Agenda
TDR Measurements Using Real World Products

- The Case for using both TDR and S-parameters
- Device Package Analysis
  - Measure Impedance
  - C-self
- Characterizing Device Evaluation Test board
  - Measure Differential Board Impedance
  - Measure impact of pogo pin socket on
    - Impedance, Time Skew, Eye Diagram
  - Measure Differential S11/21 from
    - RF Pogo pin socket to SMA
    - Comparing long and short traces
    - Example of lossy traces
- Test Socket Interposers Discontinuity Impact on 6Gbit Eye Diagram
- Comparing Pogo pin vs. Diamond Interposer vs. Soldered Test sockets on a 6Gbit Eye Diagram
- Useful Links

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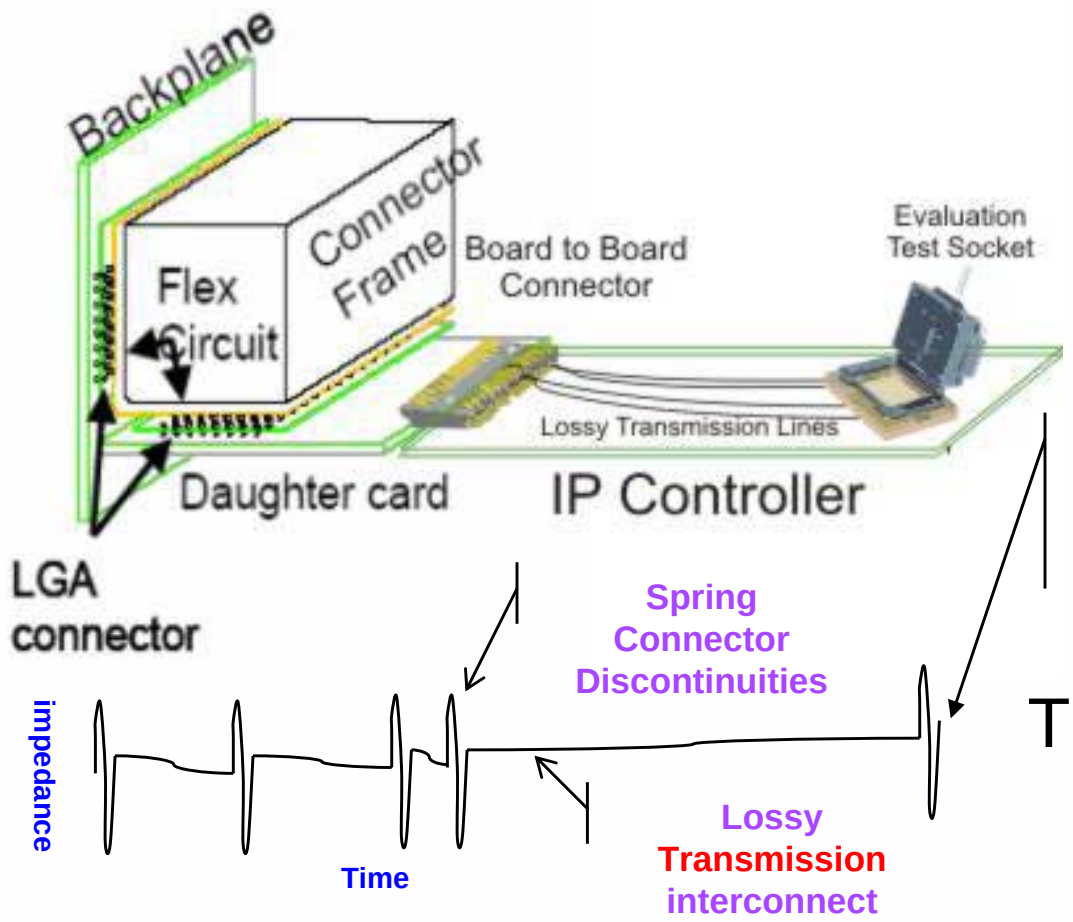
Characterizing Interconnect Systems and its components

- **Discontinuities:** Characterized and located in the Time Domain (TDR)
- **Bandwidth**: Characterized in the Frequency Domain (S-parameters)
- ***Need both techniques to DVT interconnect system***

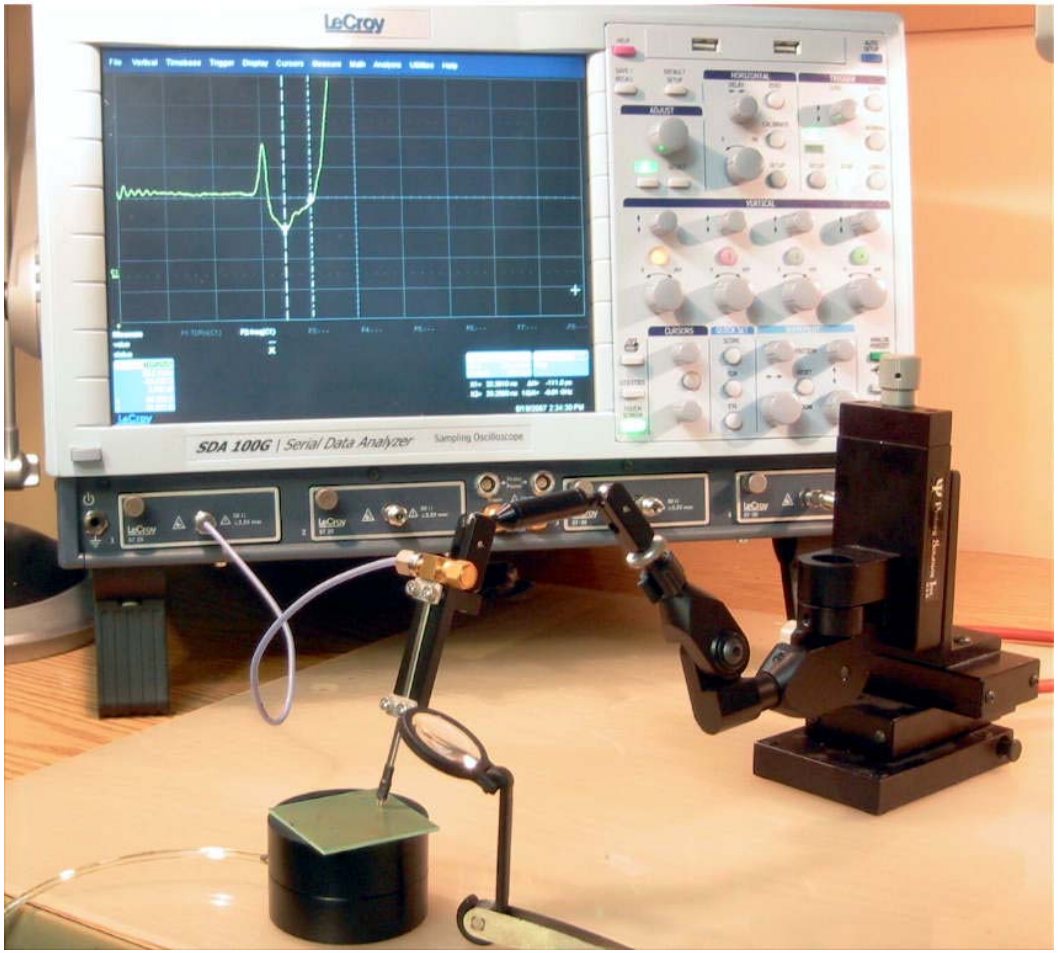


To control impedance, manage the return path as carefully as the signal path!

The most important design technique to control signal quality:

"Keep the impedance the signal sees constant all along the net"

TDR Applications – Package Analysis Setup



Probe Bump Side, 1mm Pitch J/K23

Test Equipment List

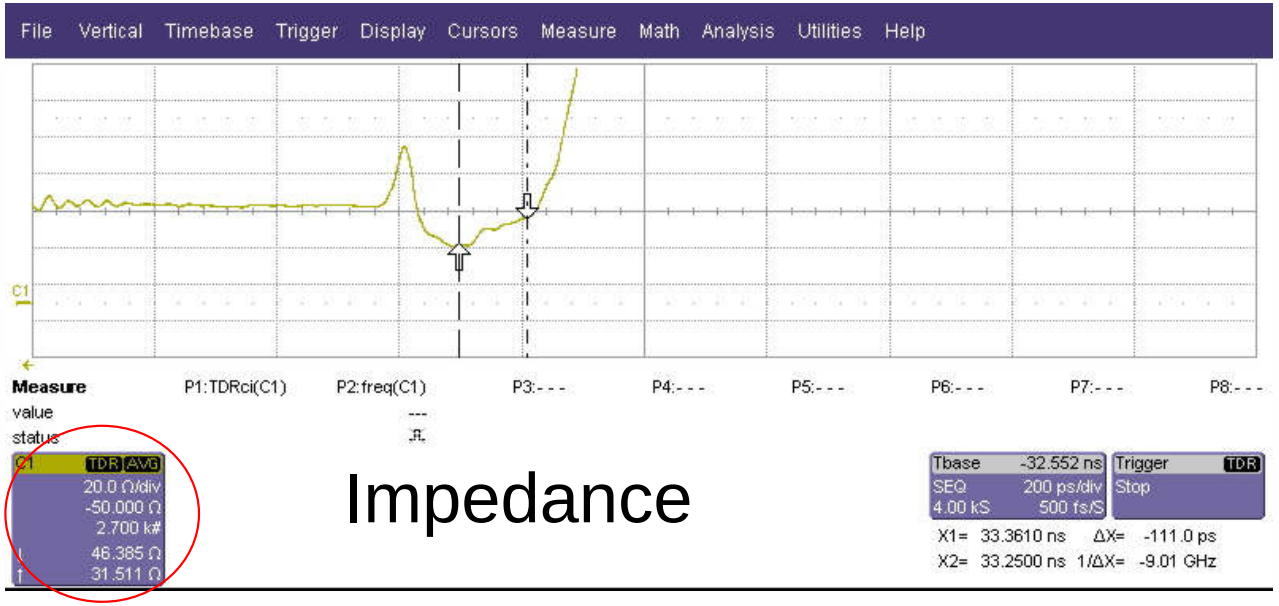
- TDR (50/100 ohm) Probe
- Probe Holder
- Micromanipulator with probe holder adapter
- Vacuum Chuck
- Vacuum Pump or Built in Supply
- 10x Micro Lens

TDR Applications – Package Analysis

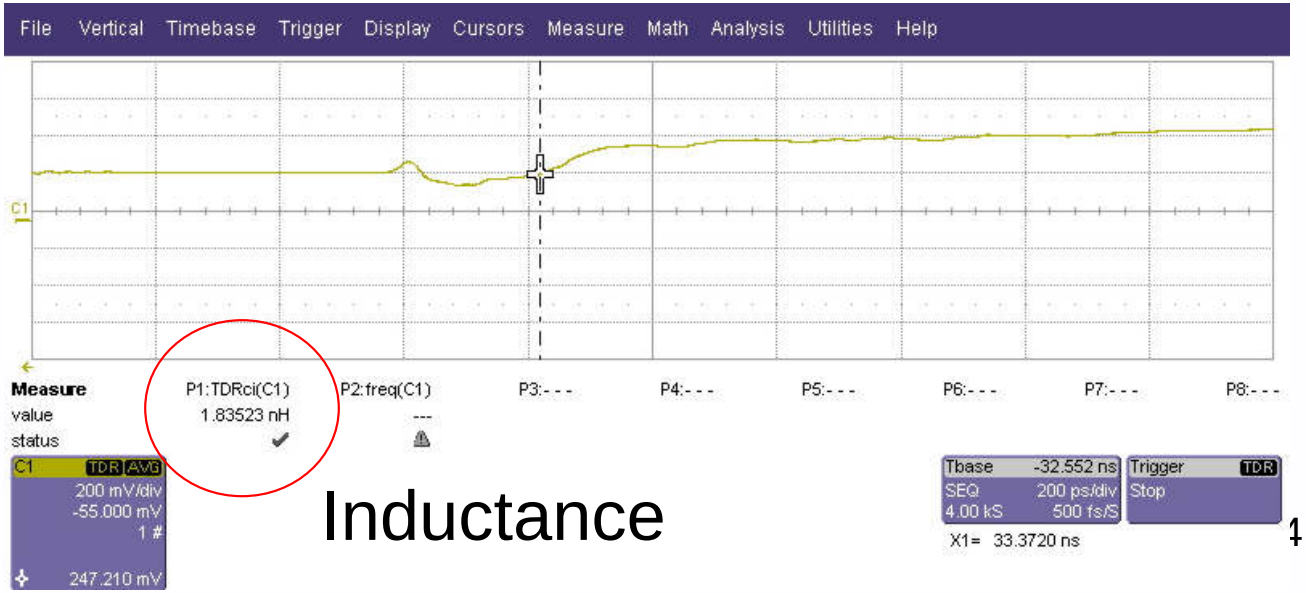
Measurements

Impedance
& Inductance

- Min
- Max
- Delta

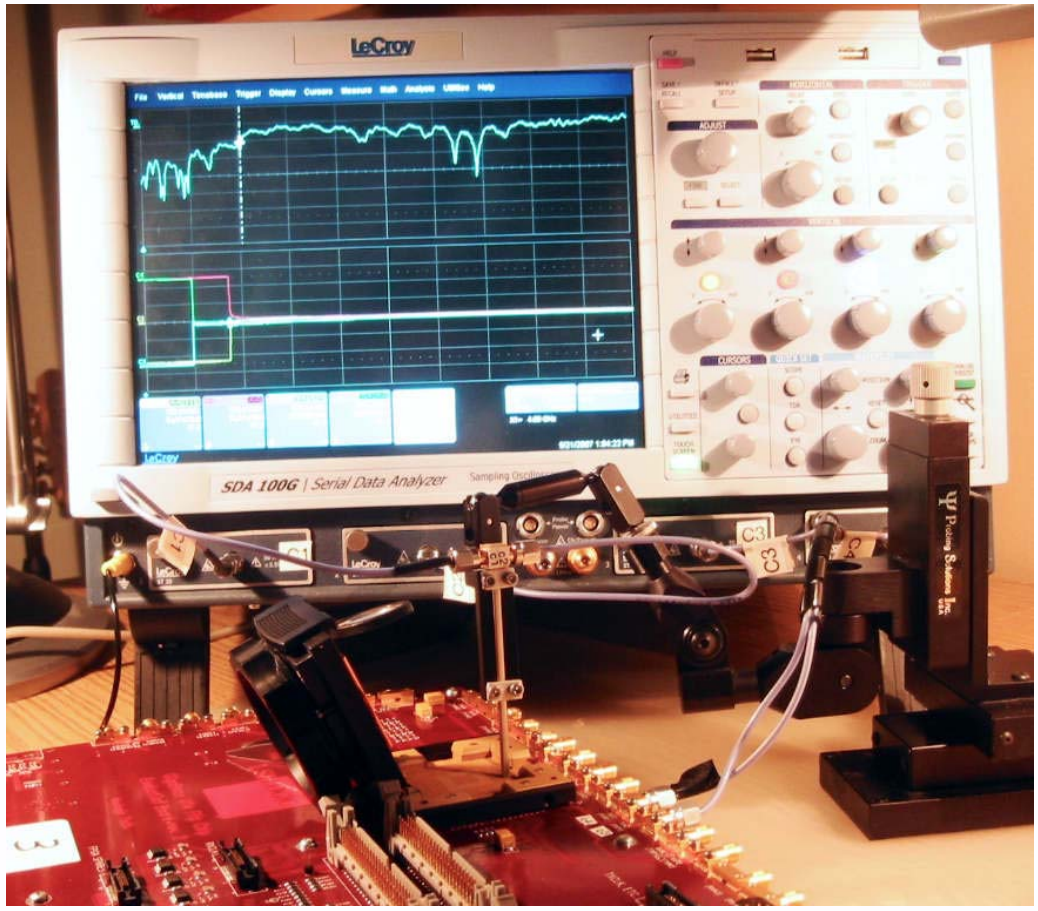


Impedance



Inductance

TDR Applications – Device Evaluation Test Board Analysis Setup

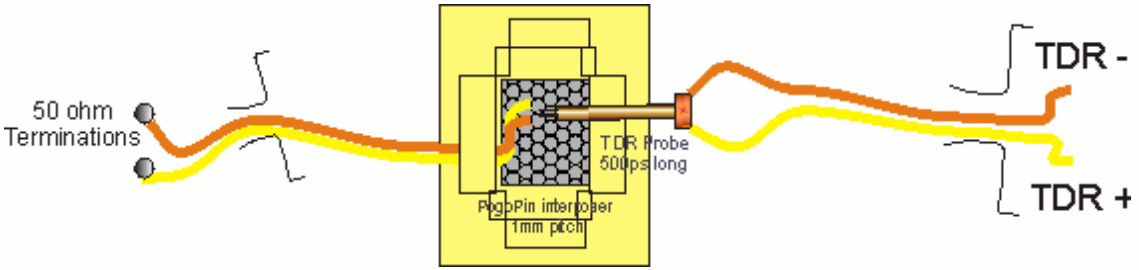


Test Equipment List

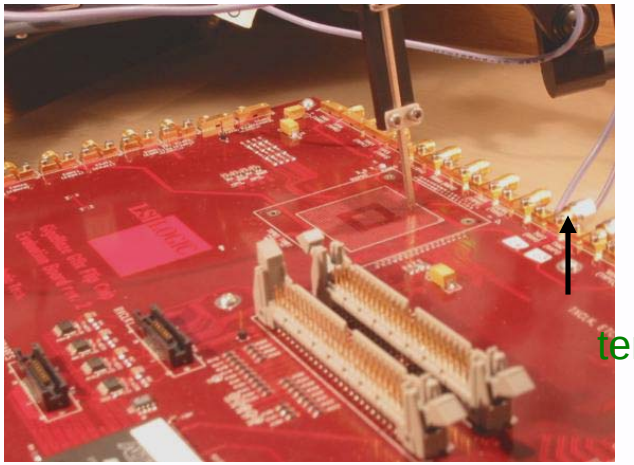
- TDR (50/100 ohm) Probe
- Probe holder
- Micromanipulator
- Vacuum Pump or Built in Supply
- 10x Micro Lens
- 4 Matched Cables

TDR Applications – Evaluation Board Analysis, Cont.

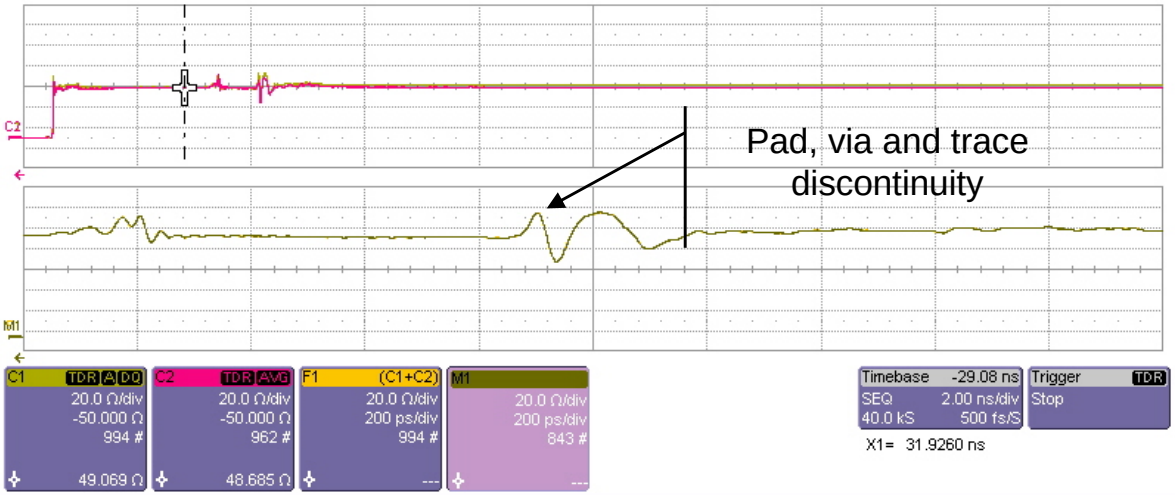
Establish Baseline Impedance With – NO Socket

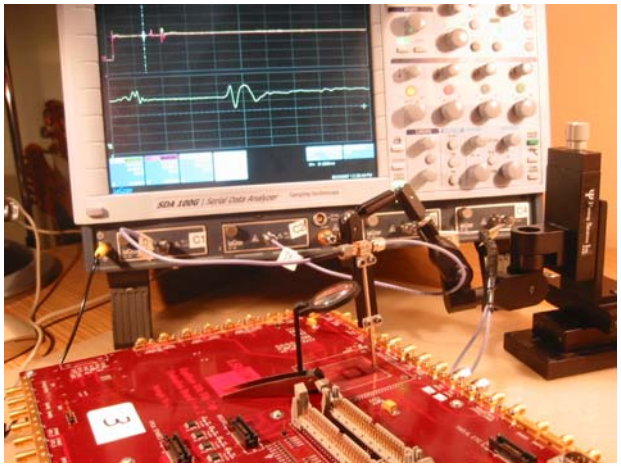


Interconnect Schematic



50 ohm terminations

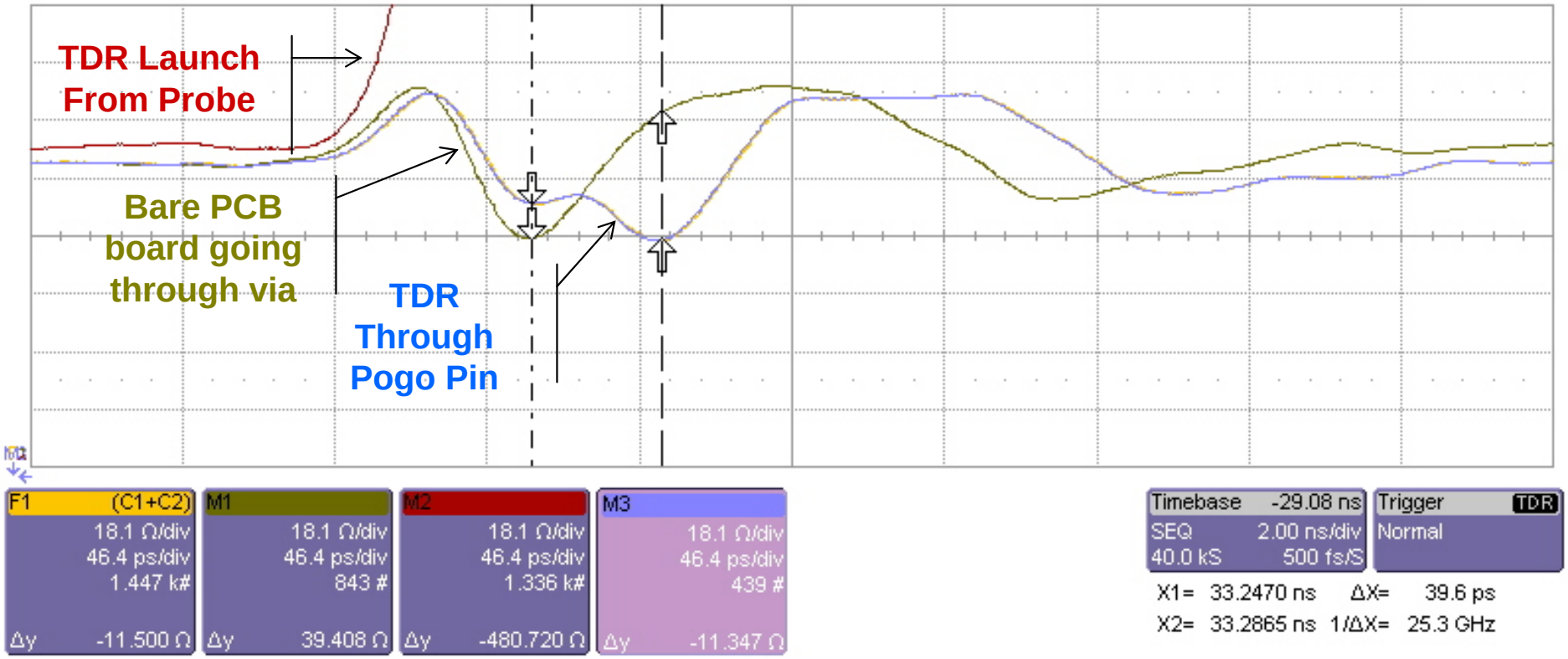




Differential TDR of Socket pads with No Socket

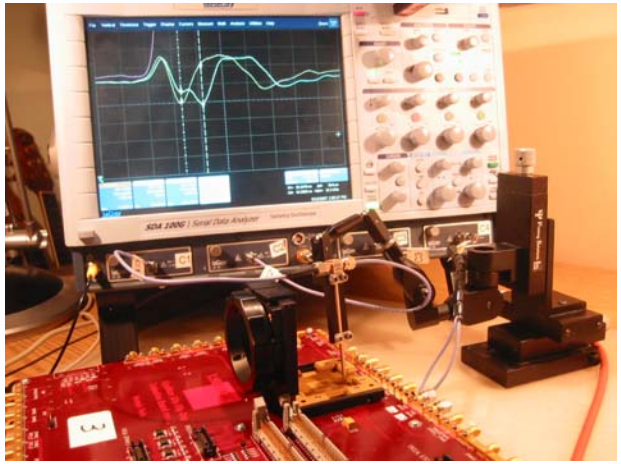
TDR Applications – Evaluation Board Analysis

Measure Impedance – With Socket



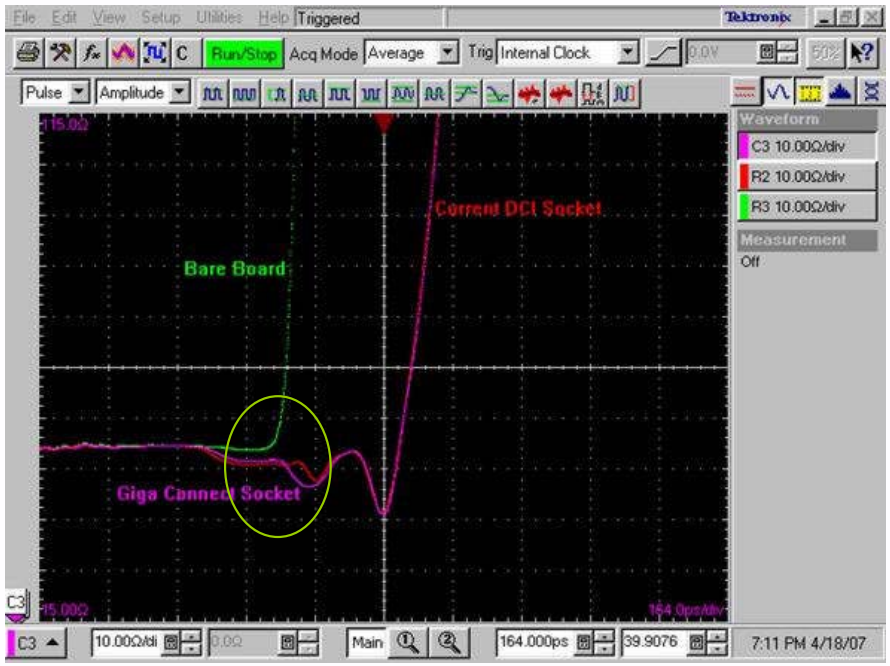
- Delta Delay Time with & without socket = 39.6ps
- Pogo pin=Inductance and capacitance interconnect

What affect will LC have on the Device Performance?



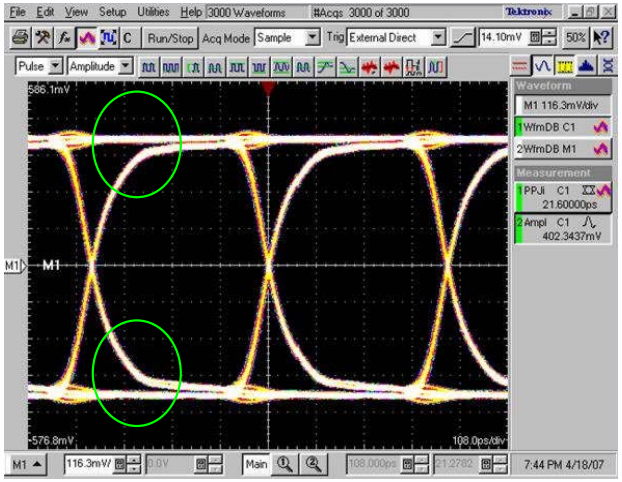
6Gbit PCI Express Evaluation Board - Real Test Case
Interposer Discontinuity impact on Eye Diagram

- More Deterministic Jitter
- Non symmetrical Eye Diagram
- Rise Time Slope Degradation

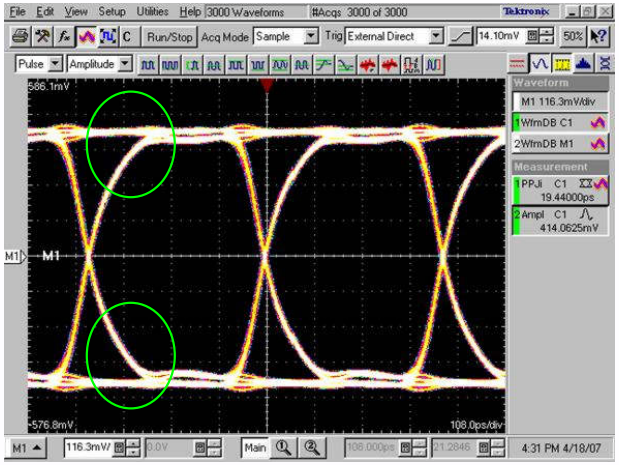


DCI Pogo Pin interposer vs. Conductive Diamond Interposer to PCB Impedance Comparison

DCI Pogo Pin Socket
RT Slope non-symmetrical eye at 6Gbit

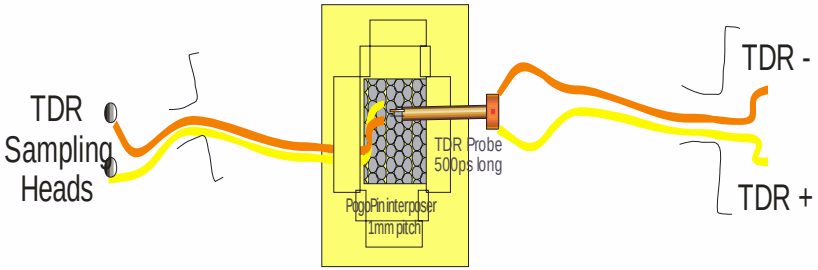


GCI Conductive Diamond Interposer Socket
RT & FT go rail to rail symmetrical eye at 6Gbit

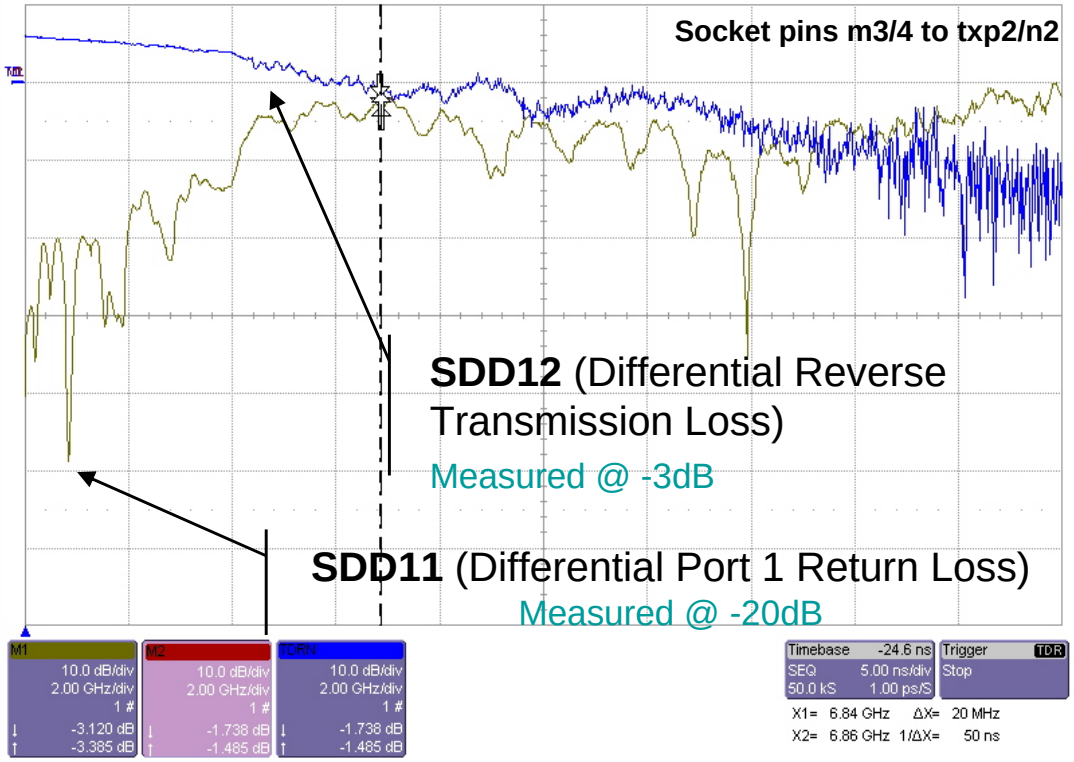


TDR Applications – Evaluation Board Analysis

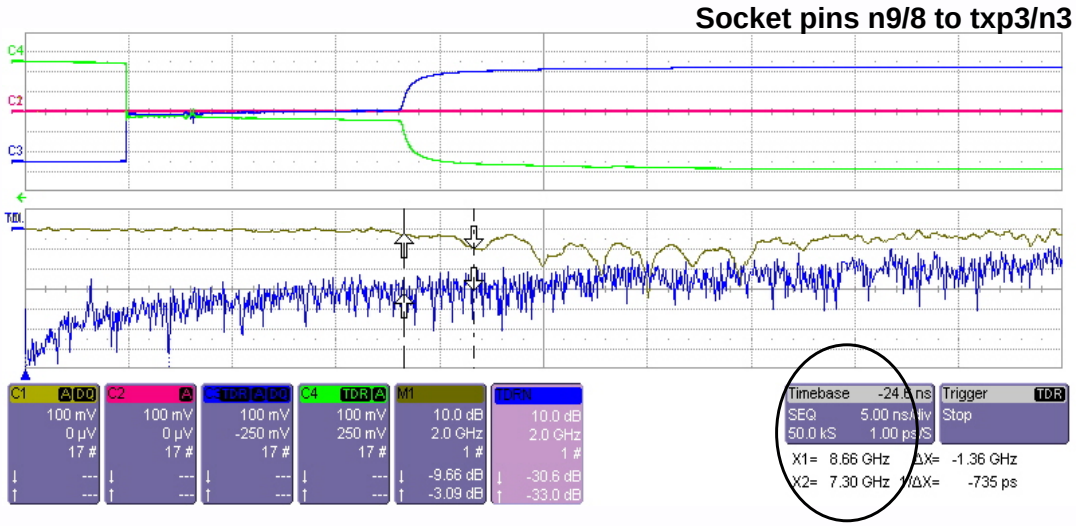
Measure Differential S11/21 S-parameters



Short Trace



Long Trace



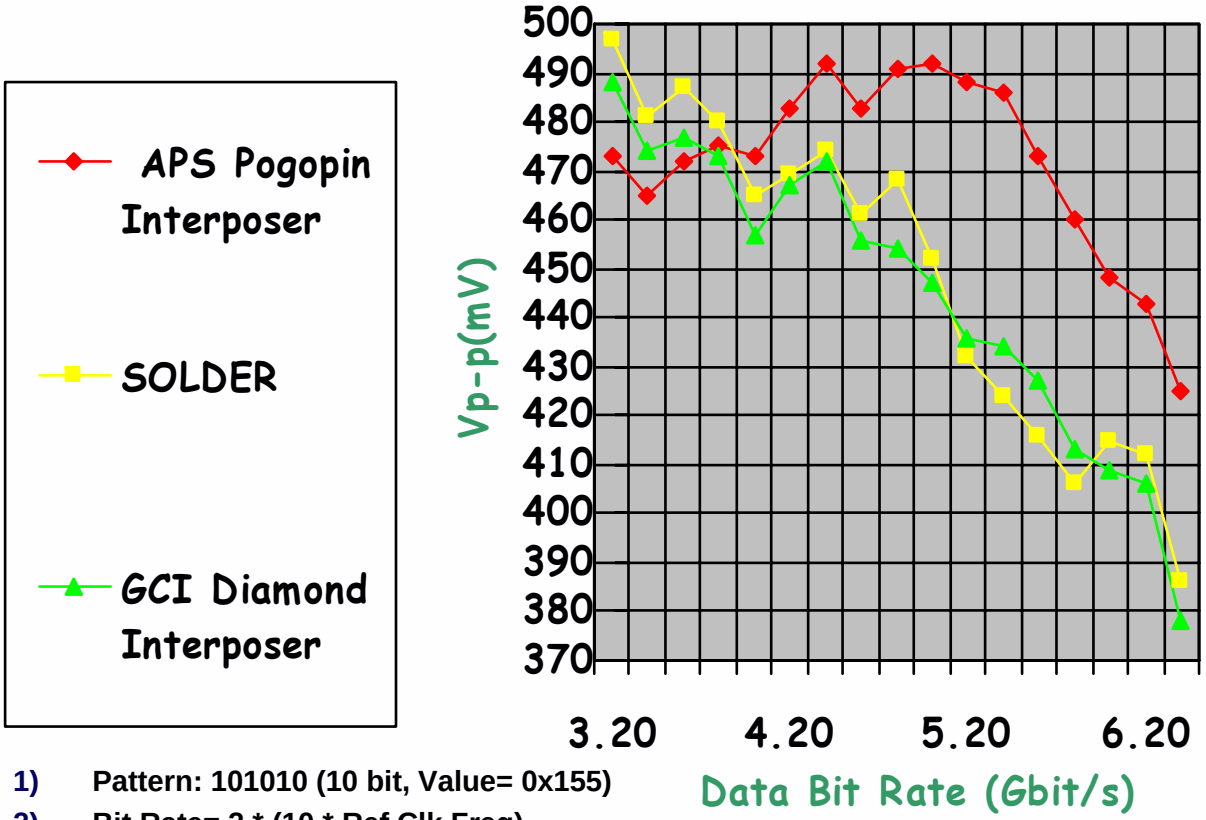
Pogo pin vs. Diamond Interposer vs. Soldered

Pogo Pins L/C Can Cause False Readings

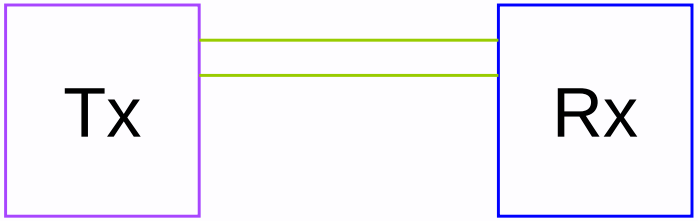
EN6110, S/N 2, TXP Vswing

Vp-p Vs. Data Bit Rate

Enigma semiconductor



1) Pattern: 101010 (10 bit, Value= 0x155)
2) Bit Rate= 2 * (10 * Ref Clk Freq)
3) All Vpp data is in millivolts
4) PRBS 31
5) TX Outputs measured at SMA connectors
6) Soldered Part was different than S/N 2



Vp-p Data Bit Rate:
3.2 Gbit/s – 6.4 Gbit/s

Diamond Interposer Closely Tracks Soldered device

- Pogo pin socket plot does not correlate with solder device (***real world***). Why?
- At low frequency, Vp-p plots low? – Pogo Pins probably capacitive
- At high frequency, Vp-p appears high? - L/C ringing adds to signal creating false bandwidth reading
- What do we look for? Eye diagram non symmetrical

Signal Integrity Resource Links

LeCroy TDR

http://www.lecroy.com/tm/products/Scopes/WaveExpert/default.asp

Conductive Diamond Test Sockets
Board to Board Connections

40GHz Gold Plated Conductive Diamond Interconnects

http://www.gigaconnections.com

Probes

Gigaprobes (30Ghz TDR hand probes)

http://www.gigaprobes.com/home.html

GGB ind. Pico Probes (40+Ghz probes)

http://www.ggb.com

Cascade Microtech (40Ghz+probe/probe stations)

http://www.cascademicrotech.com

Calibration Kit

http://www.maurymw.com