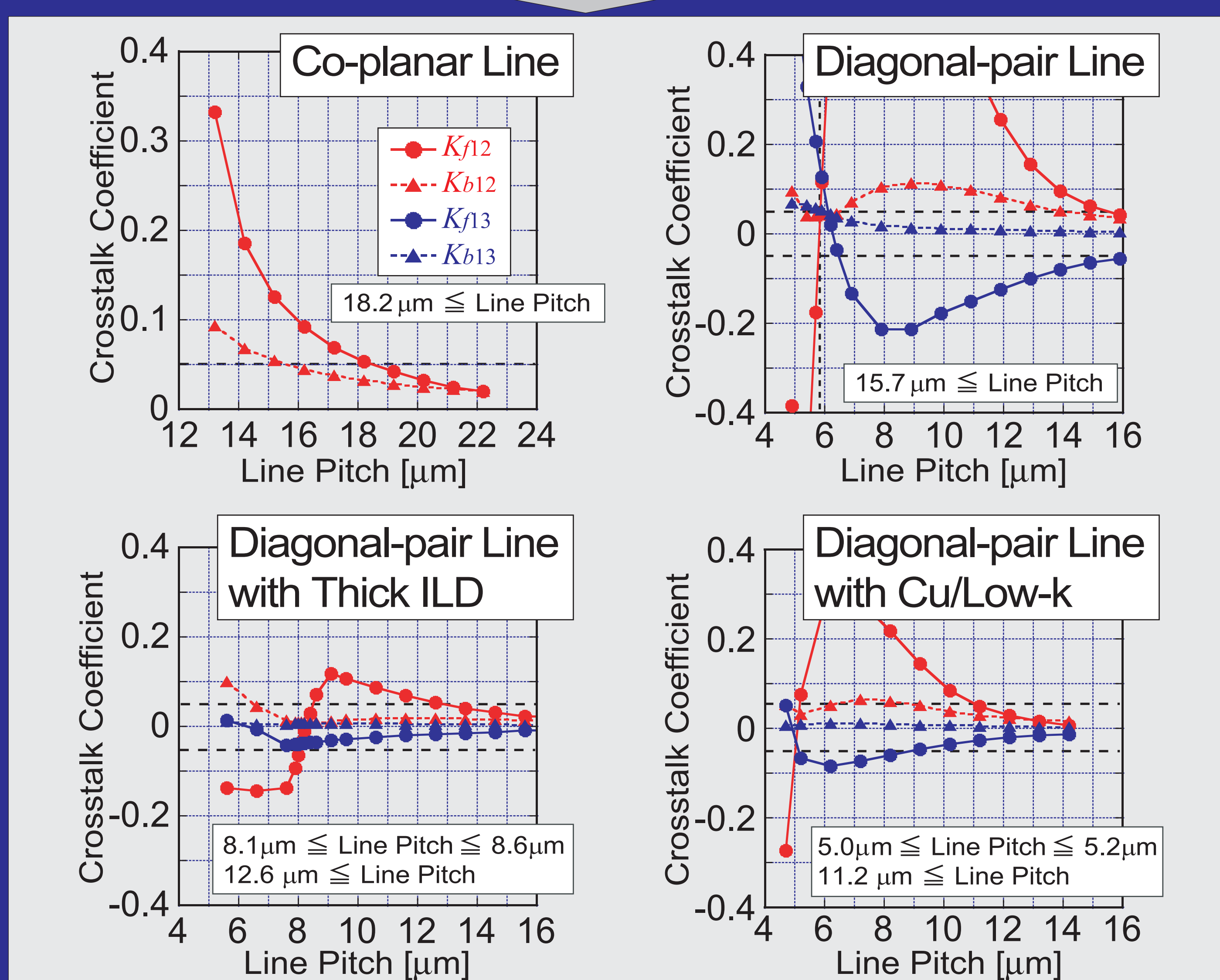
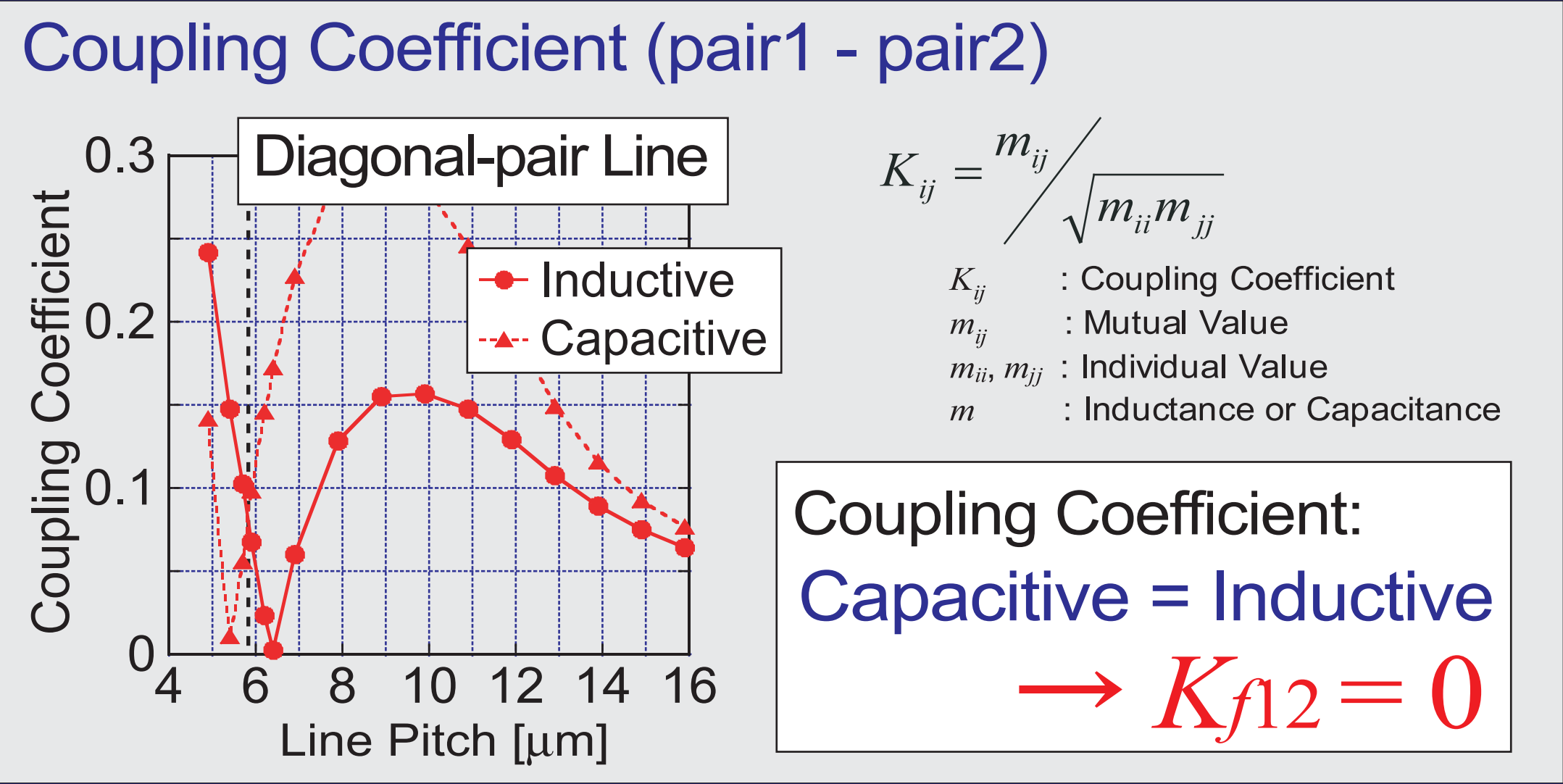
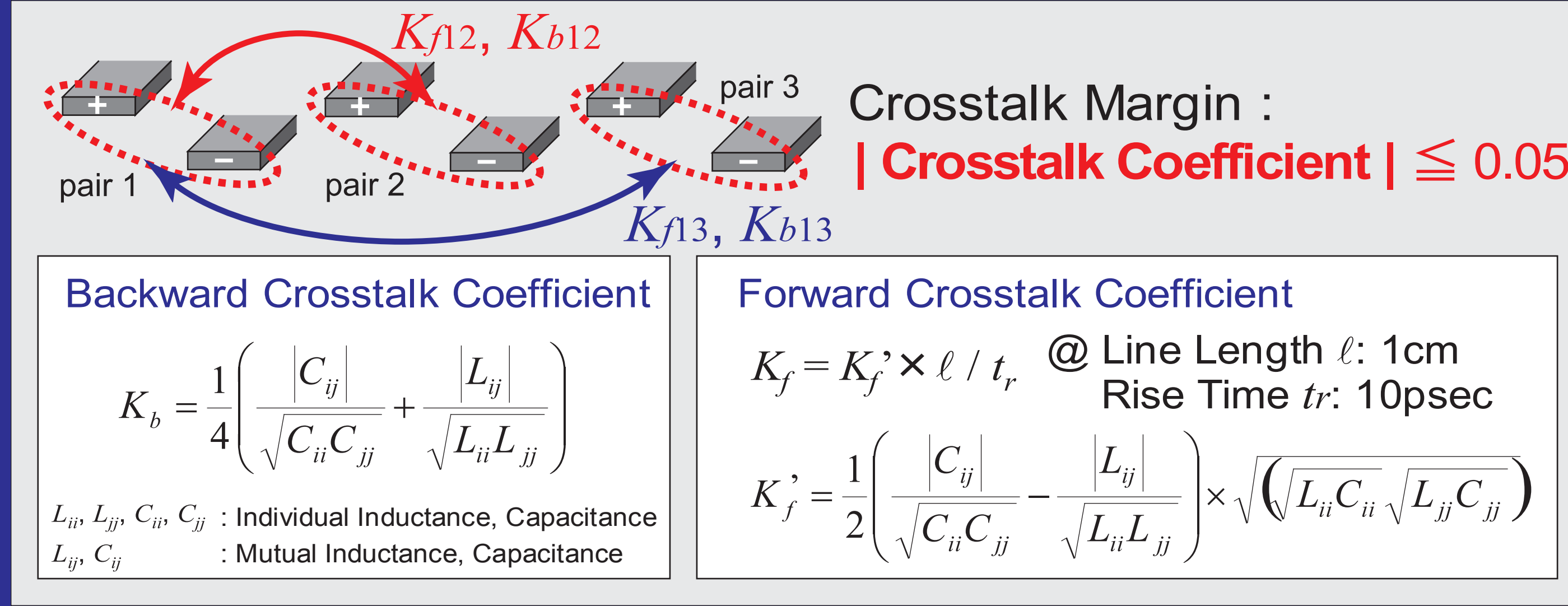
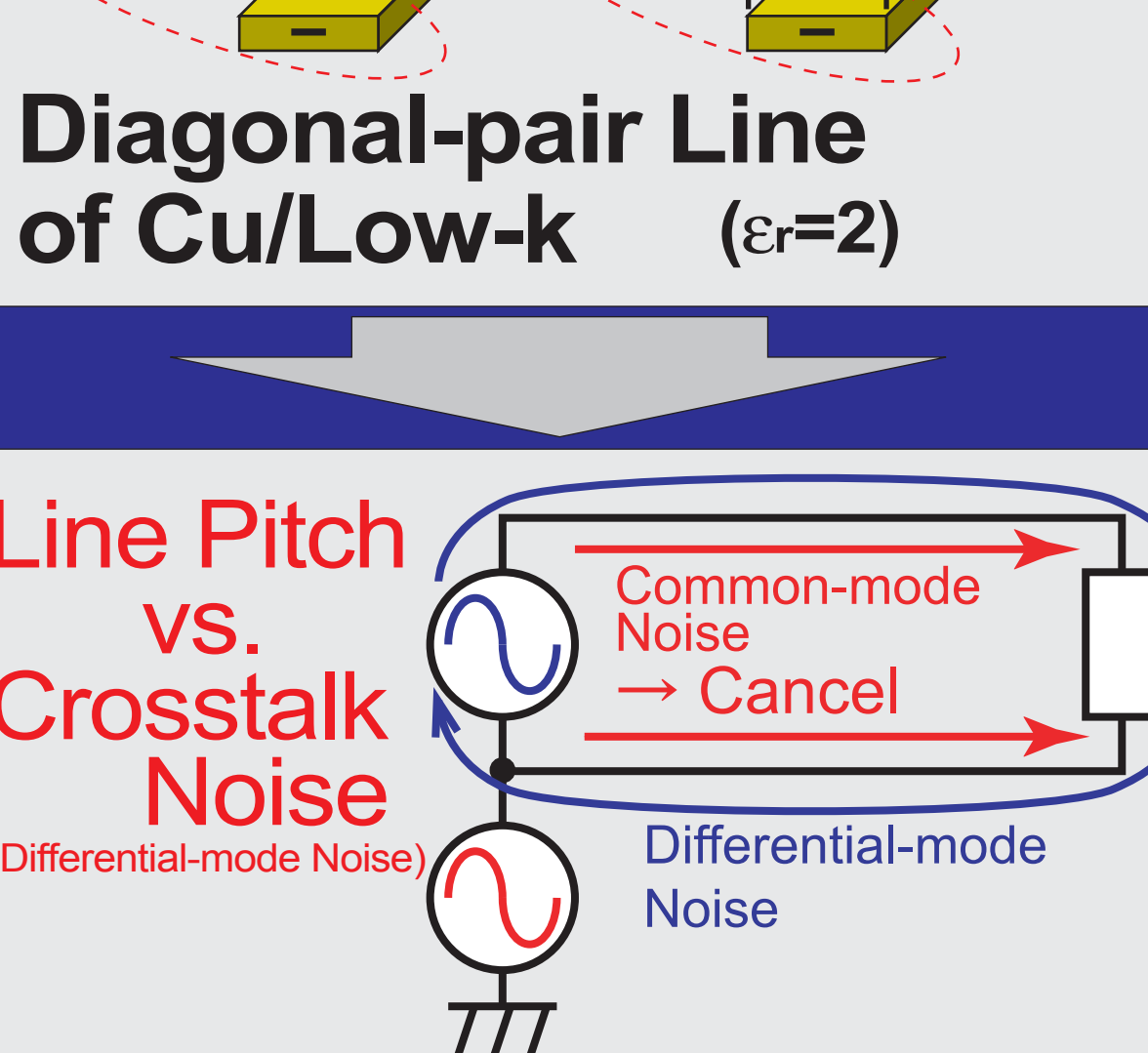
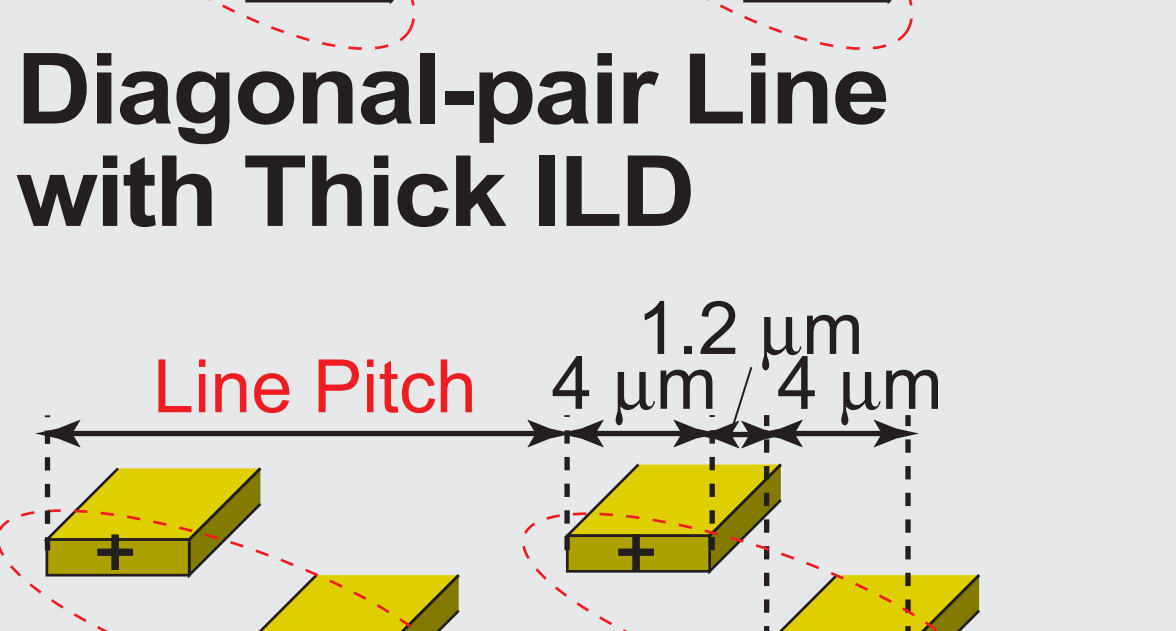
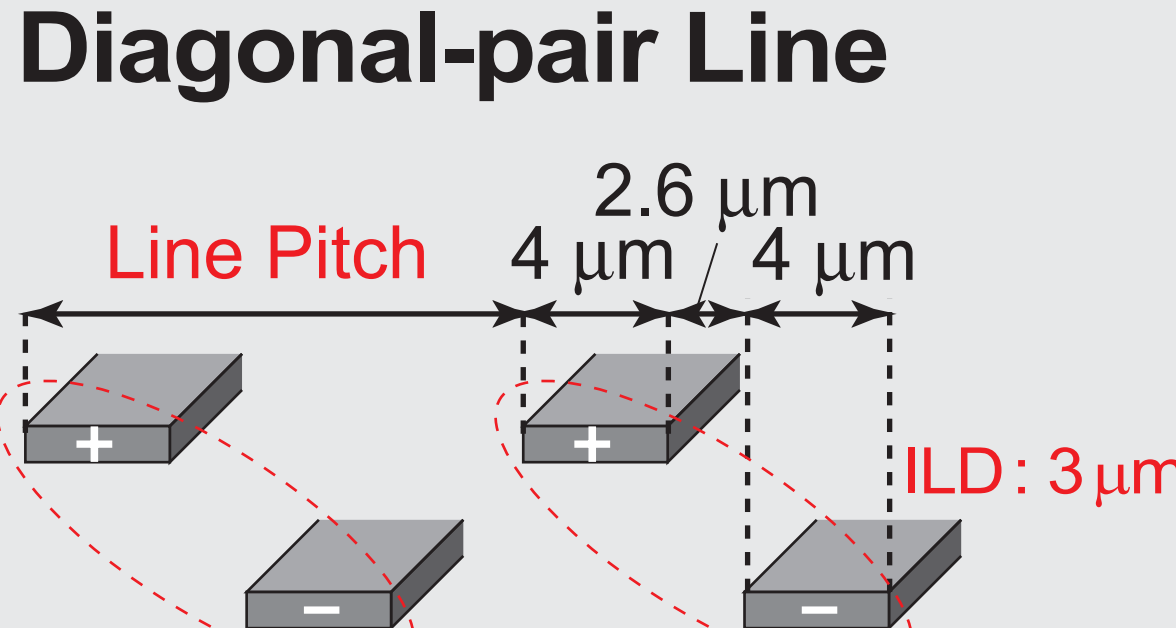
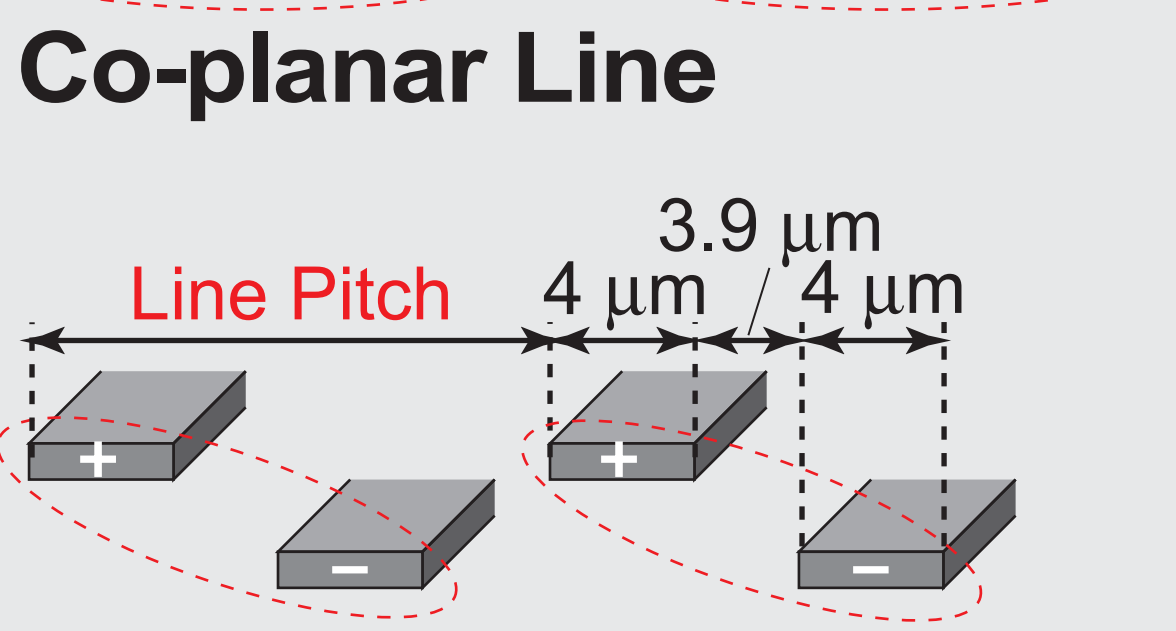
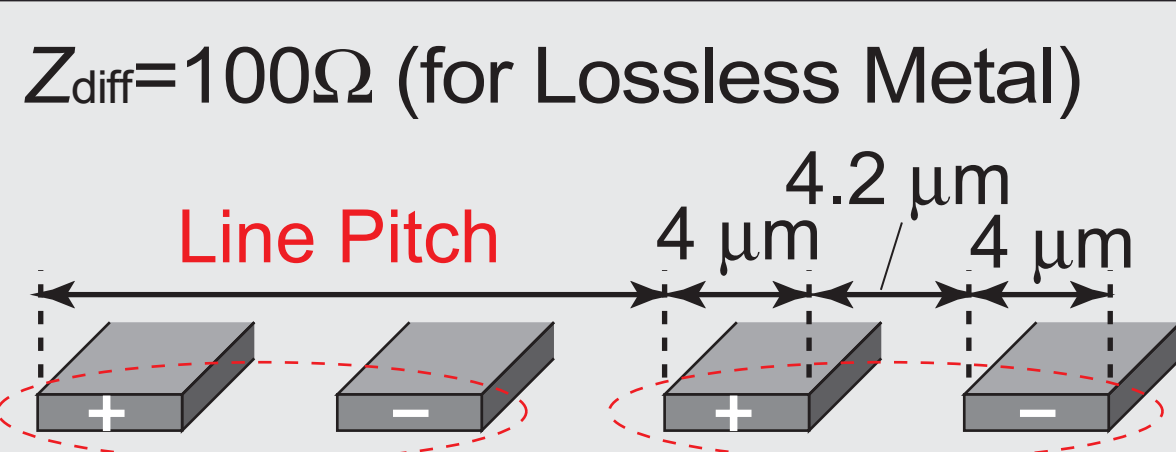
Co-planar Line



Diagonal-pair Line



4. Robustness to Crosstalk Noise



5. Conclusion & Future Work

- Co-planar and diagonal-pair lines have superior attenuation-characteristics as a long interconnect.
- Diagonal-pair lines reduce the line pitch and crosstalk noise concurrently.
→ Better design-flexibility for Si ULSI