

# IEEE 802.3ap Channel Ad Hoc Status Update - SDD21 & SDD11/22 Model Development

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Rich Mellitz, Intel

Matt Hendrick, Intel

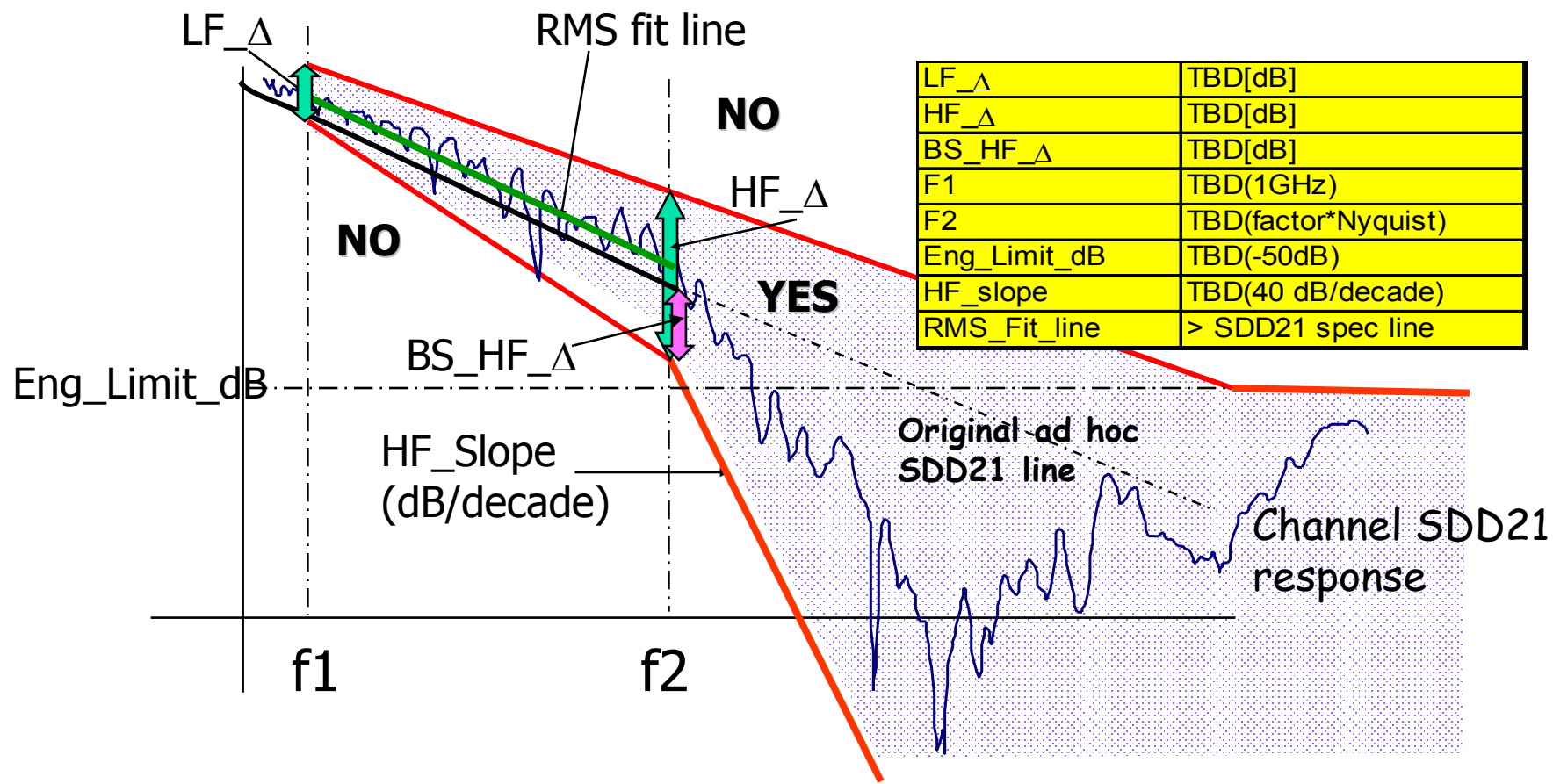
John D'Ambrosia, Tyco Electronics

# Acknowledgements

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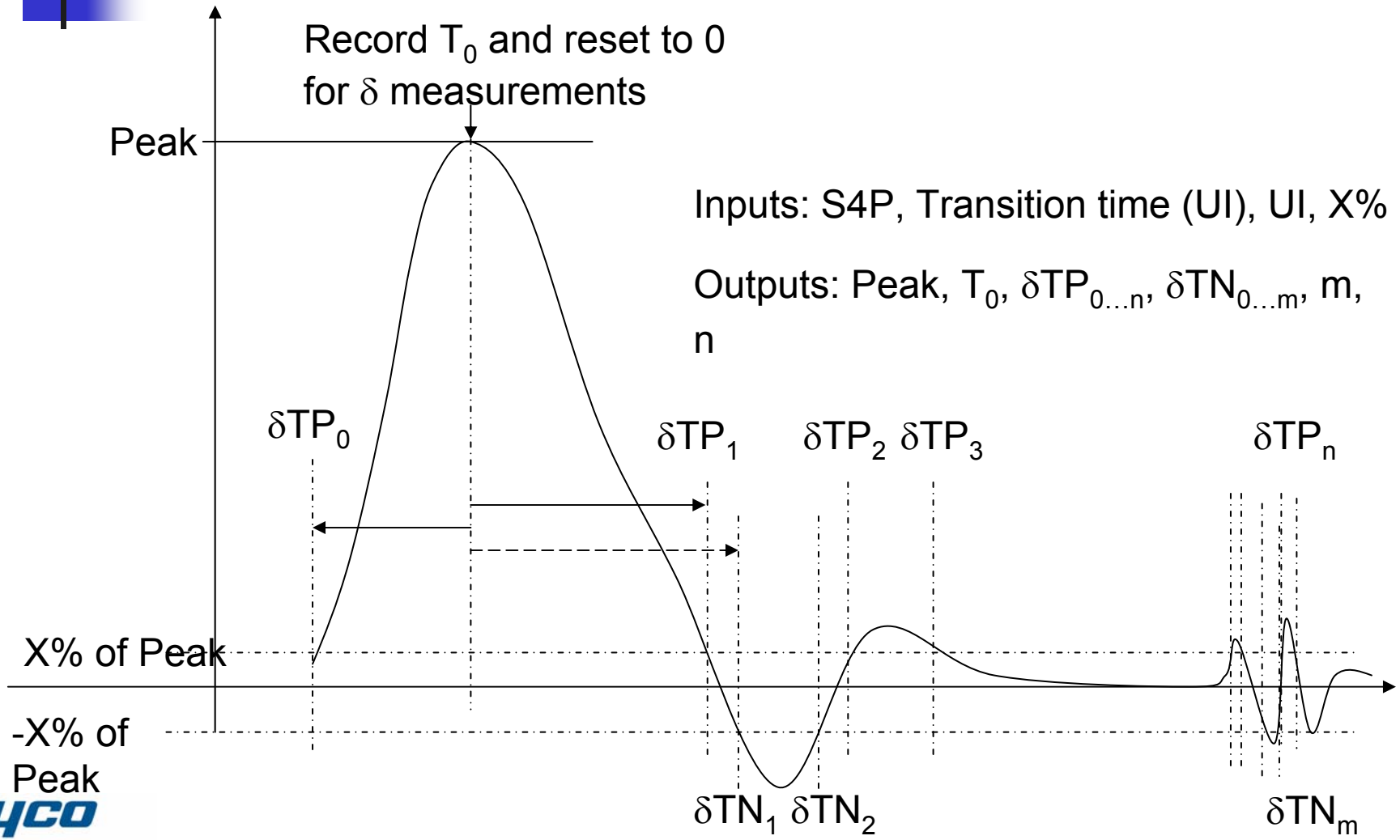
- Steve Krooswyk
- Mike Altmann

# Frequency Domain: Modified SDD21



LF_ $\Delta$	TBD[dB]
HF_ $\Delta$	TBD[dB]
BS_HF_ $\Delta$	TBD[dB]
F1	TBD(1GHz)
F2	TBD(factor*Nyquist)
Eng_Limit_dB	TBD(-50dB)
HF_slope	TBD(40 dB/decade)
RMS_Fit_line	> SDD21 spec line

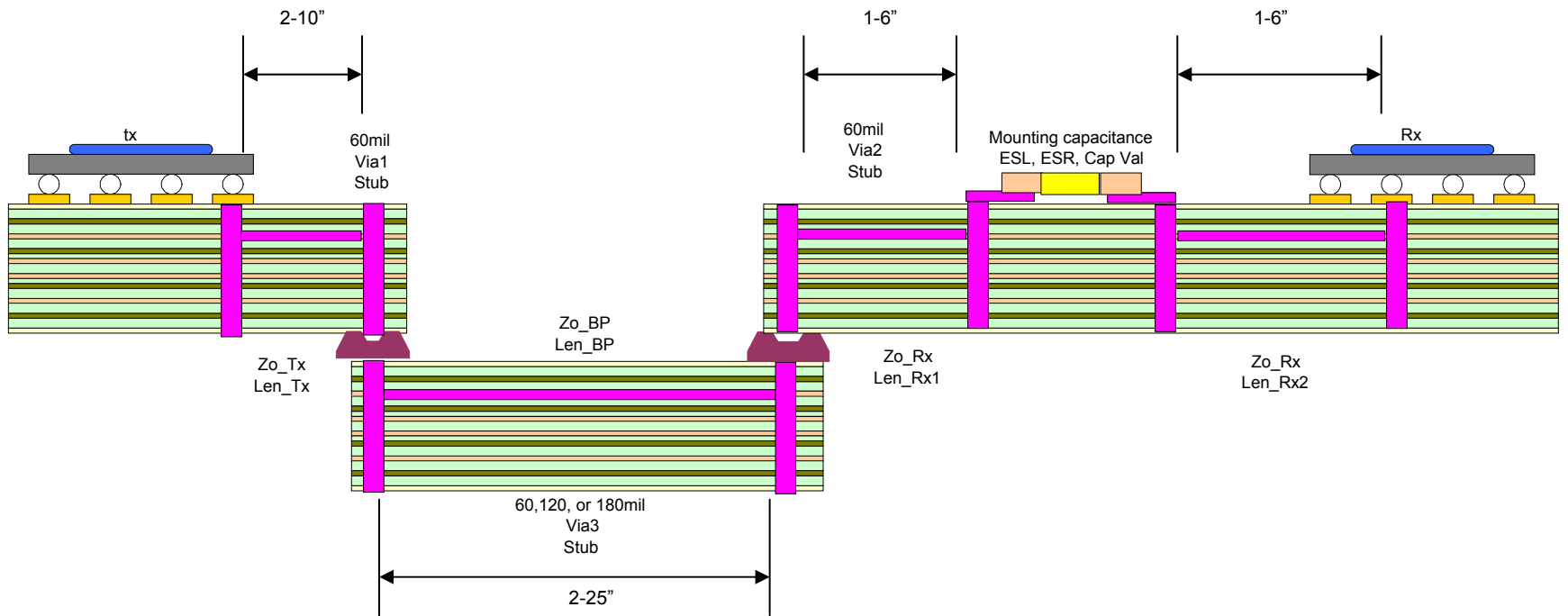
# Pulse parameters



# Course of Action

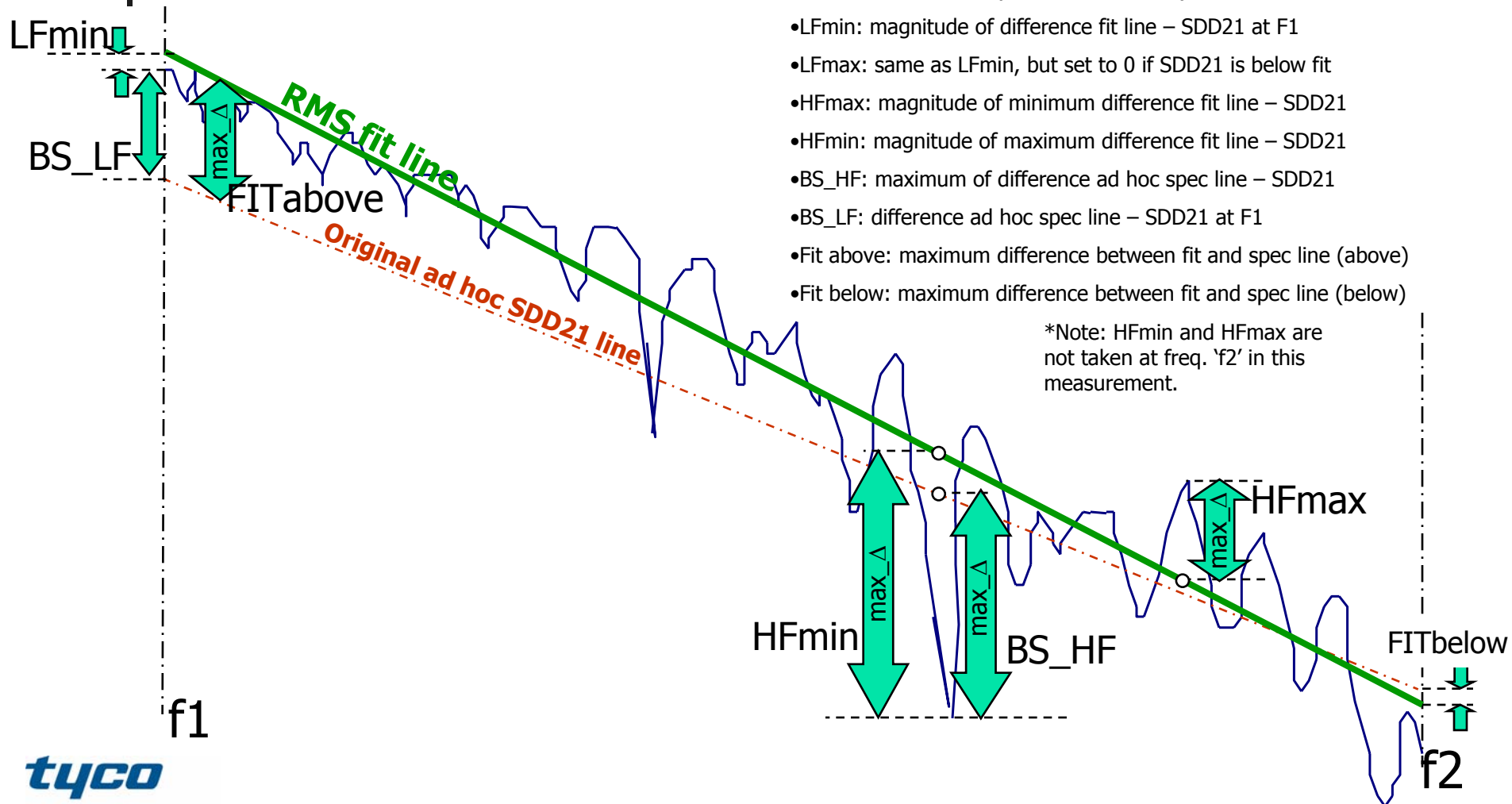
- Analyze all sorts of channels based on proposed SDD21 model and subsequent pulse response parameters
- Description of analysis
  - F1 = 1 GHz
  - F2 = 6 GHz
  - 10Gb/s Pulse
  - Settling time based on 5% of peak
  - Min, max values calculated over entire range, specified values at F1 / F2 to be determined
- Description of channels
  - Intel – 192 different simulations
    - Backplanes Summary Description
      - Lengths
      - Layer connection varied by stub length
      - Generic FR-4
    - Line Cards
      - To TP4 Length – 1" – 6"
      - TP4 – TP5 Length (no cap, but vias and stubs included) 1' -6"
      - Packaging Effects (different 10 dB packages)
      - Layer Connections varied by stub lengths
      - Generic FR-4
    - Board materials
  - Tyco – 60 different channel measurements
    - Backplanes – QR Designs (0.125" nominal thickness)
      - -13SI, -13, 9000
      - 1" to 30"
      - Top (No Counterboring) and bottom layer connections
    - Line Cards (0.092" nominal thickness)
      - -13, -13SI, -6
      - 6" and 10"
      - No AC Coupling
      - No Packaging effects
      - Top (No Counterboring) and bottom layer connections
- Through correlation analysis between frequency and time data, identify trend behavior of different parameters that impact settling time
- Look at interaction of packaging with placement of decoupling cap and impact on settling time

# Intel Simulation Topology

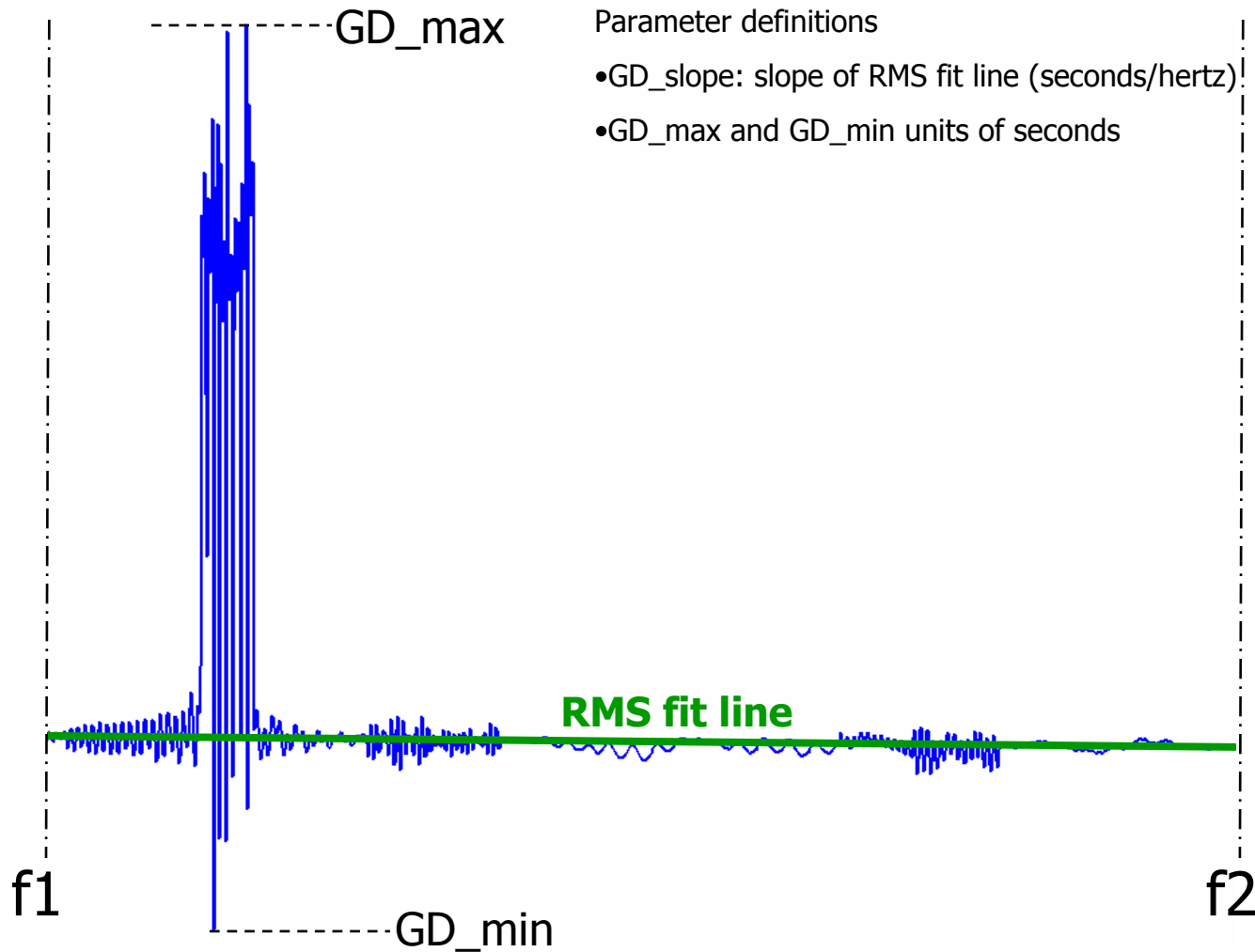


\*Note: capacitor currently shorted. Awaiting accurate HF/LF capacitance models

# Frequency Domain Calculated Parameters SDD21

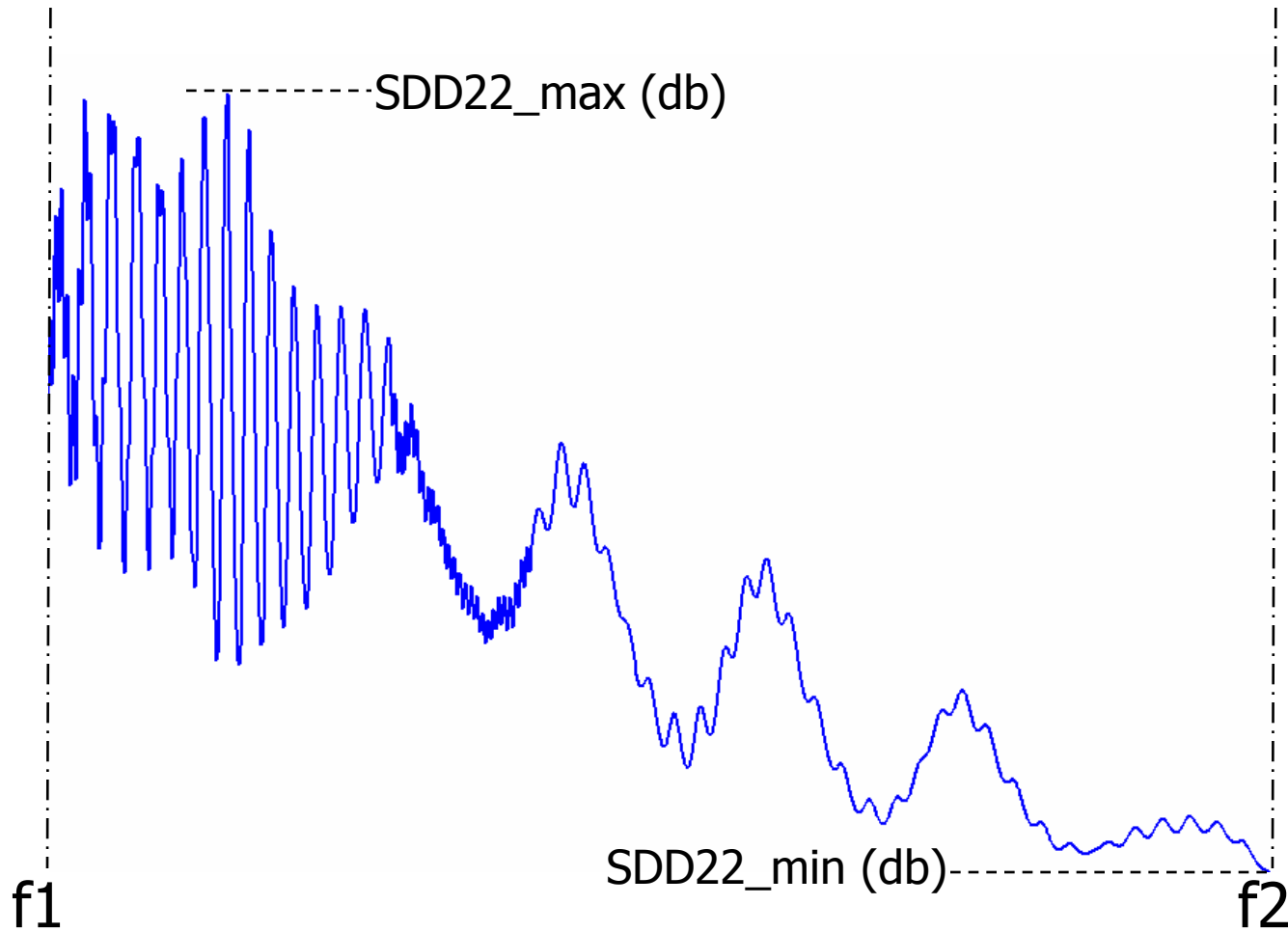


# Frequency domain: Group Delay





# Frequency domain: SDD22/11



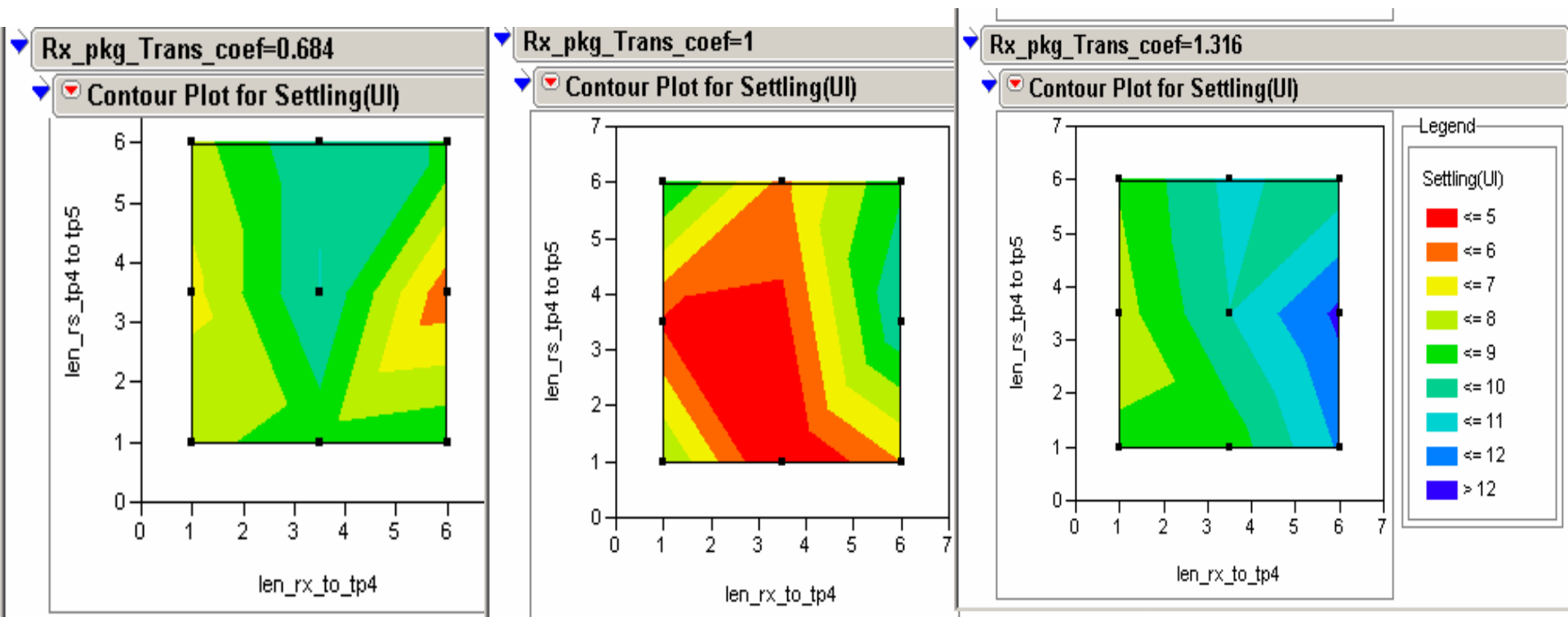
# Summary

Legend	
Strong	
Medium	
None	
Not Available	

Parameter		Correlation
LFmax	Intel	
	Tyco	
LFmin	Intel	
	Tyco	
HFmax	Intel	
	Tyco	
HFmin	Intel	
	Tyco	
BS_LF	Intel	
	Tyco	
BS_HF	Intel	
	Tyco	
FITabove	Intel	
	Tyco	
FITbelow	Intel	
	Tyco	
GD_min	Intel	
	Tyco	

Parameter		Correlation
GD_max	Intel	
	Tyco	
GDslope	Intel	
	Tyco	
SDD11max	Intel	
	Tyco	
SDD22max	Intel	
	Tyco	
SDD11min	Intel	
	Tyco	
SDD22min	Intel	
	Tyco	
peak	Intel	
	Tyco	
n(TP)	Intel	
	Tyco	
m(TN)	Intel	
	Tyco	
TP(-1)	Intel	
	Tyco	
TP(1)	Intel	
	Tyco	
Total Length	Intel	
	Tyco	

# Effect due to 10dB packages



- 10 dB packages have a large impact.
- Reference [http://ieee802.org/3/ap/public/channel\\_model/mellitz\\_m1\\_0105.pdf](http://ieee802.org/3/ap/public/channel_model/mellitz_m1_0105.pdf)

# Conclusions

- Further investigation of simulation results and outliers from both sets of data necessary
- Parameters used in analysis based on proposed SDD21 model are strong indicators of settling time
- SDD11 / SDD22 of TP1 / TP4 lacked correlation to settling time
- Group Delay
  - Looked at in range of F1 / F2
  - Minimum value had greatest correlation to settling time
  - But correlation with actual channel data wasn't as strong as simulated.
- Critical –
  - Rx line card and package design causes variability in settling time
  - Packaging design could increase the settling time

# Recommendations

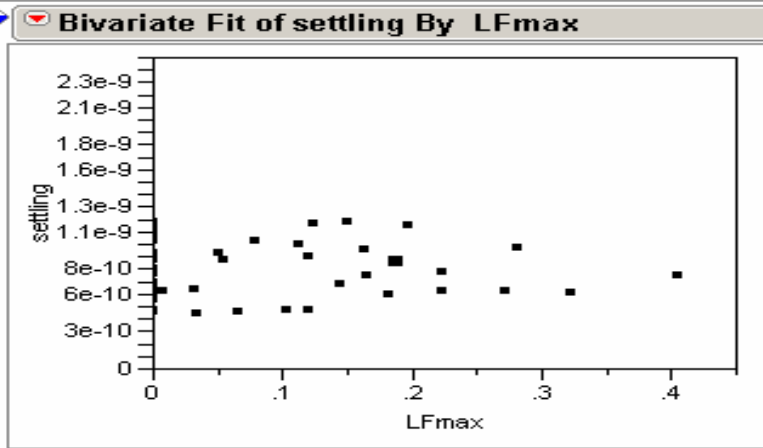
- Adopt proposed TP1/TP4 Informative SDD21 model template
  - To be done - specify LF and HF parameter at F2
  - Evaluate need of all parameters in model
  - Specific recommendations for each value needs to be completed upon Signal Ad Hoc analysis
- Eliminate proposed TP1/TP4 Informative SDD11 / 22 mask
  - Leave to normative analysis with inclusion of packaging effects
- Eliminate TP1/TP4 Informative Group Delay template

# Backup Slides

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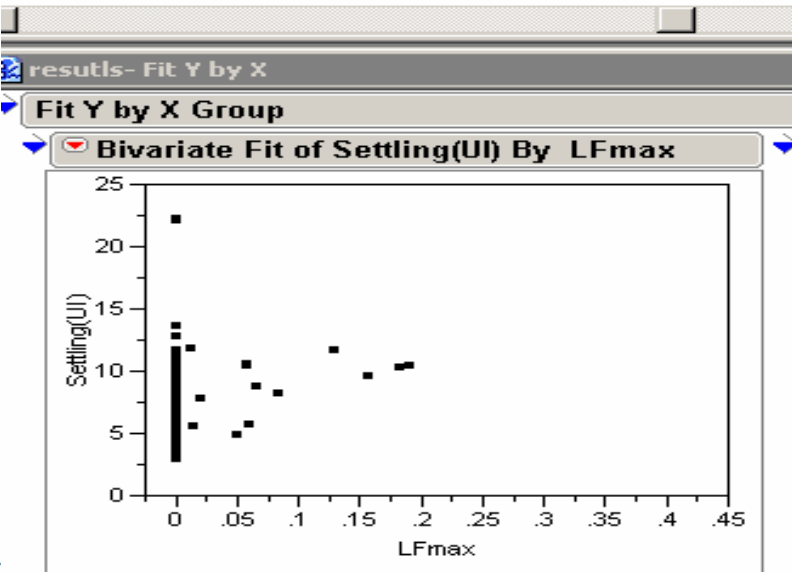
# LF max

Tyco



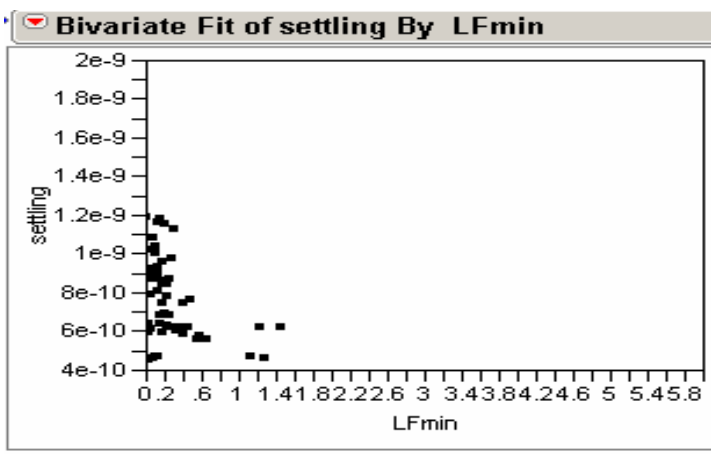
- No apparent correlation

Intel



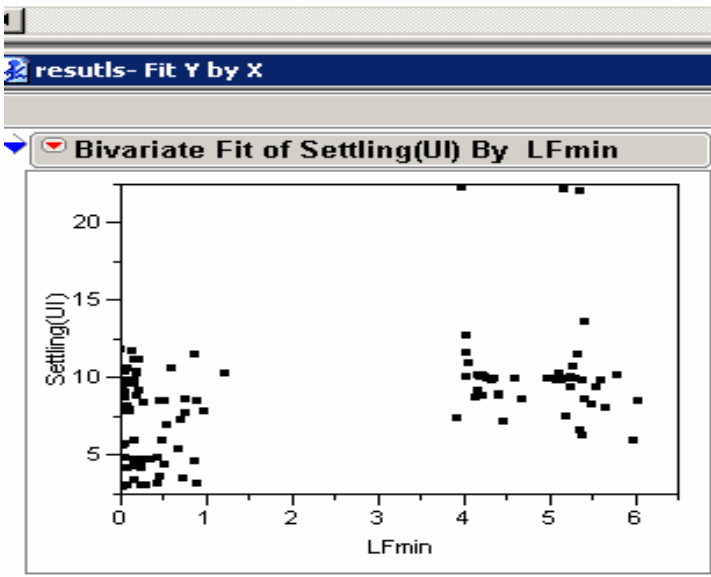
# LF min

Tyco



- Simulations show another distribution

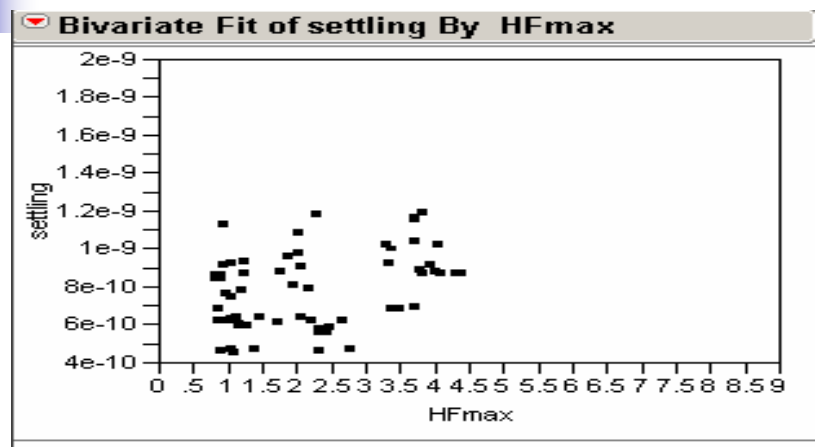
Intel



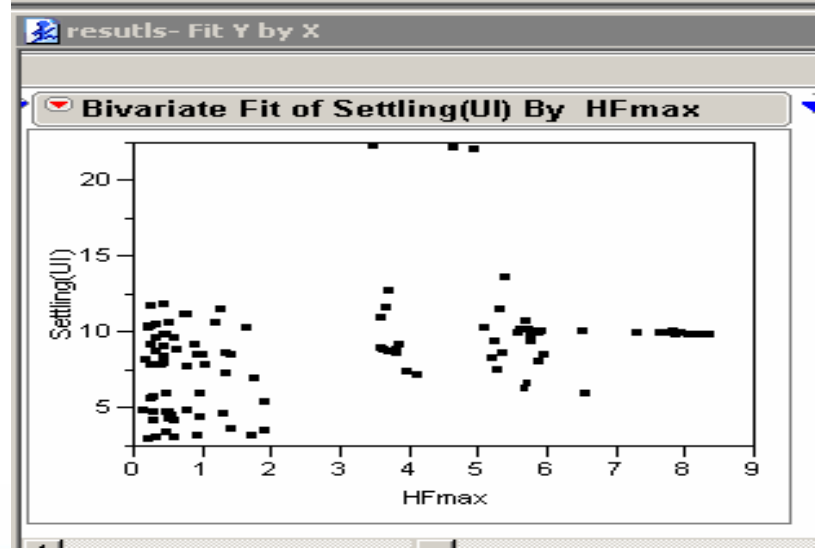


# HF max

Tyco

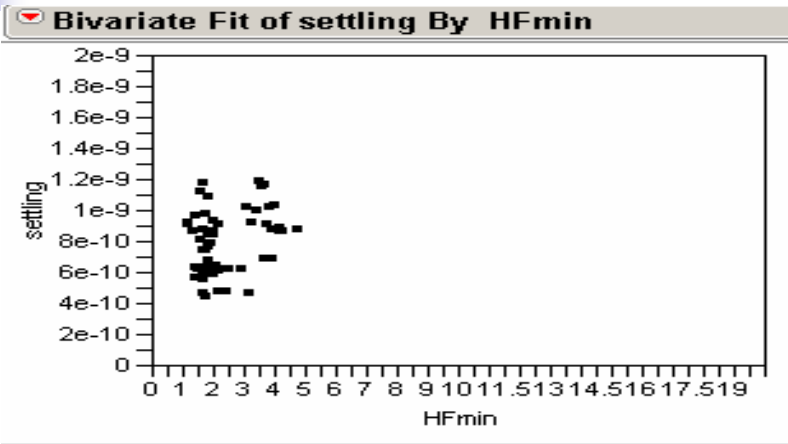


Intel



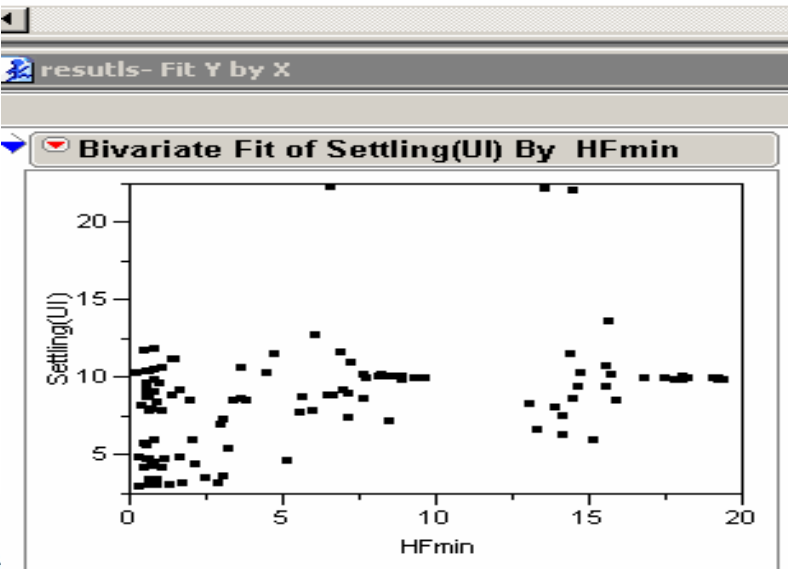
# HF min

Tyco

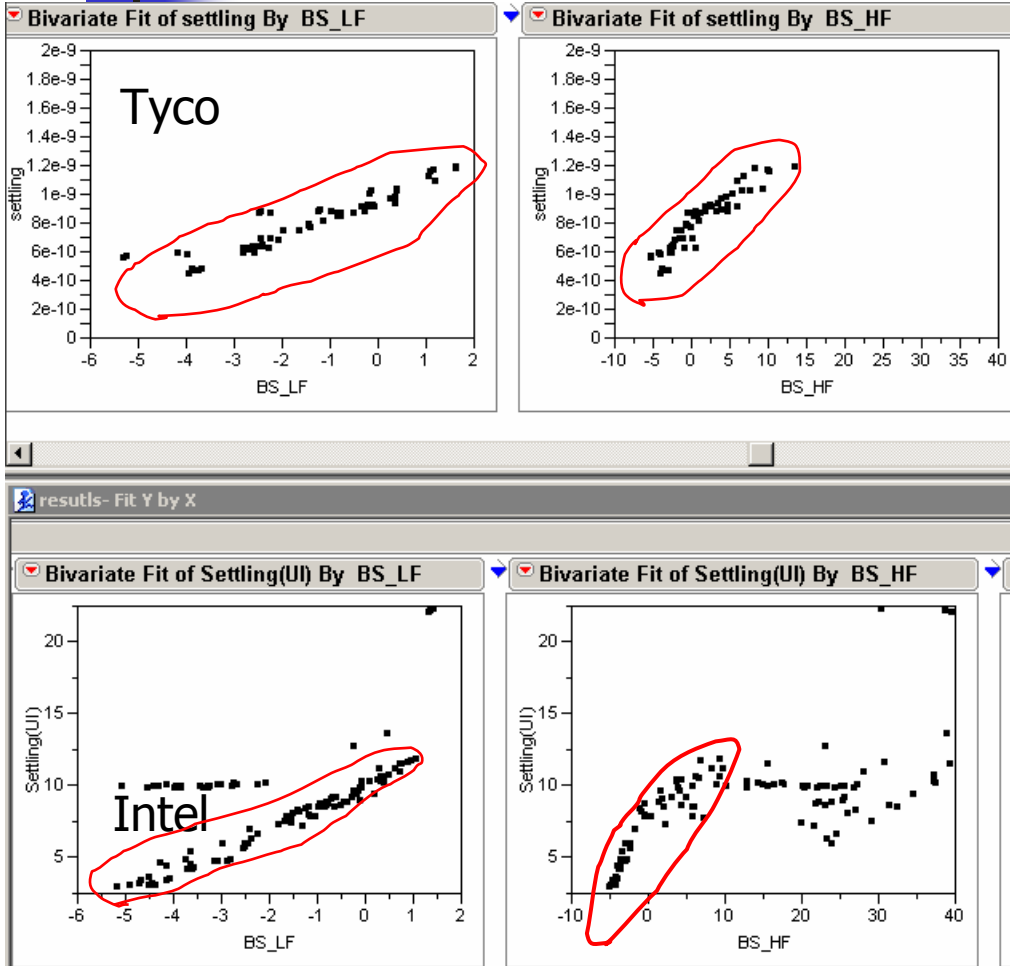


- No correlation
- 2 sim distributions

Intel



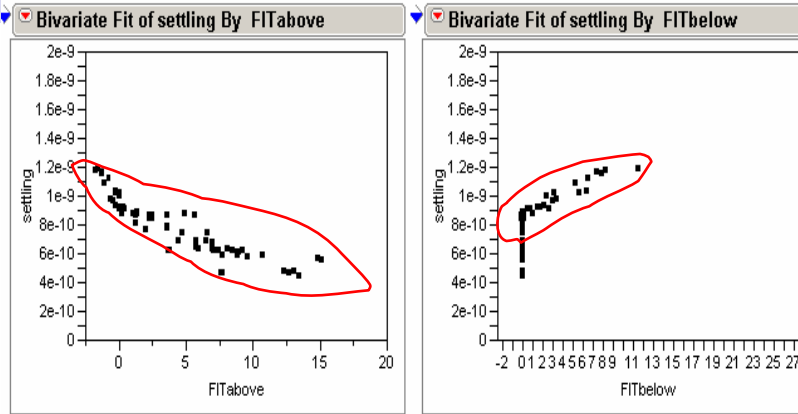
# BS\_LF / BS\_HF



- Correlation but Intel data has 2<sup>nd</sup> distribution

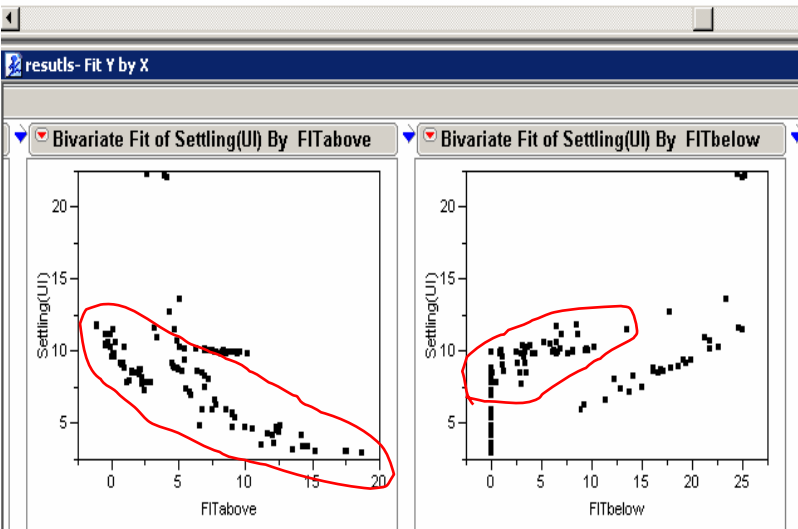
# Fit Above / Fit Below

Tyco

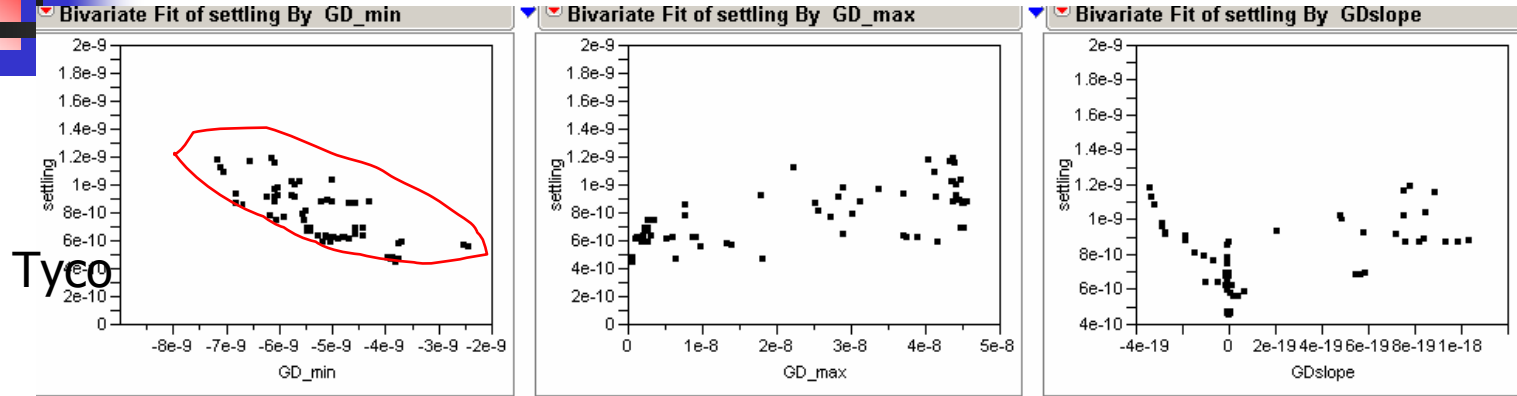


- Strong influence but sim data has some outliers.

Intel

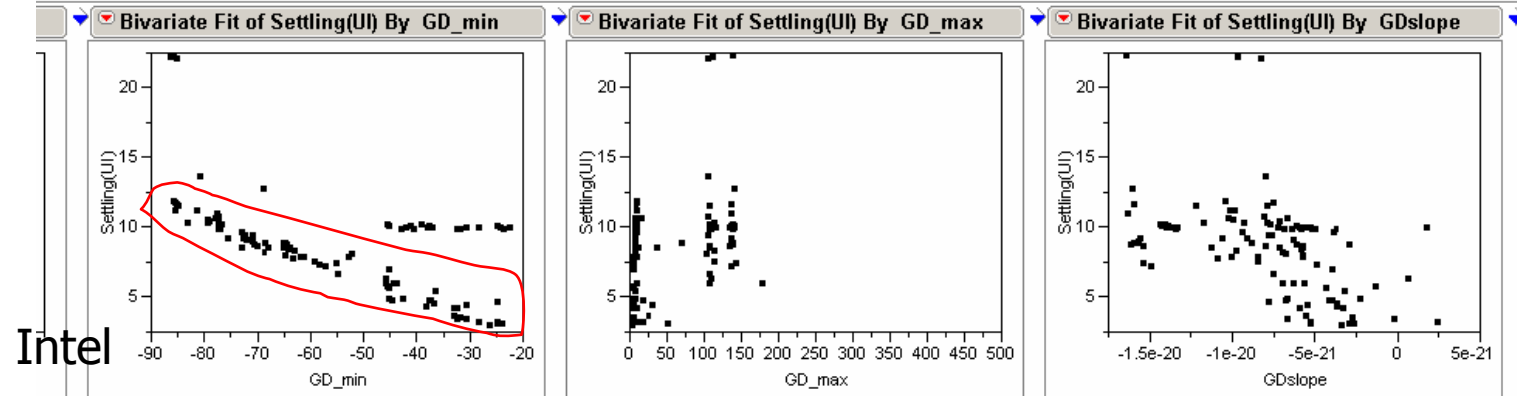


# Group Delay



Tyco

results- Fit Y by X



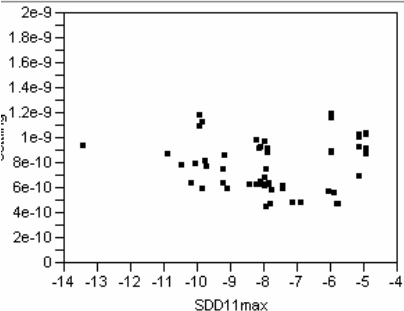
Intel

- GD\_min ... correlation but simulations had second distribution
- GD\_max and GD\_slope ... no correlation

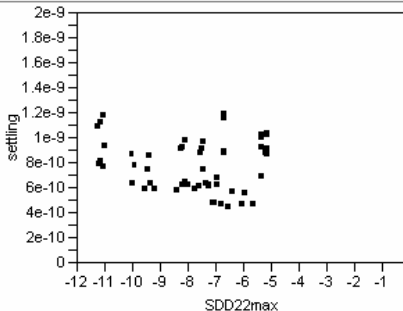
# SDD11 / SDD22

Tyco

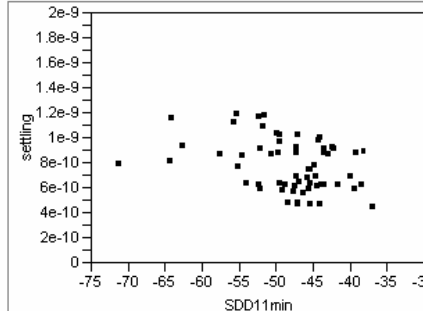
Bivariate Fit of settling By SDD11max



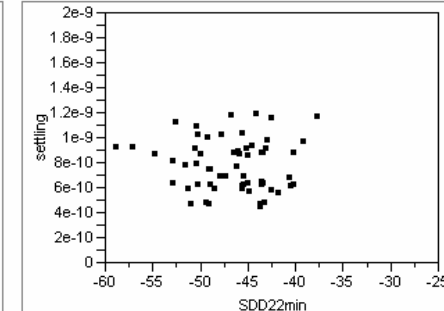
Bivariate Fit of settling By SDD22max



Bivariate Fit of settling By SDD11min



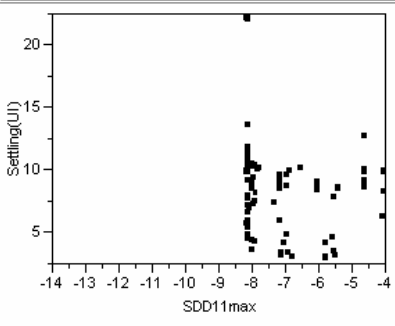
Bivariate Fit of settling By SDD22min



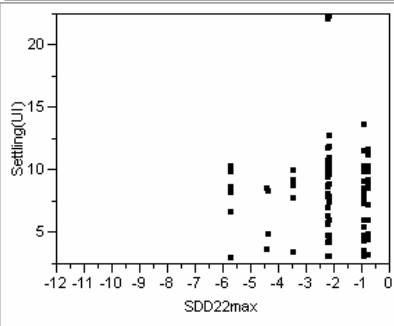
Intel

results- Fit Y by X

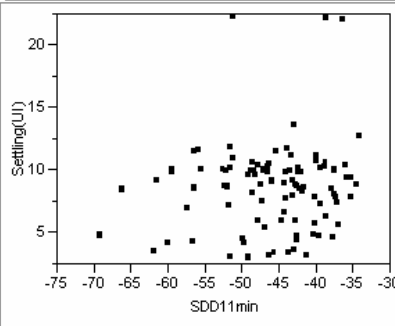
Bivariate Fit of Settling(UI) By SDD11max



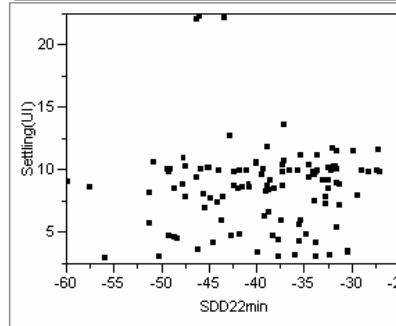
Bivariate Fit of Settling(UI) By SDD22max



Bivariate Fit of Settling(UI) By SDD11min



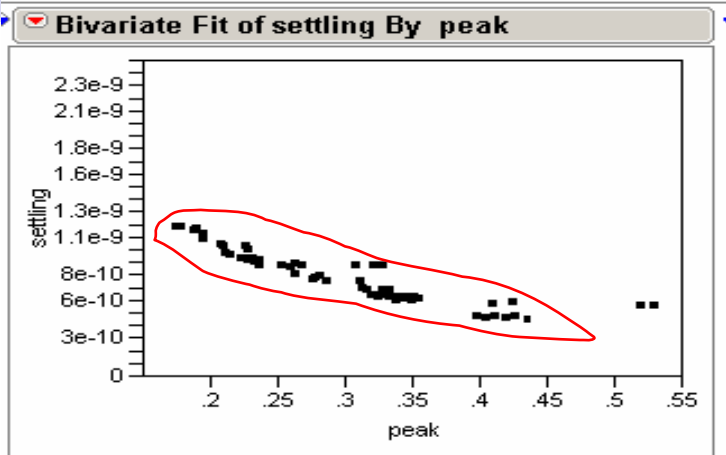
Bivariate Fit of Settling(UI) By SDD22min



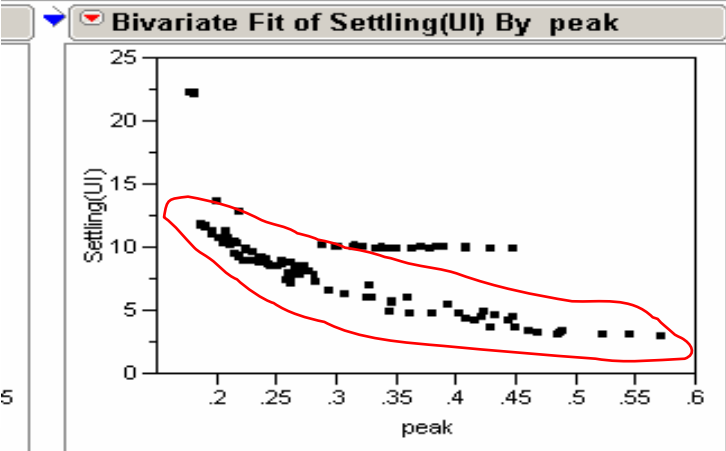
■ No correlation

# Pulse Response Peak

Tyco



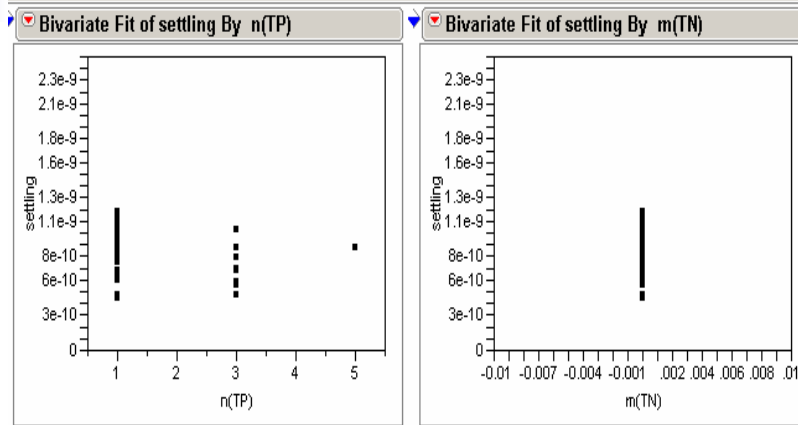
Intel



- Good peak correlation
- Sim data as 2<sup>nd</sup> distribution and outlier
- Settling is % of peak. Should it be absolute?

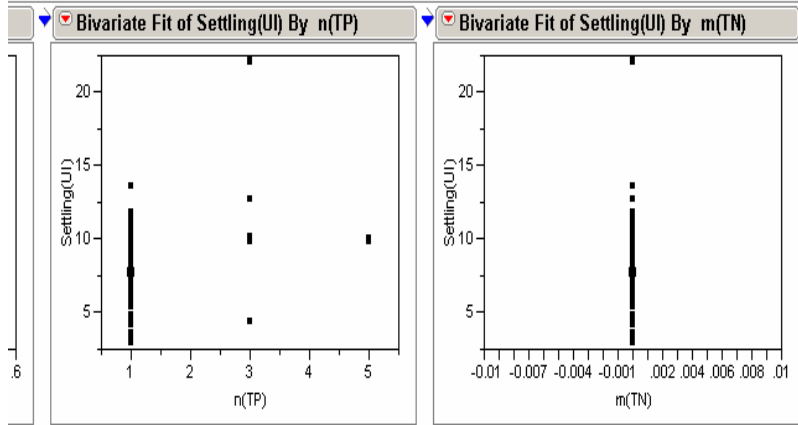
# Number of Crossings

Tyco



- No negative crossings
- Max of 5 positive crossings
- But not via > 200 mils stub and based on 5 %

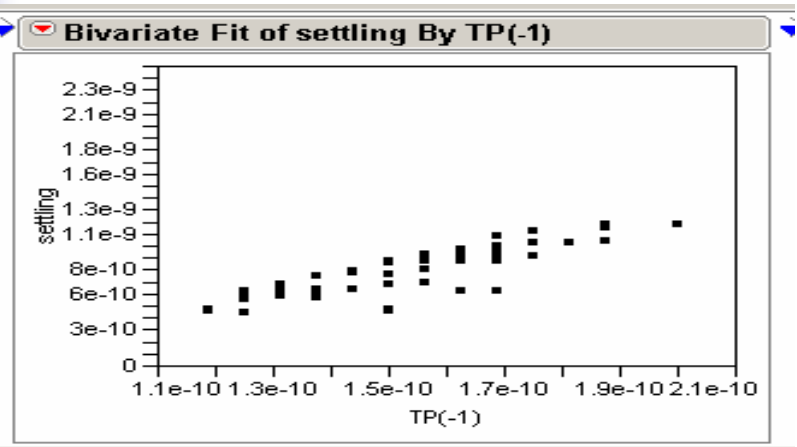
Intel



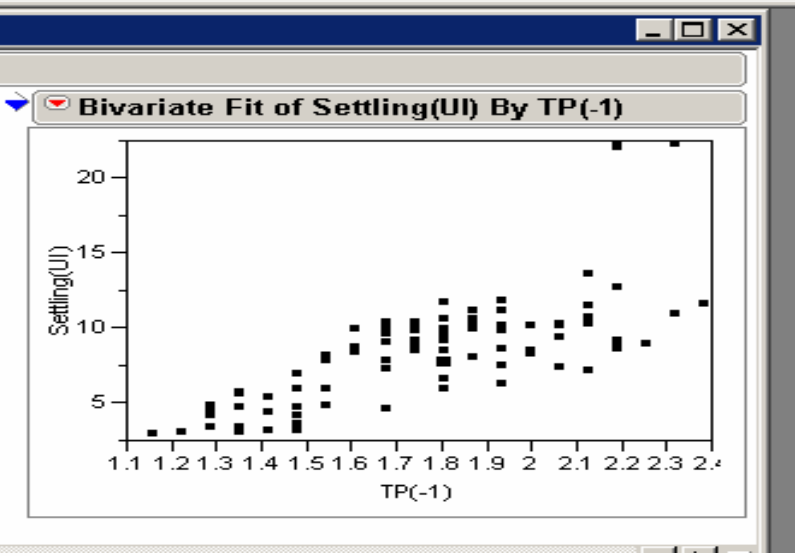


# First Crossing (TP-1)

Tyco

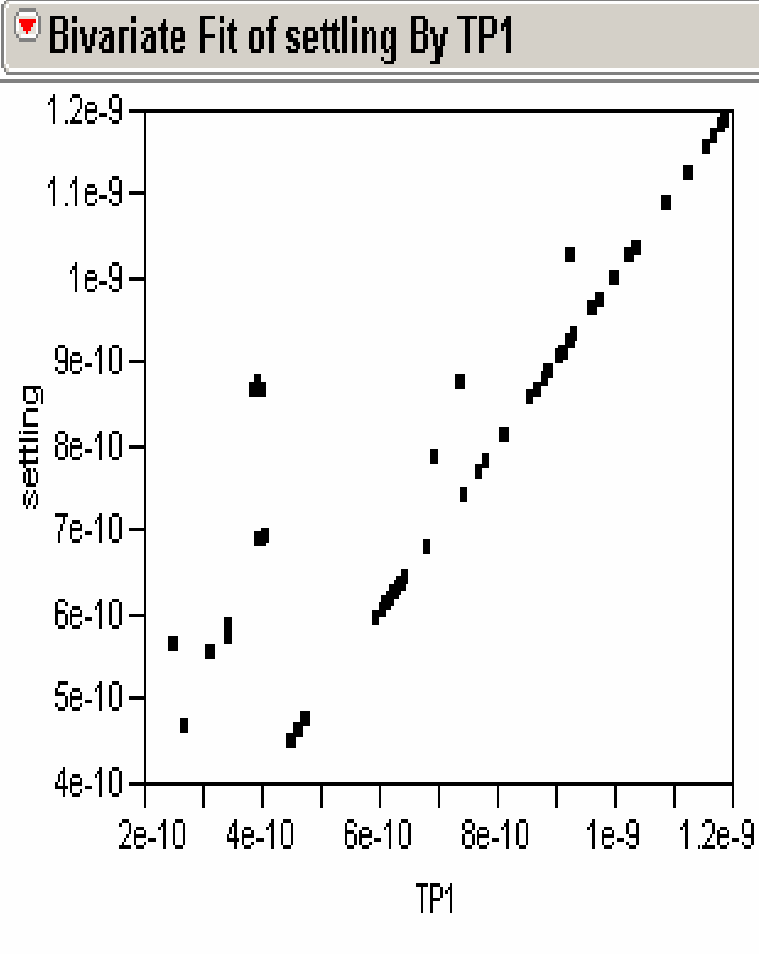


Intel



- Strong correlation
- Sim has wider distribution and an outlier.

# TP1

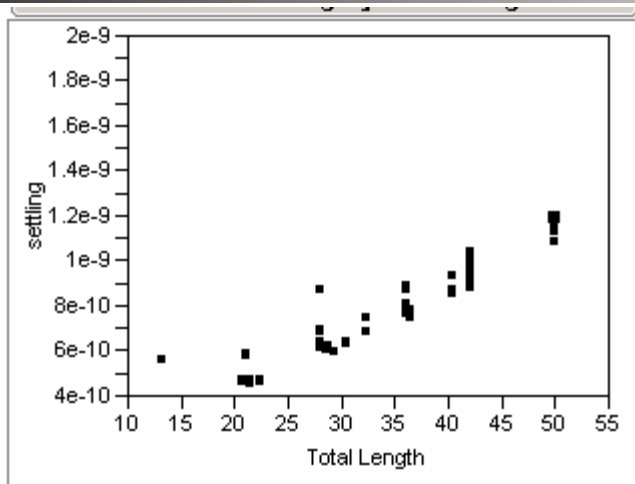


Tyco

- Good correlation but outliers

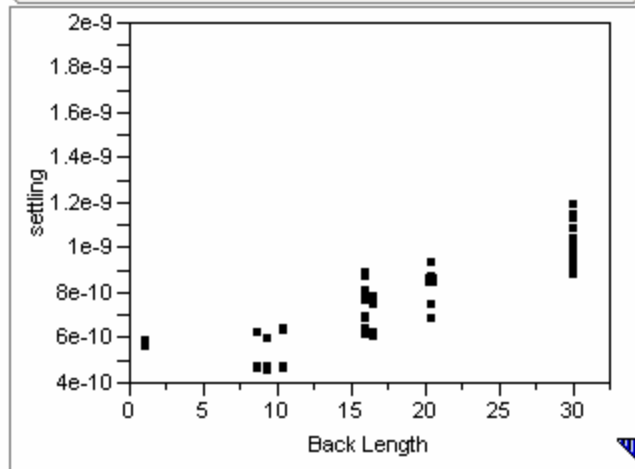
# Backplane / Line Card Length

Tyco



- Overall length has strong correlation
- LC length not strongly correlated

Bivariate Fit of settling By Back Length



Bivariate Fit of settling By Line Length

