VITESSE

05-425r0
SAS-2 Channel Model Simulations

Serial Attached SCSI

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YOUR PARTNER FOR SUCCESS

SAS-2 Channels

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- SAS-2 Physical layer Specification must be driven by Representative Channels from the user base.
  - Chassis, Backplane & Cable connections
- Expense of Equalizer (size, power …) is directly proportional to the channel difficulty.
- S-Parameter Sources Considered (Thank You)
  - Chassis, Backplane & Cable (HP, Dell and VTSS measurements)
  - iPASS™ (Molex and VTSS measurements)
  - Infiniband (VTSS measurements)

S-Parameter Conversion
Touchstone File to Differential S-Parameters

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- Single Ended Scattering Parameters converted to Differential

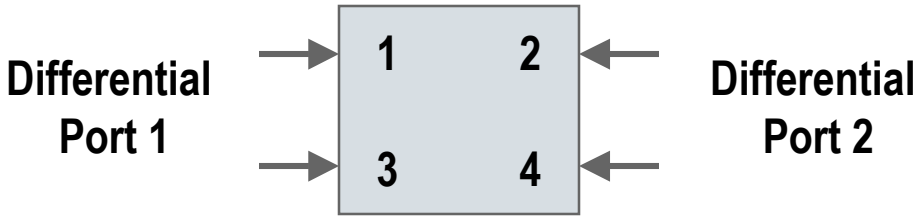
$$S_{d1d1} = \frac{1}{2}(S_{11} - S_{13} - S_{31} + S_{33})$$

$$S_{d1d2} = \frac{1}{2}(S_{12} - S_{32} - S_{14} + S_{34})$$

$$S_{d2d1} = \frac{1}{2}(S_{21} - S_{41} - S_{23} + S_{43})$$

$$S_{d2d2} = \frac{1}{2}(S_{22} - S_{42} - S_{24} + S_{44})$$

Port Definition



SAS-2 Channels Simulation Methodology

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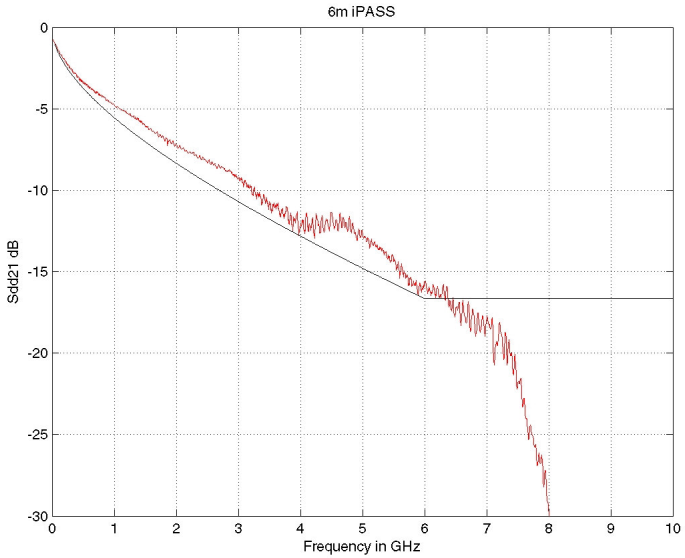
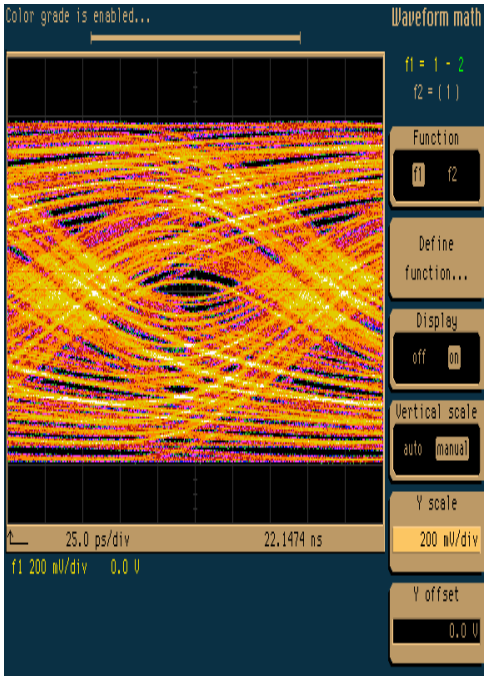
Simulation Approach

- Use Piece Wise Linear (PWL) file of transmitted waveforms (PRBS-7)
  - w/ & w/o De-Emphasis
- Use ideal Rx/Tx termination
- HSpice simulation of S-parameter File
- Comparison to measured when possible

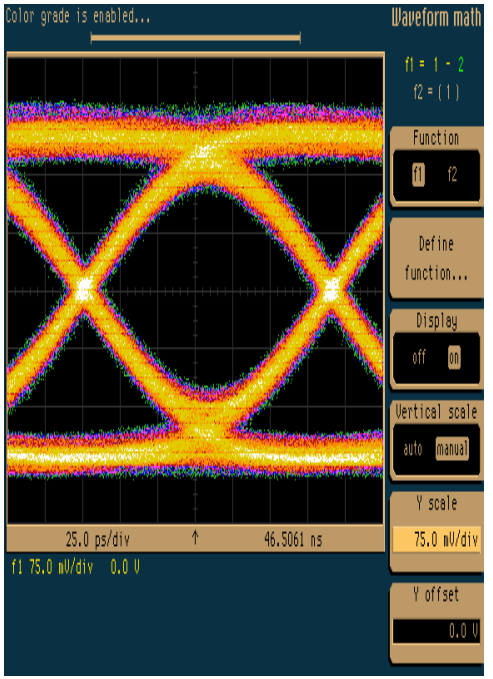
Example 6M iPASS™



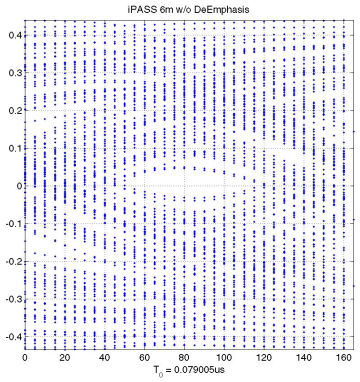
Measured Output w/o De-Emphasis



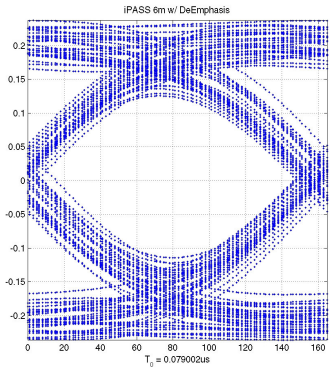
Measured Output w/ De-Emphasis



Simulated Output w/o De-Emphasis



Simulated Output w/ De-Emphasis



SAS-2 Chassis Channel Models

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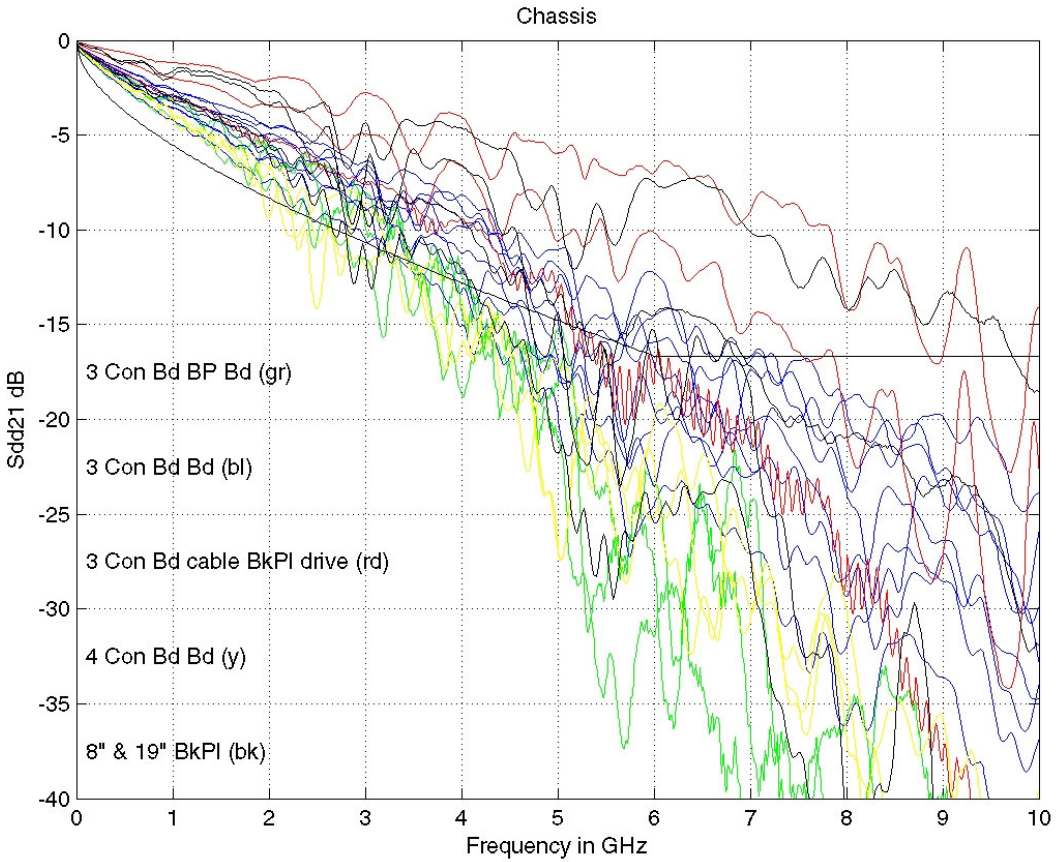
- Chassis S-Parameters
  - 05-384r0, 05-390r0, 05-389r0, 5-393r0 & In House JBOD Chassis



SAS-2 Channels Simulation Results

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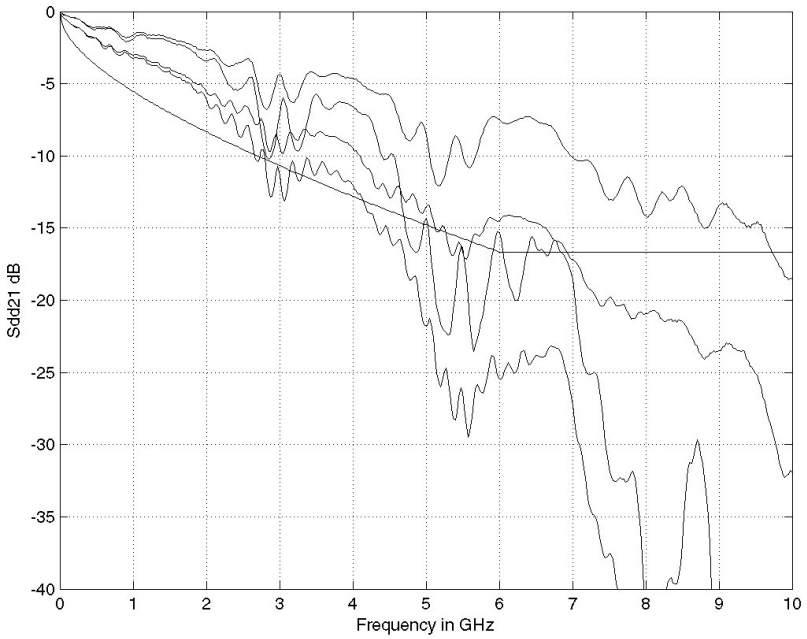
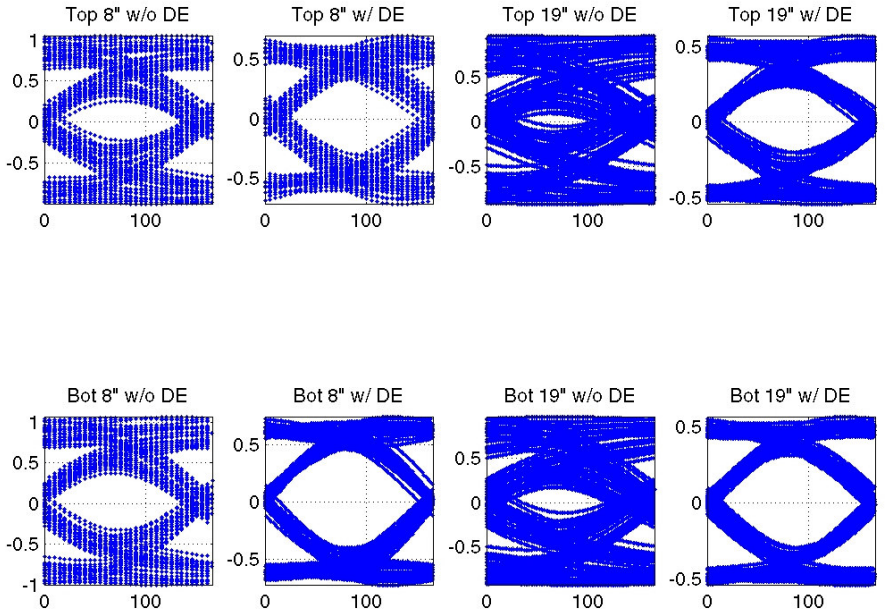
- Simulated Chassis 05-393r0 : 4 Boards 3 Mated Connectors
- Spice Based Simulation
  - Use PWL of transmit waveforms
  - Simulate S-Parameter File



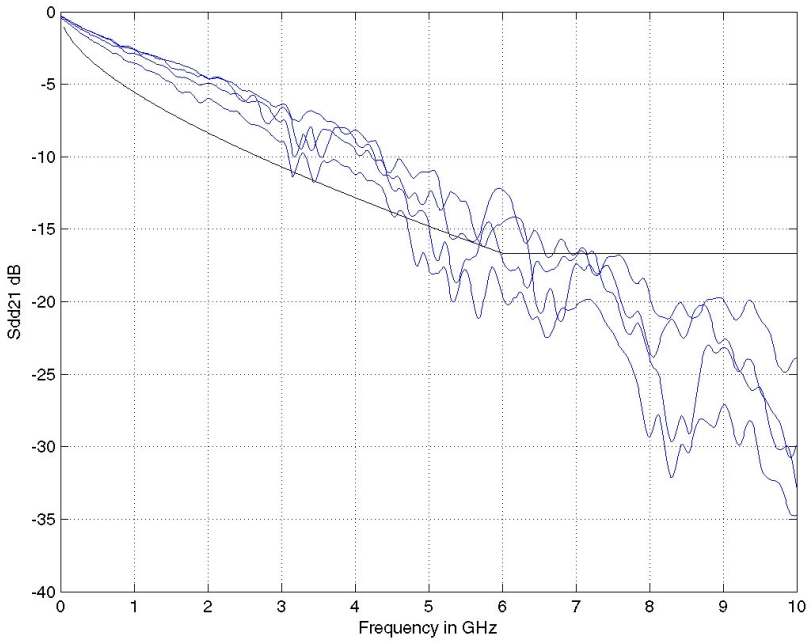
Simulated Output
w/o & w/ De-Emphasis



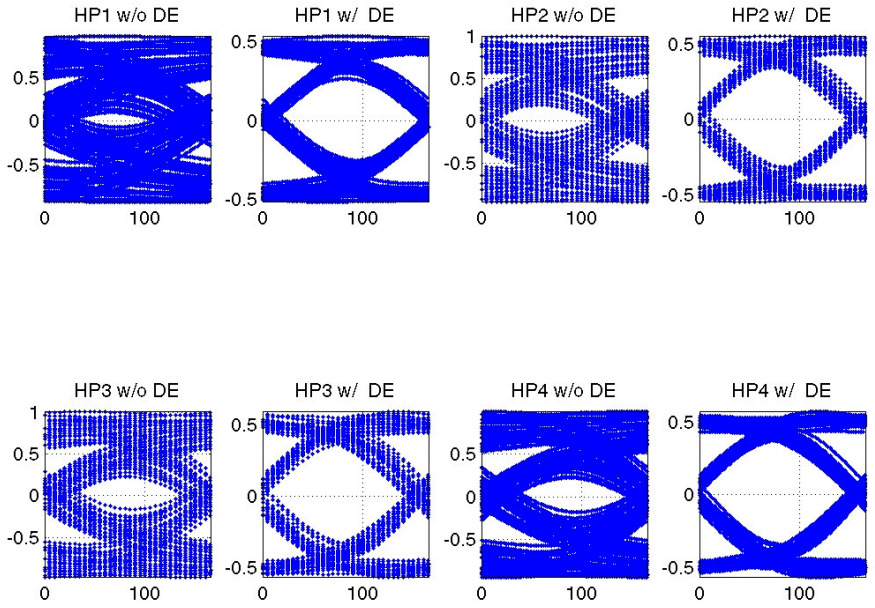
SAS-2 Channels Simulation Results

VITESSE

- Chassis Channels 05-384r0: 3 Connectors Board to Board (1 of 2)
- Spice Based Simulation
  - Use PWL of transmit waveforms
  - Simulate S-Parameter File



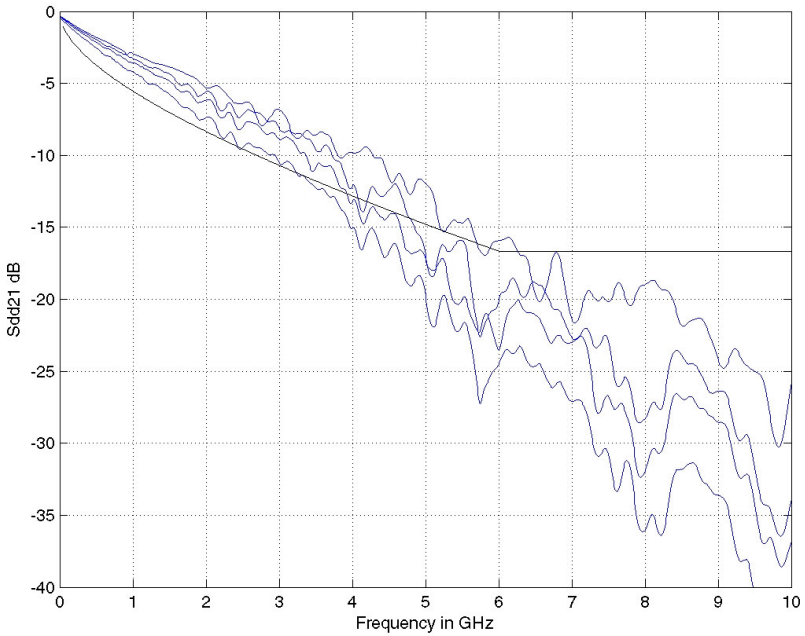
Simulated Output
w/o & w/ De-Emphasis



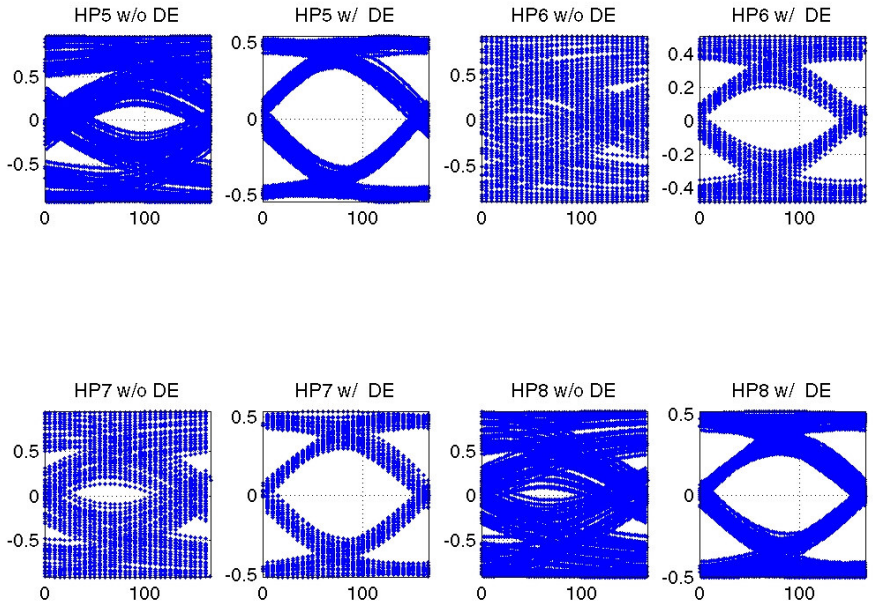
SAS-2 Channels Simulation Results

VITESSE

- Chassis Channels 05-384r0: 3 Connectors Board to Board (2 of 2)
- Spice Based Simulation
  - Use PWL of transmit waveforms
  - Simulate S-Parameter File



Simulated Output
w/o & w/ De-Emphasis

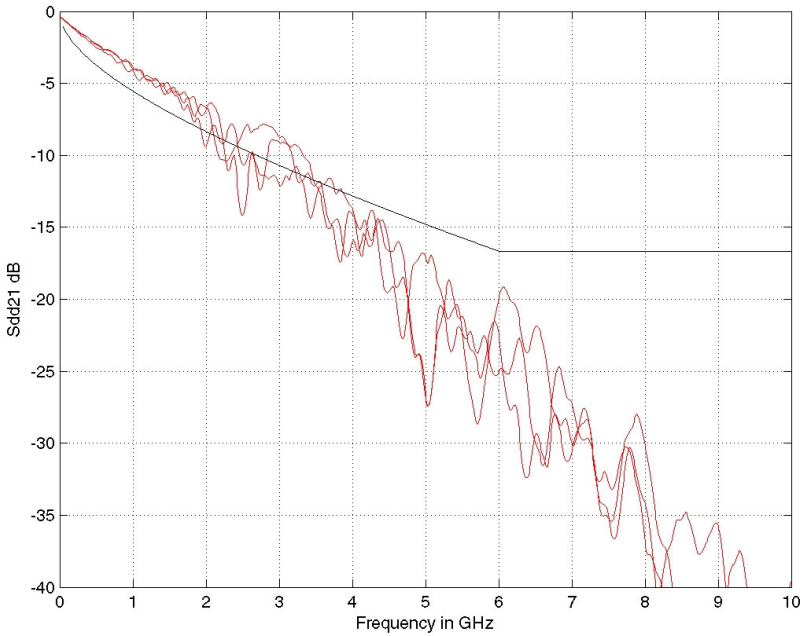


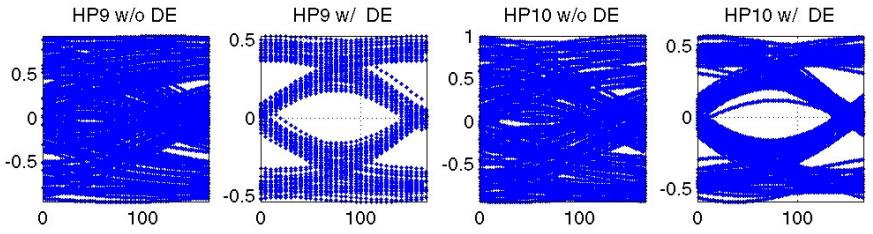
SAS-2 Channels Simulation Results

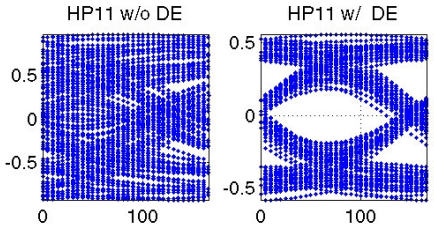
VITESSE

- Chassis Channels 05-389r0: 4 Connectors Board to Board
- Spice Based Simulation
  - Use PWL of transmit waveforms
  - Simulate S-Parameter File

Simulated Output
w/o & w/ De-Emphasis





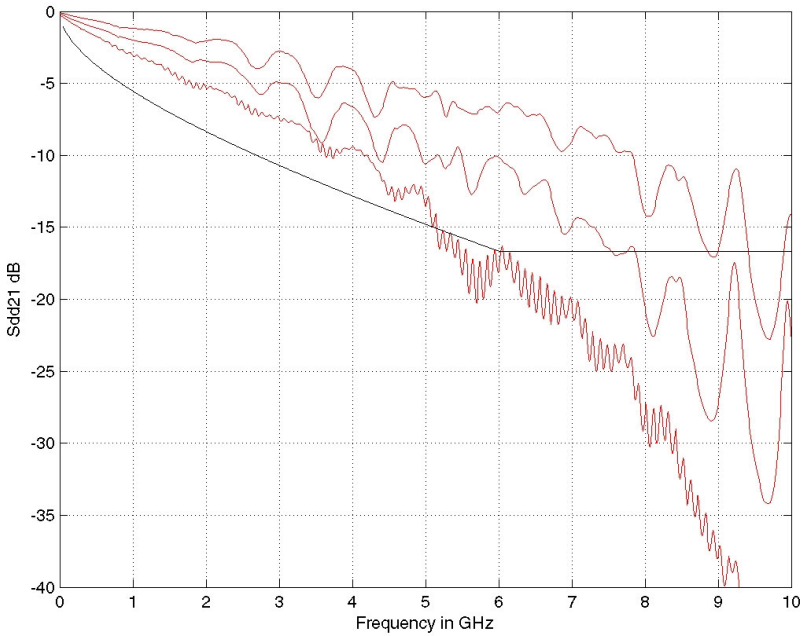


Note: these are yellow in composite Sdd21 plot

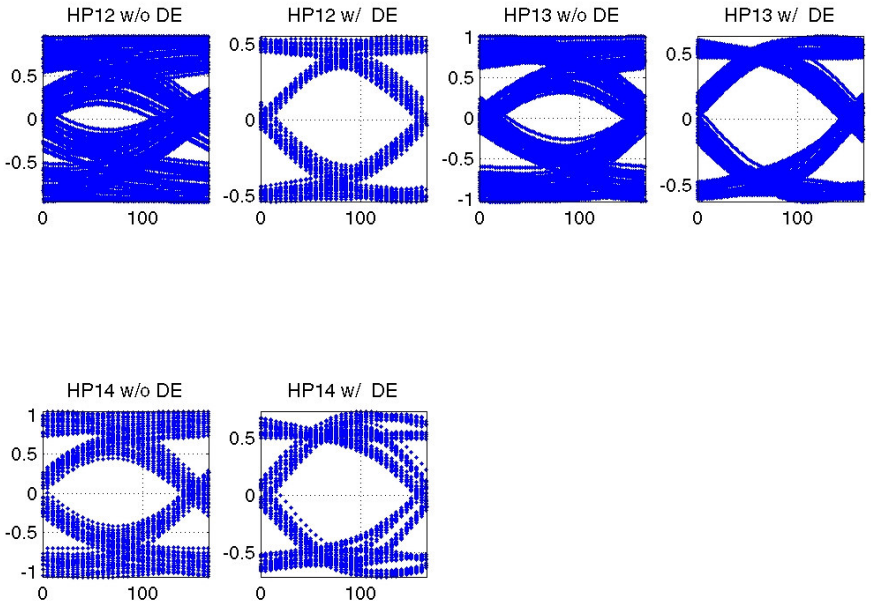
SAS-2 Channels Simulation Results

VITESSE

- Chassis Channels 05-390r0: 3 Connectors Board/Cable/Backplane/Drive
- Spice Based Simulation
  - Use PWL of transmit waveforms
  - Simulate S-Parameter File



Simulated Output
w/o & w/ De-Emphasis



SAS-2 Channels Simulation Results

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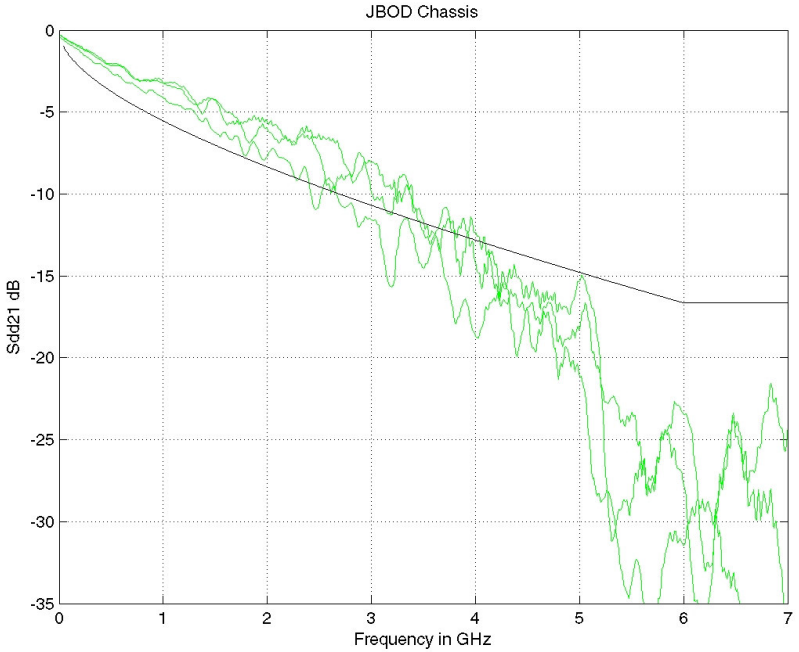
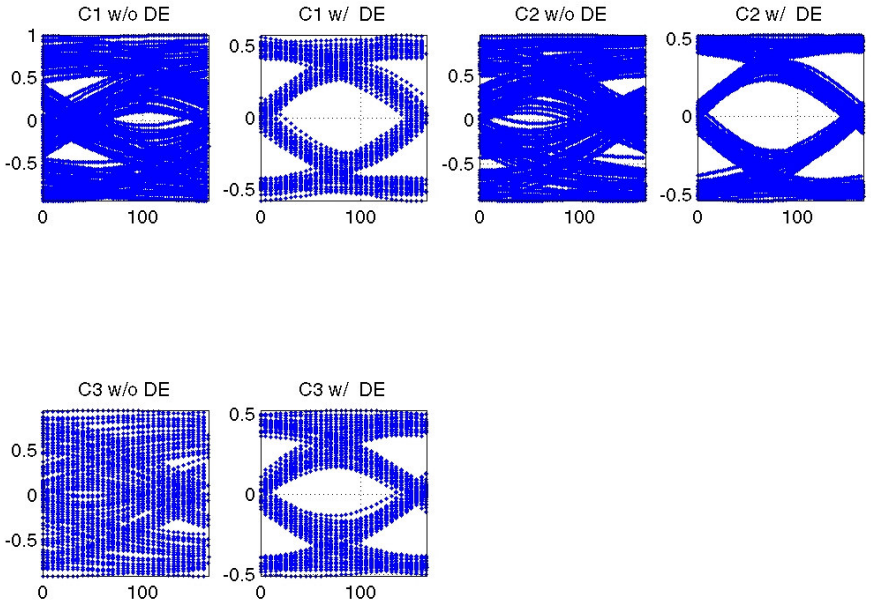
- Chassis JBOD (In House)
- Spice Based
  - Use PWL of transmit waveforms
  - Simulate S-Parameter File



Simulated Output
w/o & w/ De-Emphasis



SAS-2 External Cable Channel Models

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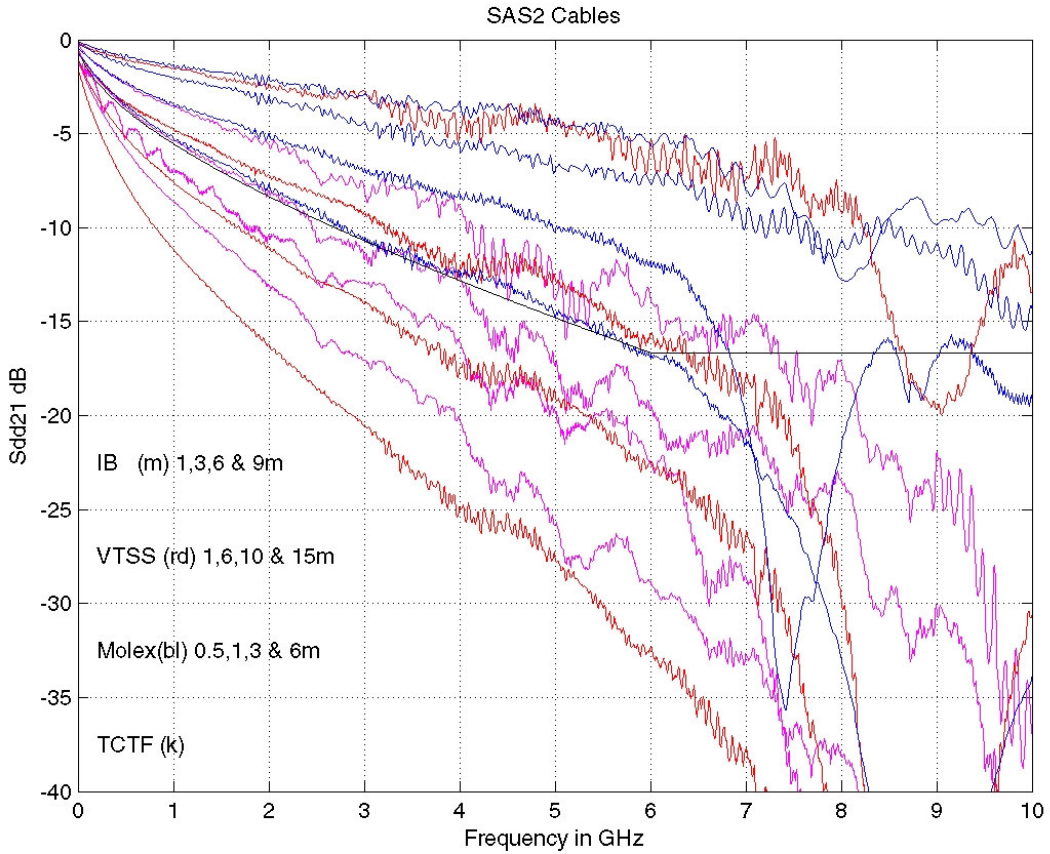
- Cable S-Parameters
  - iPASS™ 05-398r0
  - In House iPASS™ & InfiniBand



SAS-2 Channels Simulation Results

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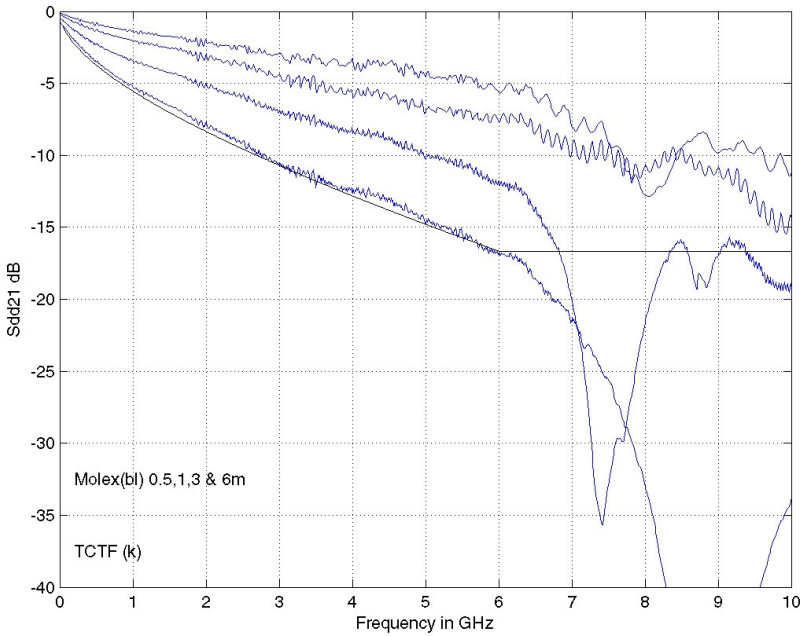
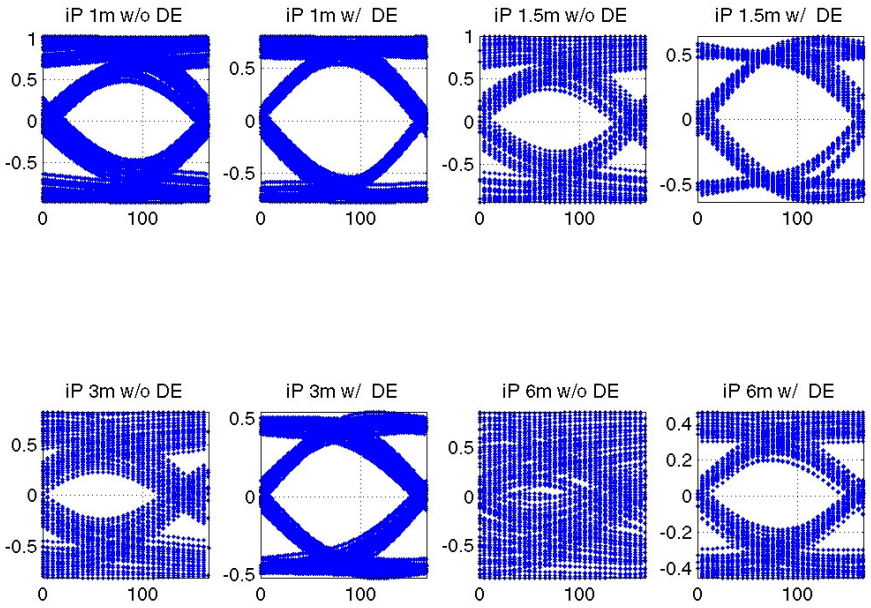
- 0.5m, 1m, 3m, & 6m iPASS™ Channels 05-398r0
- Spice Based Simulation
  - Use PWL of transmit waveforms
  - Simulate S-Parameter File



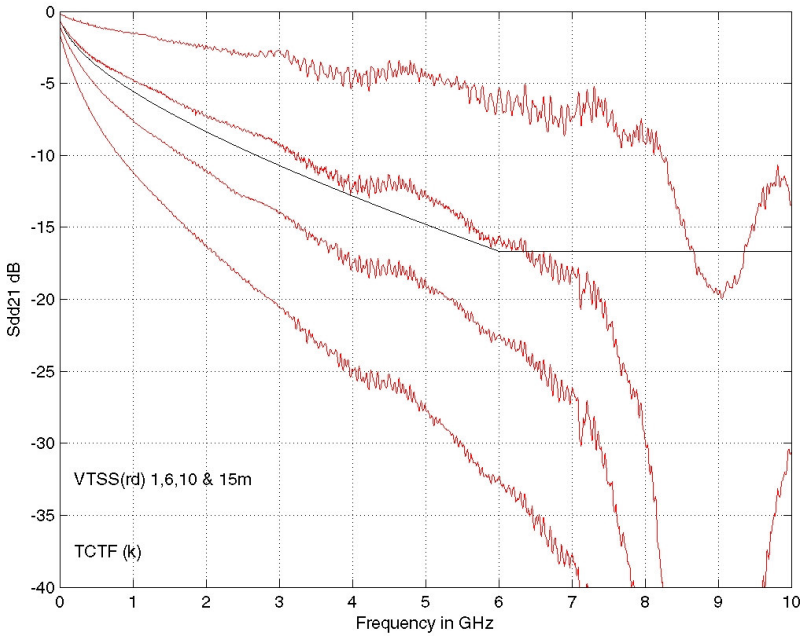
Simulated Output
w/o & w/ De-Emphasis



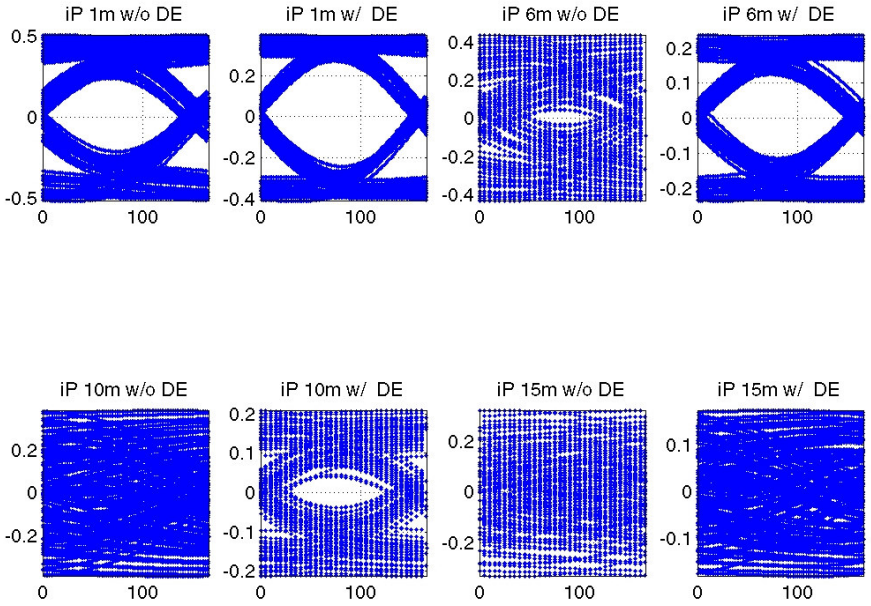
SAS-2 Channels Simulation Results

VITESSE

- 1m, 6m, 10m, 15m iPASS™ Channels
- Spice Based Simulation
  - Use PWL of transmit waveforms
  - Simulate S-Parameter File



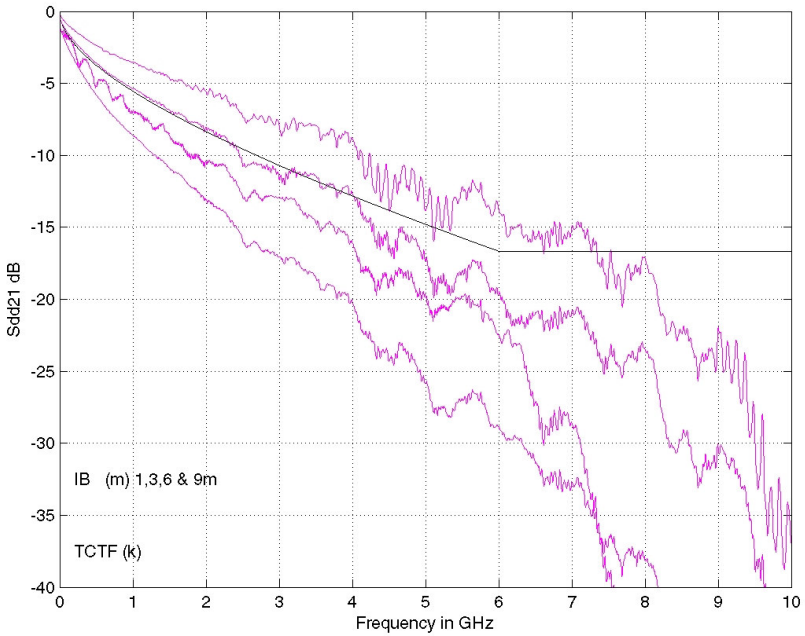
Simulated Output
w/o & w/ De-Emphasis



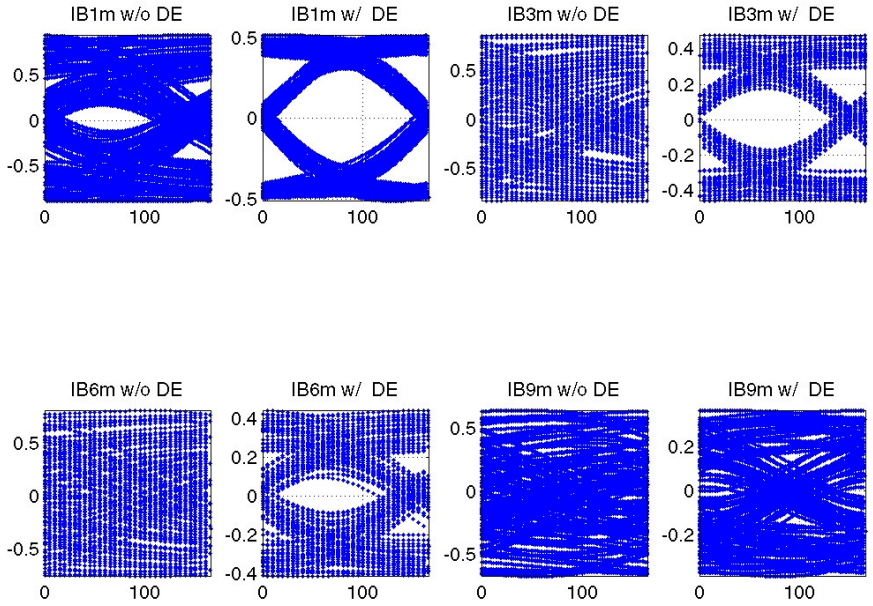
SAS-2 Channels Simulation Results

VITESSE

- 1m, 3m, 6m & 9m InfiniBand Channels
- Spice Based Simulation
  - Use PWL of transmit waveforms
  - Simulate S-Parameter File



Simulated Output
w/o & w/ De-Emphasis



Summary

VITESSE

- SAS-2 Channels based on S-parameters have been explored
  - Chassis, Backplane & Cable (HP, Dell and VTSS)
  - iPASS™ (Molex and VTSS measurements)
  - Infiniband (VTSS measurements)
- SAS-2 Channels will result in closed eyes w/o Tx De-Emphasis
- SAS-2 Chassis Channels will Require Equalization
  - All Chassis Channels look Feasible
- SAS-2 External Cables will Require Equalization
  - External Cable length up to 10m with iPASS is Feasible
  - External Cable length up to 6m with InfiniBand looks Feasible
- A set of representative S-Parameters could serve as channel definition.
- Question, Is this a representative set of all end-user channels?