Waveform Considerations on Shared Driver Signals

Micron Memory Japan

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Overview

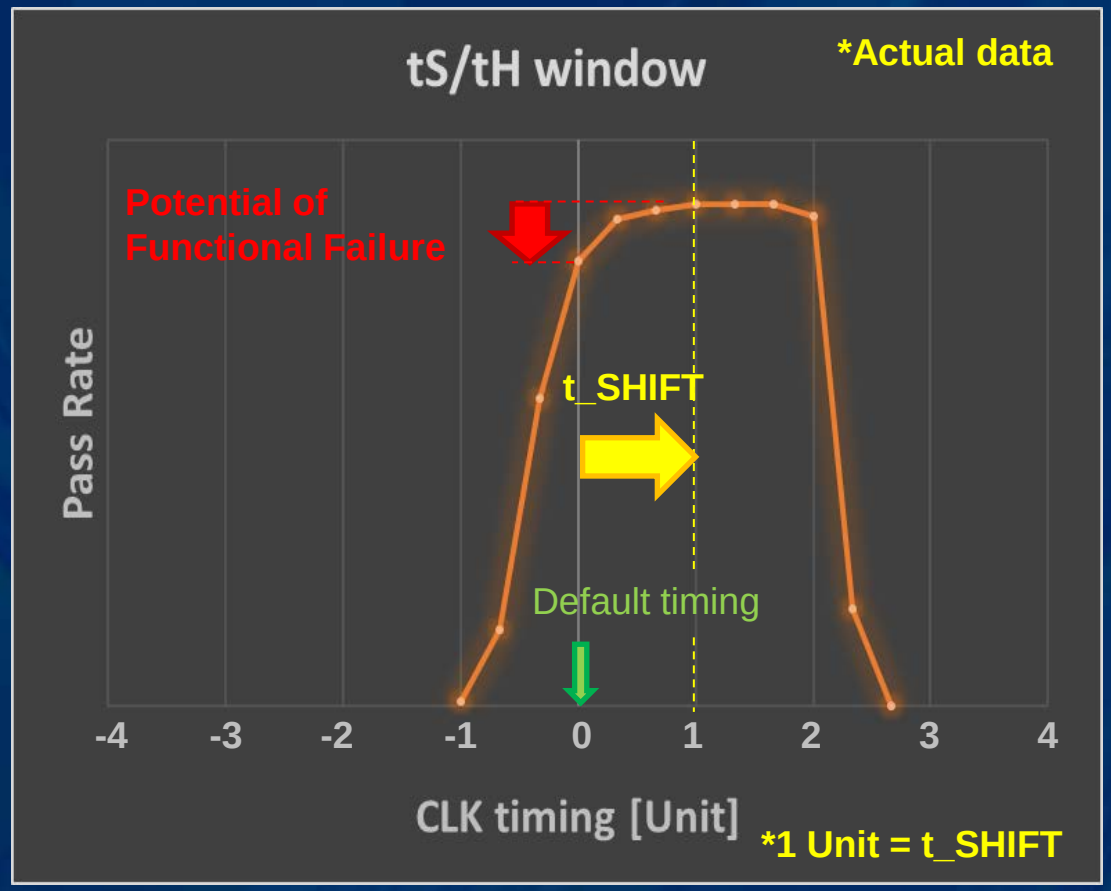
- Background
- Problem statement with real case examples
- Waveform simulation
- High frequency and KGD
- Ask of the industry
- Summary

Introductory Background

- Increasing parallelism by driver sharing can reduce test costs.
- Limited tester resources require high sharing of driver signals.
- Understanding & managing high sharing impacts is challenging.
- These challenges will be highlighted in this presentation.

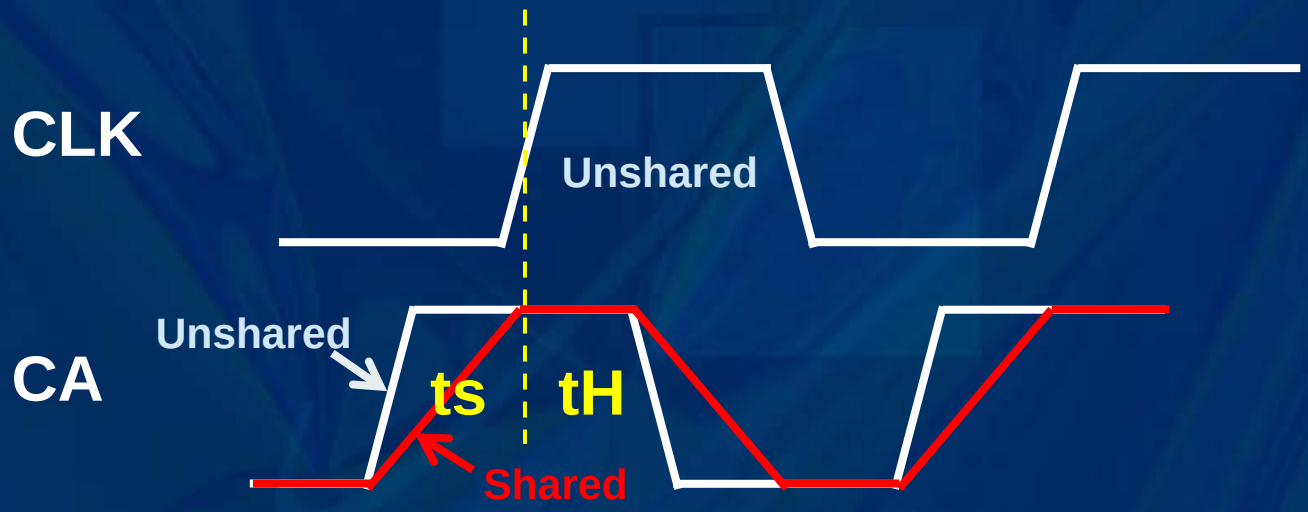
Problem Statement

- **During test program debugging functional failures observed.**
  - What caused tS/tH window between CLK vs. CA to shift?



Combination, Unshared & Shared Driver

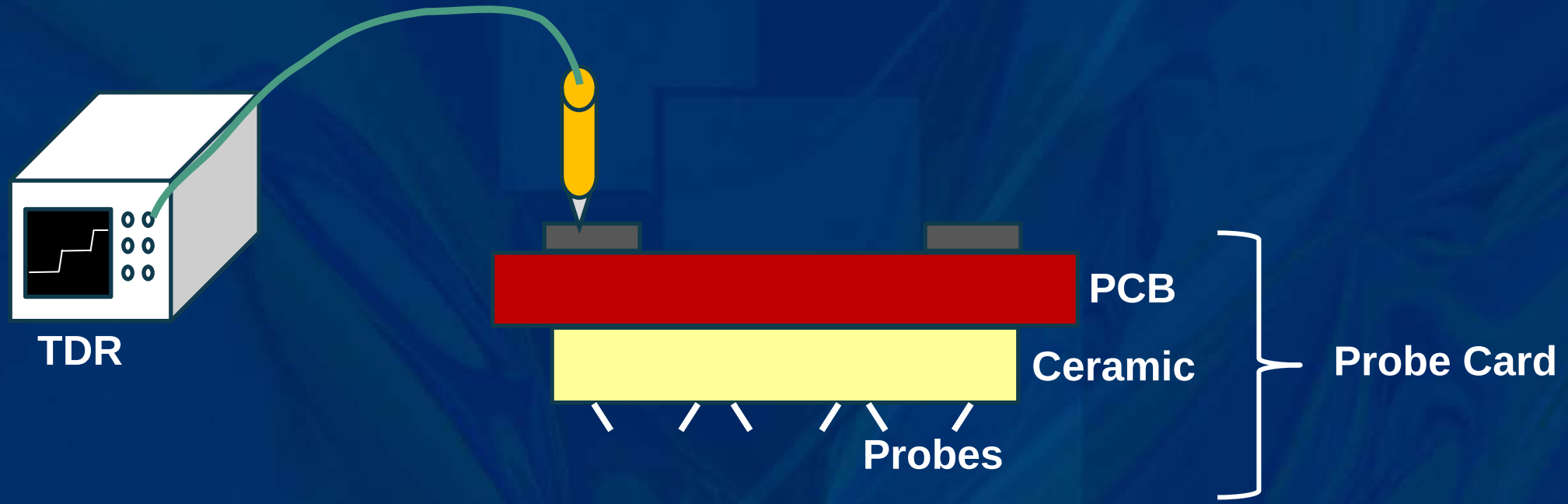
- In this case, both unshared and shared drivers were used. It was known that there was a timing delay between CLK & CA due to slower rise time on the shared CA driver.
  - CLK pin – Unshared
  - CA (Command / Address) pins – Shared



Compensating for Timing Delays

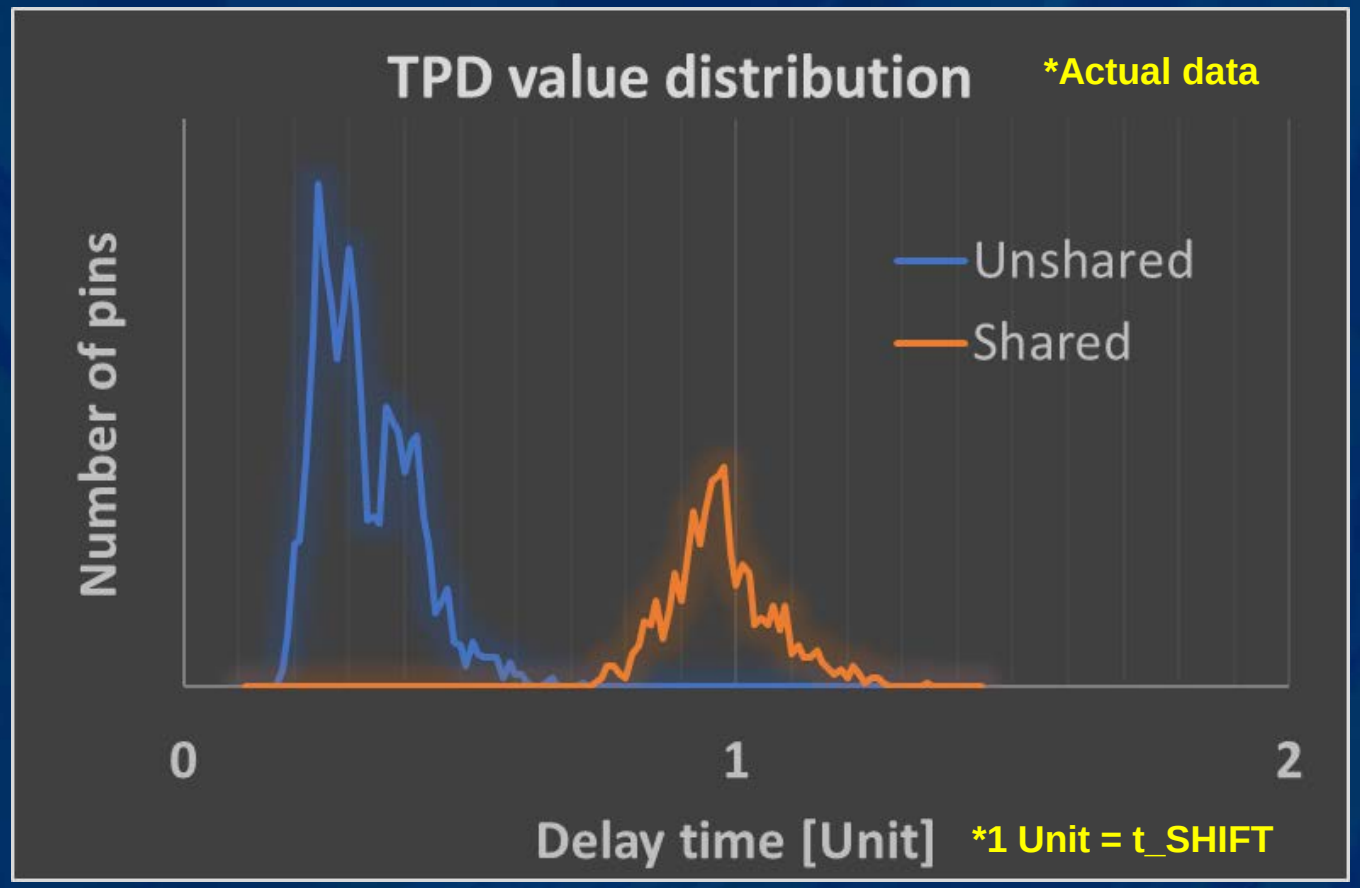
- **TPD value by TDR measurement can compensate timing delays.**

*TPD : Time Propagation Delay



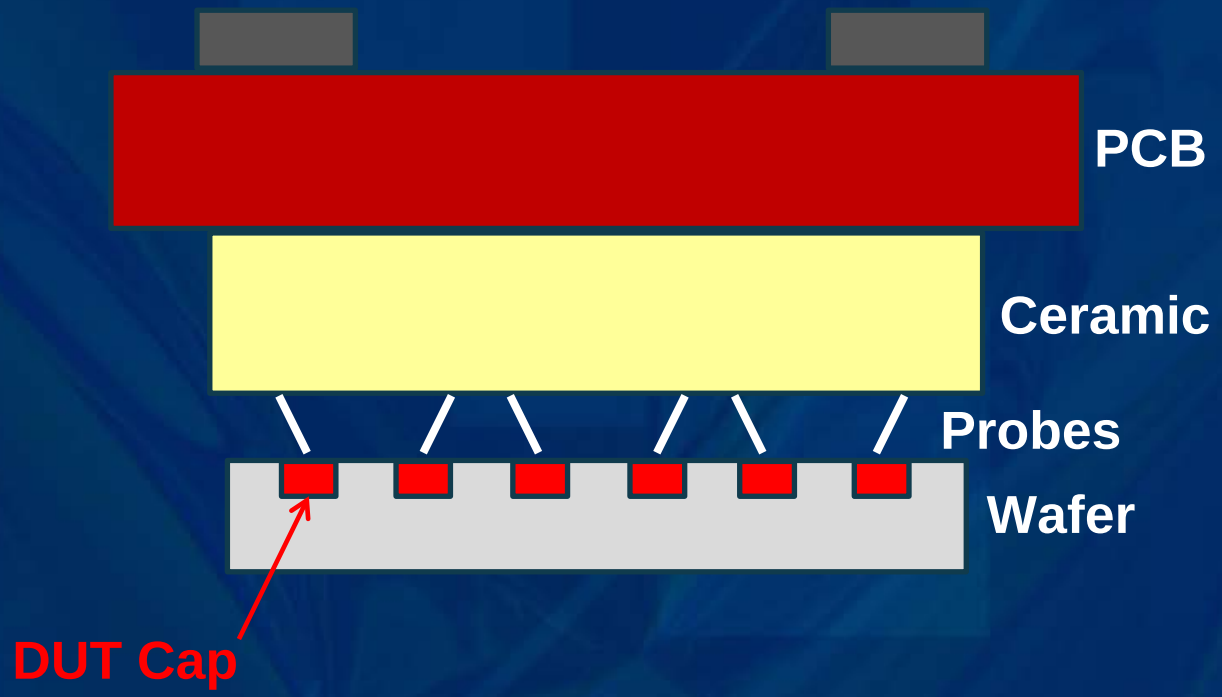
Distribution of Measured TPD Value

- **TPD values were implemented, functional fail still occurred.**
  - Any other parameters missed in design?



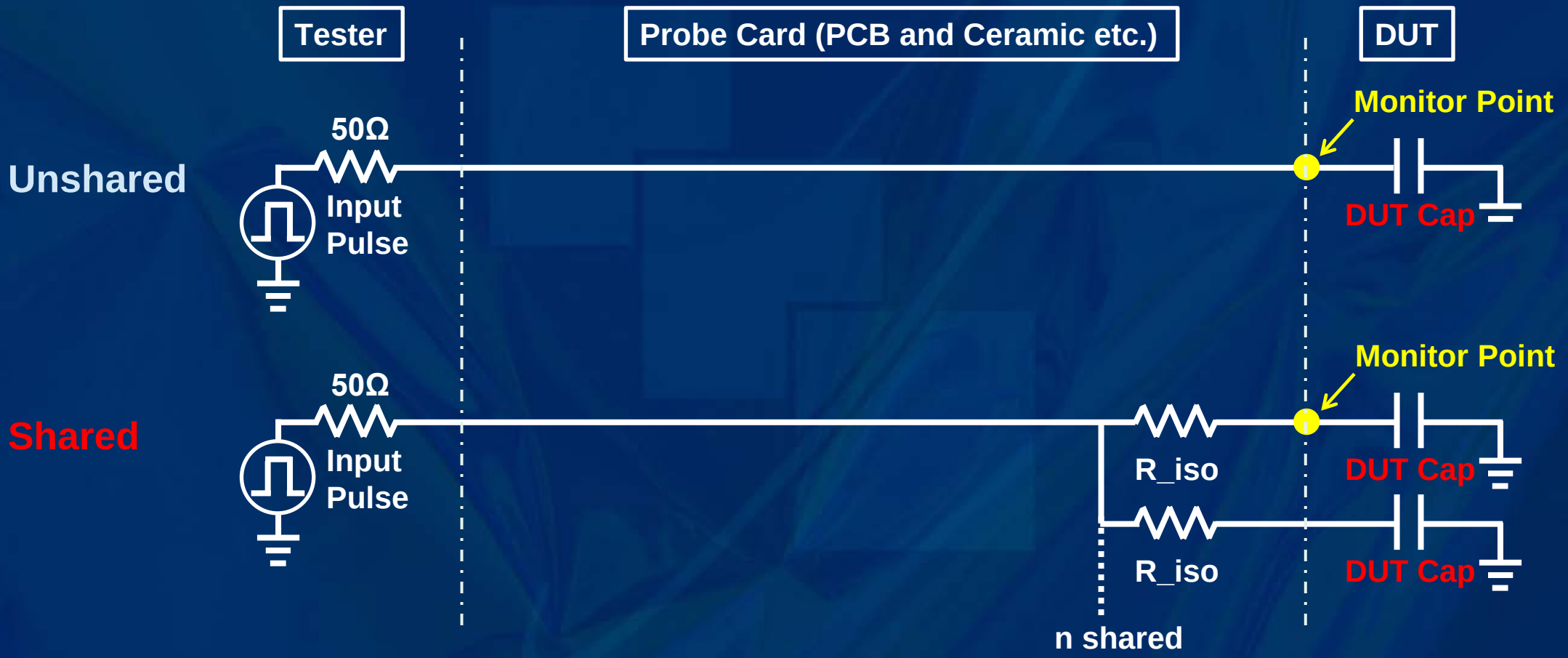
Missing Parameters

- **What if the input capacitor on the device pads were missed?**



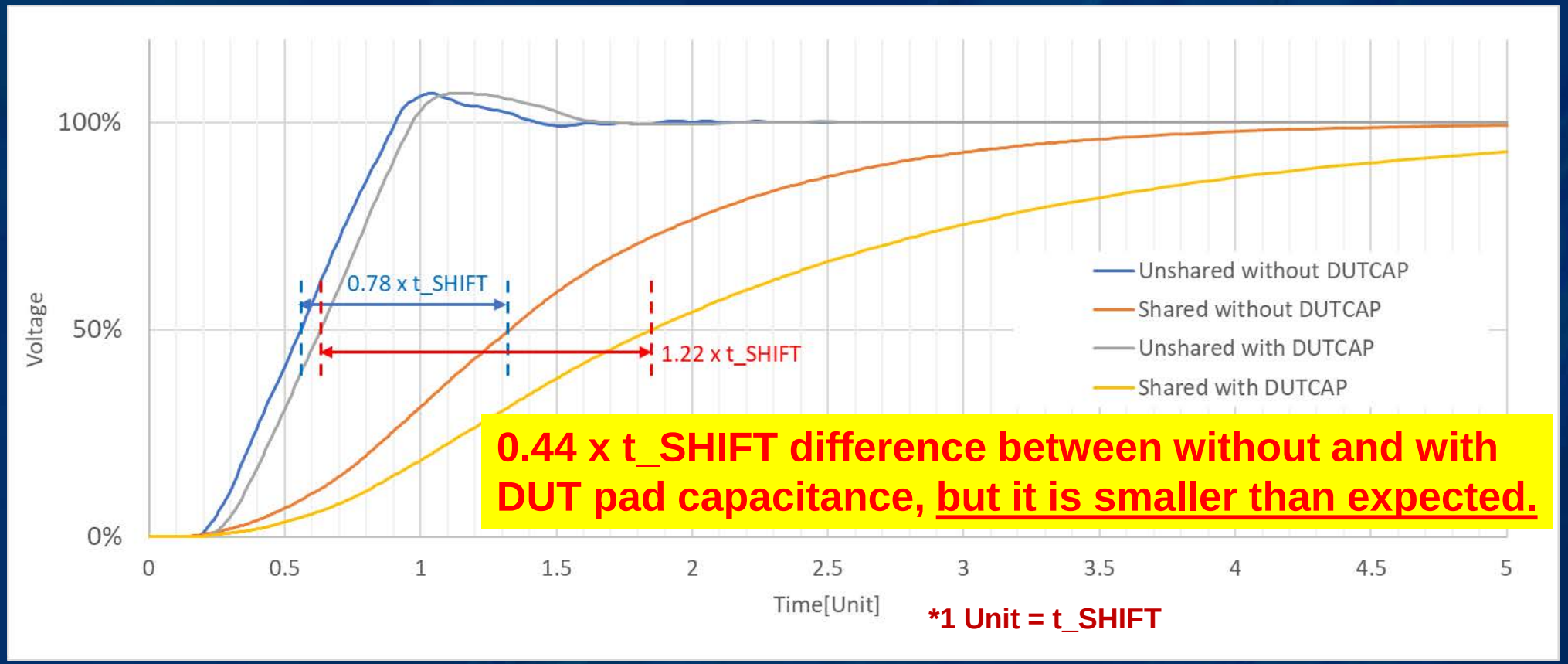
Waveform simulation (1)

- **Simulation model**



Waveform simulation (2)

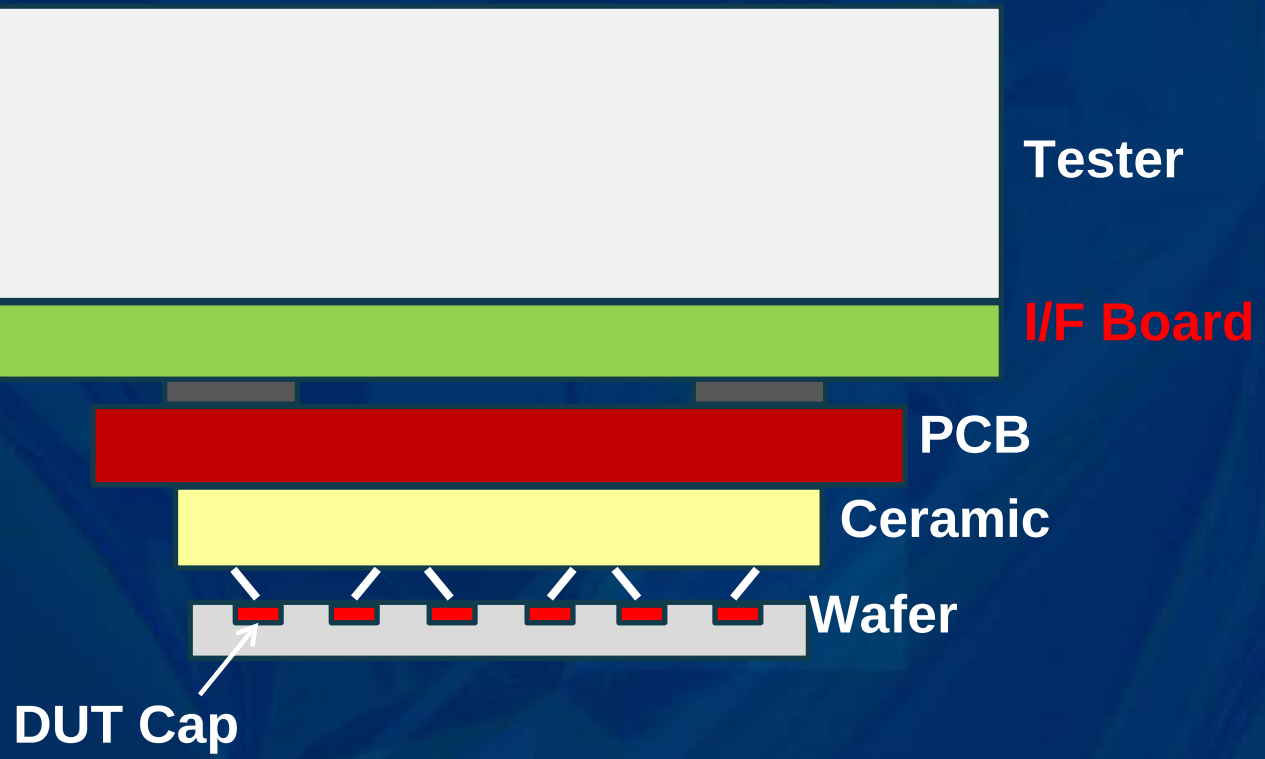
- **Difference between without & with DUT pad capacitance**



- **Other missing parameters?**

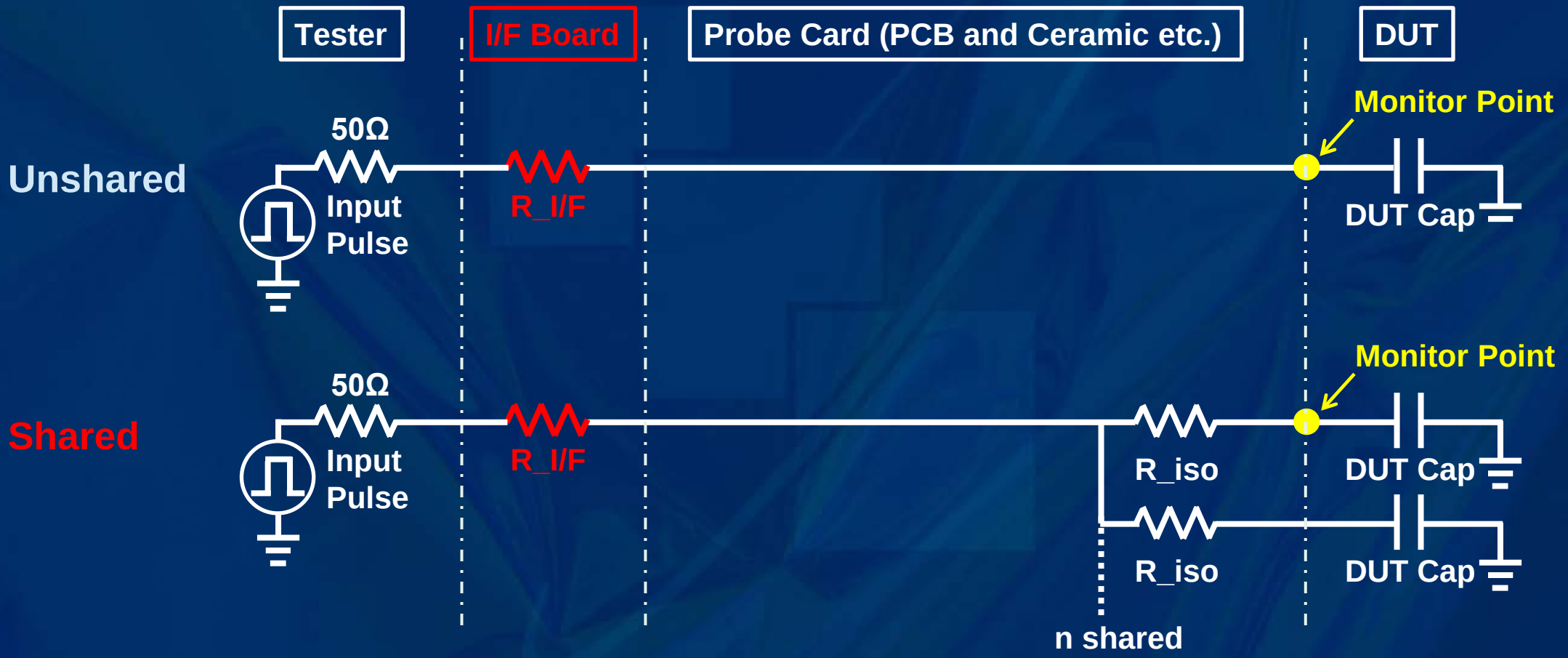
Another Missed parameter

- What if resistance of the I/F Board was missed in simulations?



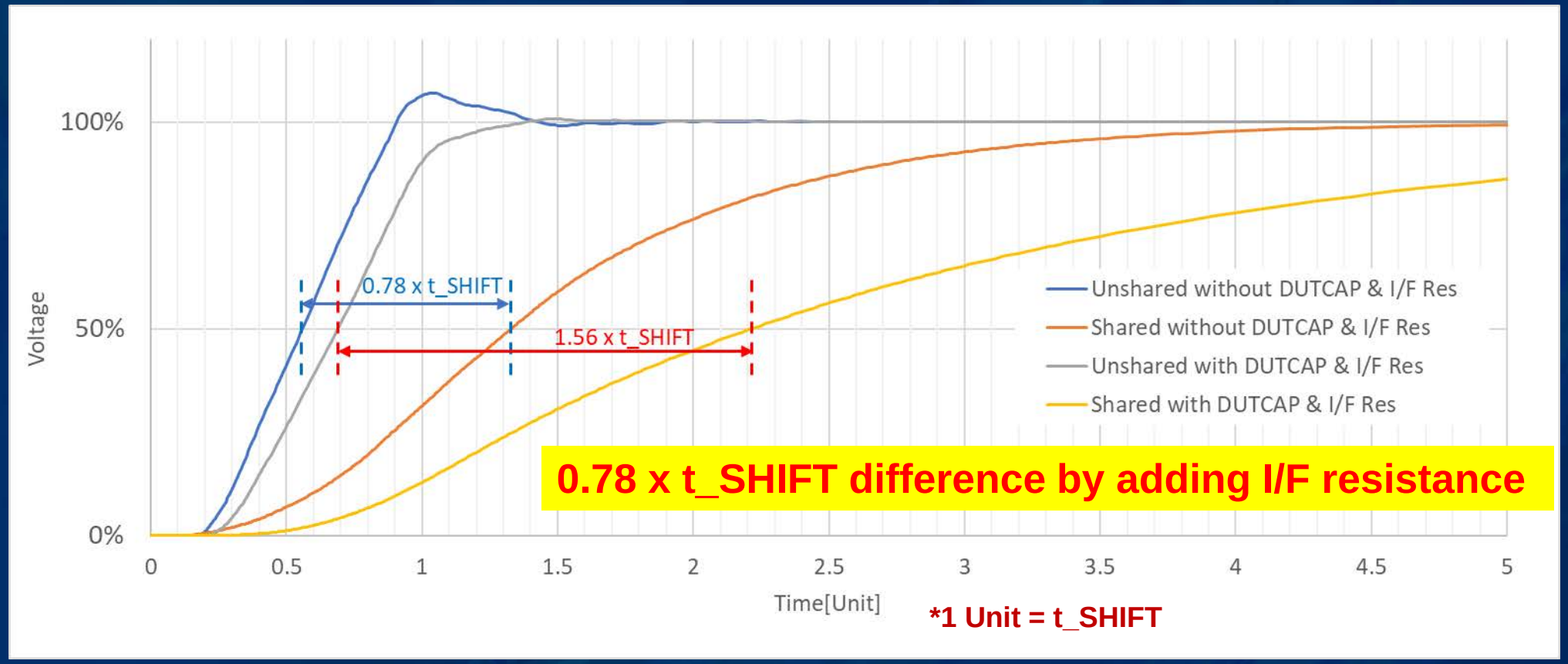
Waveform simulation (3)

- **Simulation model (2)**



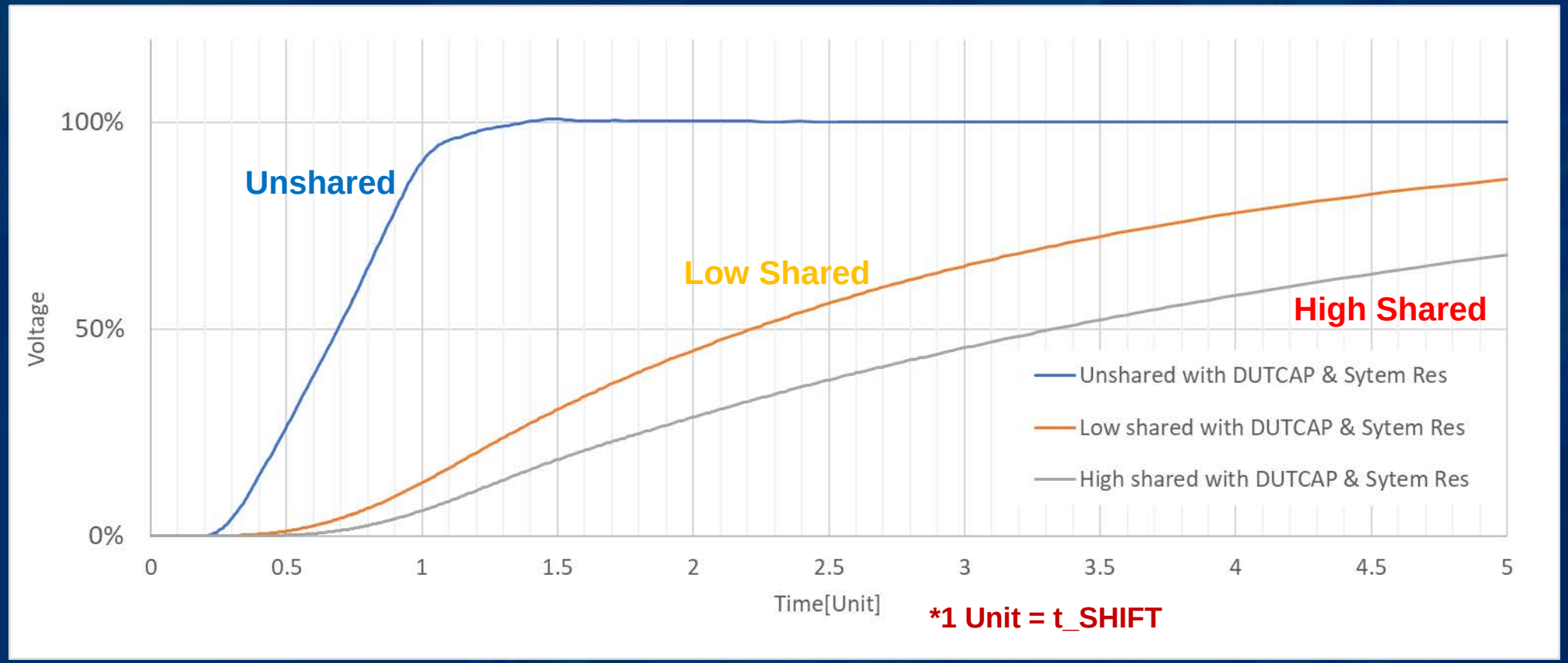
Waveform simulation (4)

- **Adding an additional resistance from the I/F board**



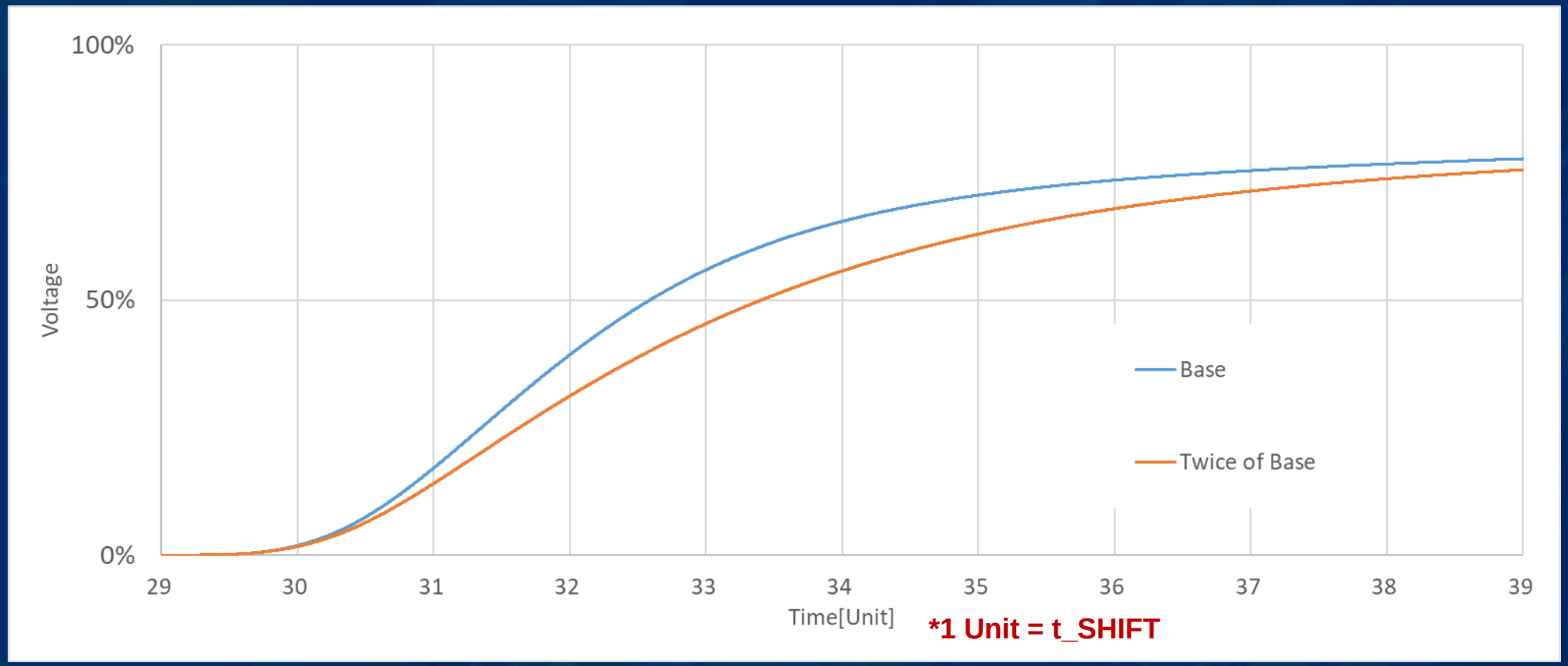
Waveform simulation (5)

- **Dependency on number of shared drivers**



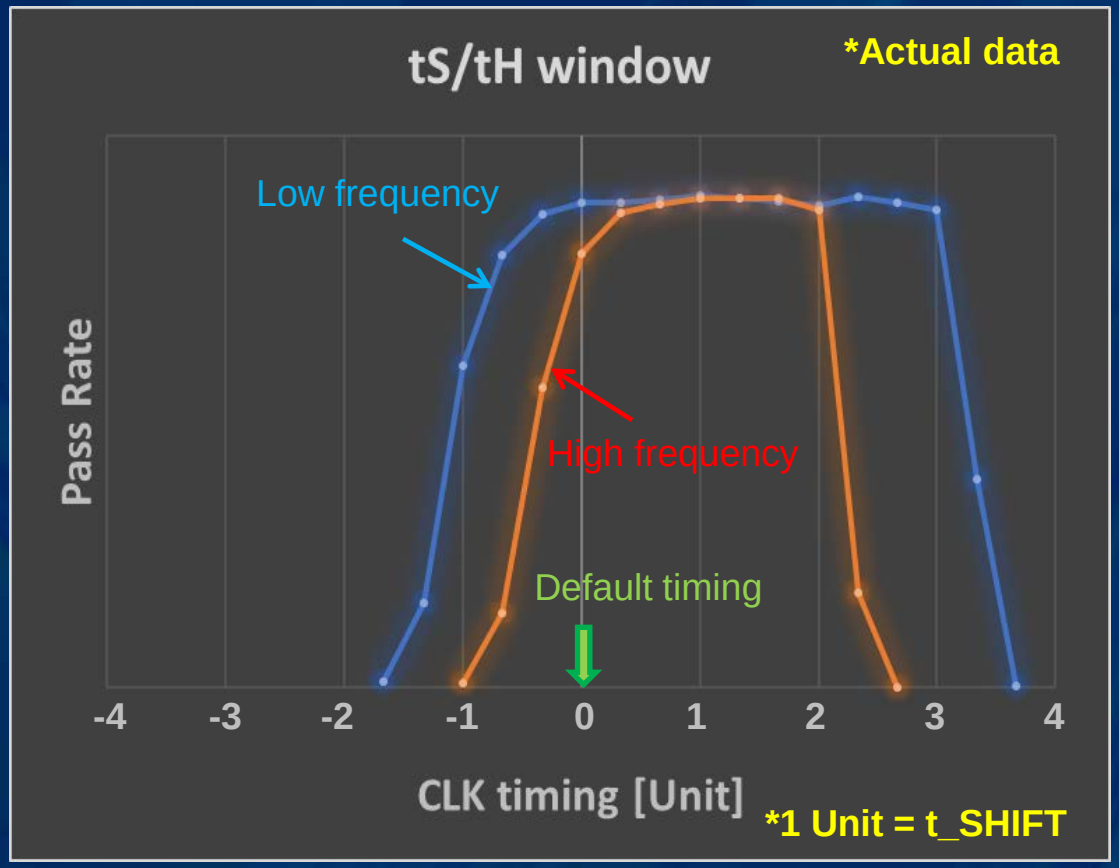
Waveform simulation (6)

- **Changing wiring capacitance on the probe card**



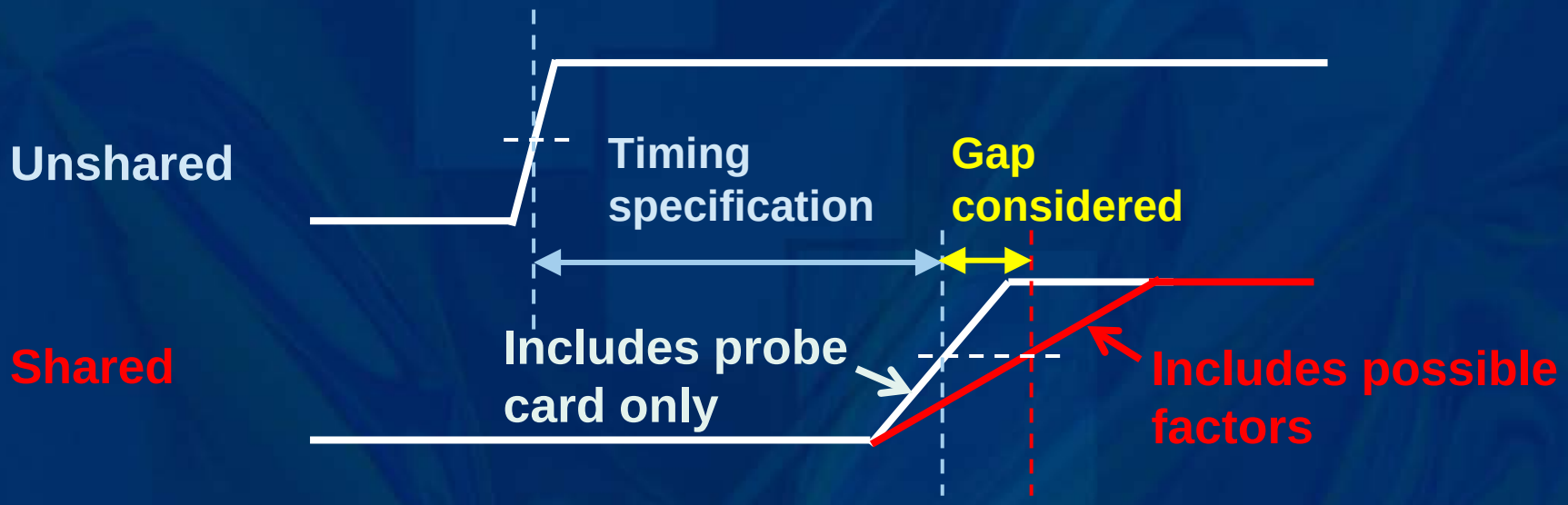
High Frequency Functional Testing

- **High test frequency reduces test time but narrows tS/tH window.**
  - Overcoming shifted tS/tH window (shared & unshared signal).



Used Case Known Good Die (KGD)

- As KGD timing specification is guaranteed by wafer test, the shared/unshared phenomena must be accounted for during test.



Ask of Probe Card Industry

- **Lowering the value & variation of capacitance & resistance of trace lines helps to keep test conditions equally between Duts.**
- **Micron is asking Probe Card supplies to help in this area**

$$\tau = (R_{CARD} + R_{ISO} + R_{SYSTEM}) \times (C_{CARD} + C_{DUTCAP} + C_{SYSTEM})$$

Summary

- Factors other than probe card can change a tester's waveform.
- Micron considers the whole ATE test cell system during design.
- Probe Card trace to trace difference in capacitance, resistance, shared & unshared is an area for Probe Card Suppliers to help.

Acknowledgements

- **Special thanks to:**
  - **Micronics Japan Co., Ltd.:**
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