Presentation to IEEE P802.3ap Backplane Ethernet Task Force
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Title: **EIT Simulation Results**

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Simulation setup for EIT

Simulation model base setup

Configuration	NRZ FFE3/DFE5
Launch amplitude set to minimum	800 mVpp
Transmitter DJ set to maximum	0.15 UIpp
Transmitter RJ set to maximum	0.0107 UIrms (0.15UIpp @ 10^{-12} BER)
Tx/Rx termination set to nominal (ideal)	5050/5050 ohms
Receiver DJ	0.10 UIpp
Receiver RJ set to maximum	0.0107 UIrms (0.15UIpp @ 10^{-12} BER)
Data rate	10.3 Gbps
Receiver offset	200 ppm
Data pattern (through channel)	PRBS23
Random noise	1.46mV rms
Minimum latch overdrive	10mV
Package	Spec_RL_cap_like
Simulation time	1M bits

Note:

- Several parameters are not set for worst case evaluation (i.e. results are still optimistic for concluding limits on a test which must support all PVT variation)
  - Terminations (both Tx & Rx) are ideal 50ohm
  - Minimum latch overdrive is set to what's considered a nominal value
  - Simulation time is relatively low

Simulation setup for EIT

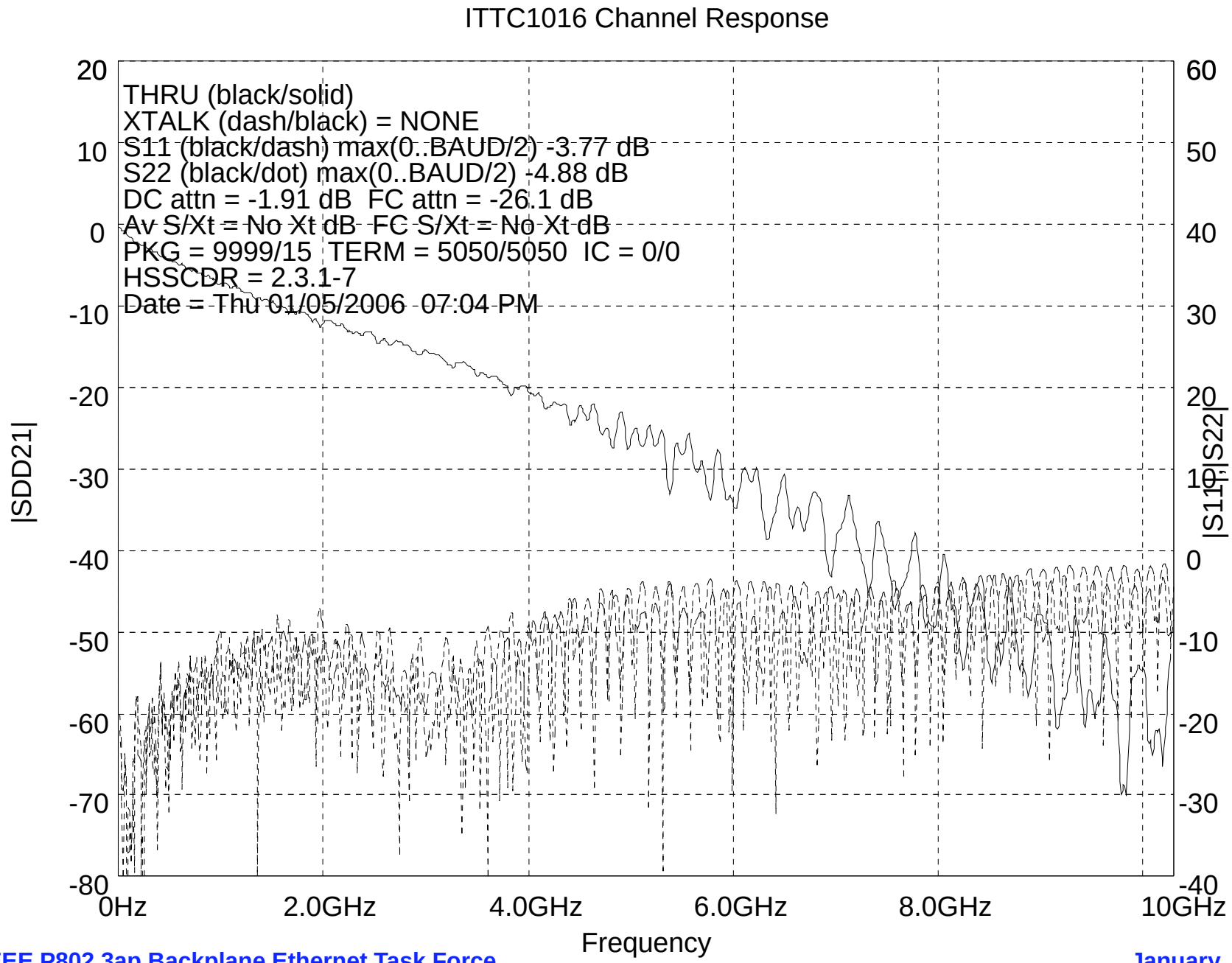
Simulations run on 2 test channels

- Agilent ITTC1016
  - Simulated channel
- Agilent TC
  - Measured channel
  - Mct = 1.015, Bct = -0.03dB

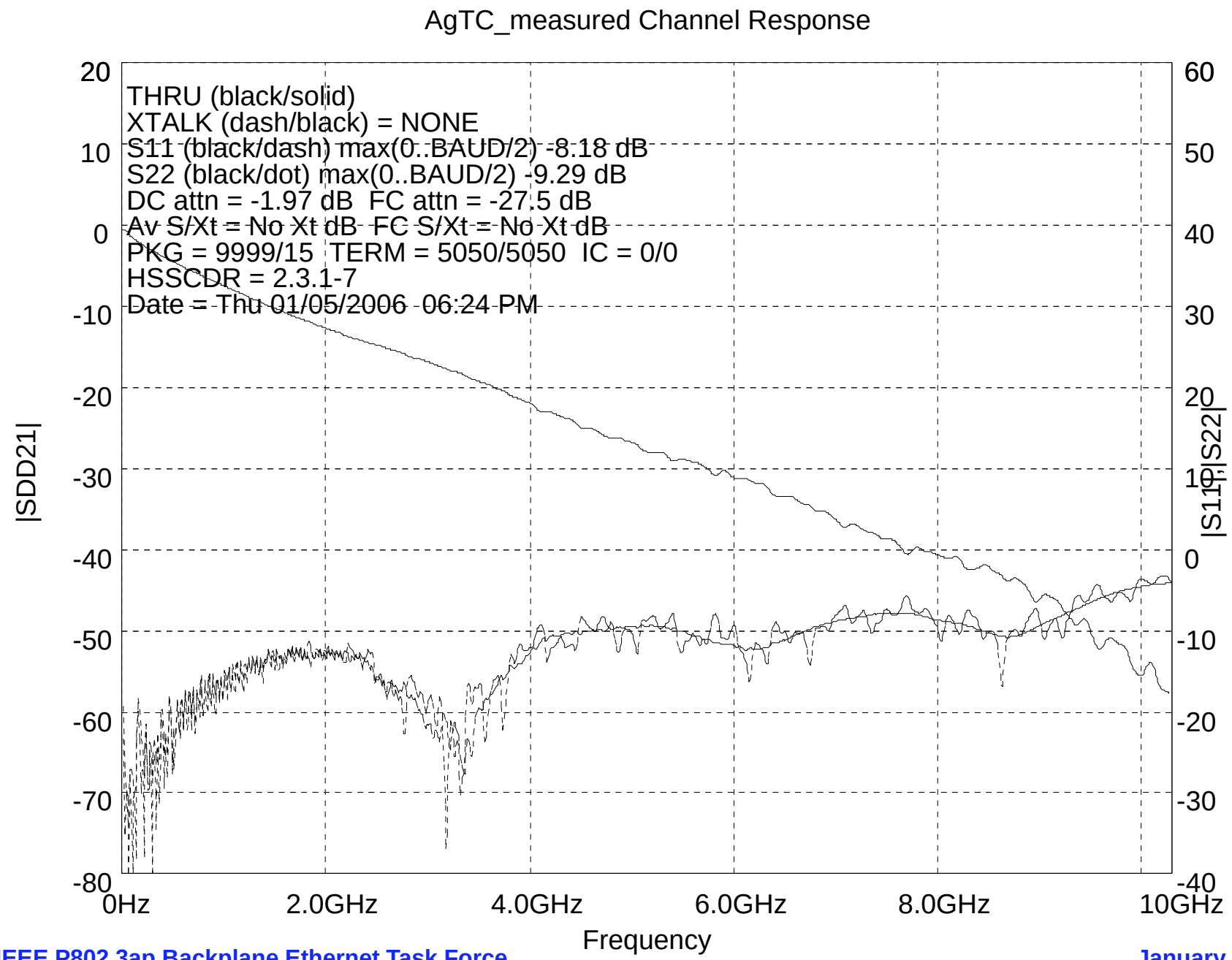
Results run with varying % of DCD

- 0%, 3.13%, 6.25% UIpp DCD
- Amount of Tx DJ (SJ) appropriately reduced by % DCD to keep a constant 0.15UIpp

Agilent ITTC1016 Channel (Simulated)



Agilent TC (Measured)



Simulator Handling of Xtalk Channels

Xtalk channels are driven the same as through channels

- Same Tx/Rx package model concatenated with the Xtalk channel
- Same FFE coefficients applied
- Same launch voltage used

Same data frequency is used on Xtalk channel

- However, phase offset is constantly changed to slide Xtalk interference through the data window

Data pattern is generally defaulted to the same as defined for the through channel, but this can be over-ridden

- Therefore, patterns of 1010, 1100, etc. can be used to simulate the EIT

The resulting Xtalk signal can be arbitrarily scaled

- Generally it is defaulted to a 1.0x factor, but scaling will be used to simulate the EIT

Approach Taken to Simulate EIT

Drive the through channel with a 1010 (5GHz) data pattern

- Determine the outer eye height seen at Rx package input
  - This value will be the base Xtalk voltage

Use a copy of the through channel sparms as the Xtalk (interference) channel

- Drive this Xtalk channel with a 1010 pattern, while using PRBS23 for the through channel
- Since Xtalk channel is driven the same as the through, the signal seen from the prior step will appear as the base Xtalk signal

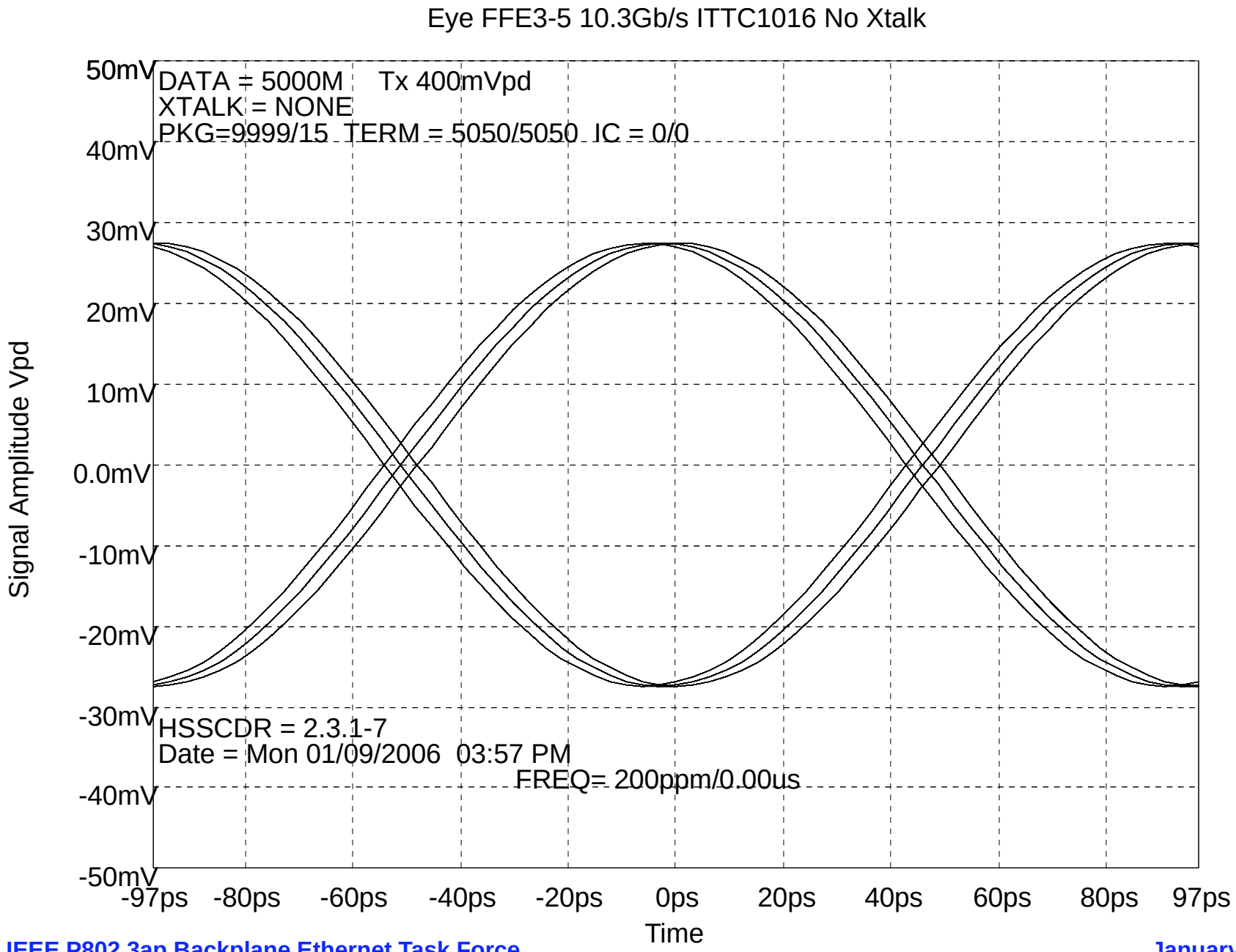
Apply appropriate Xtalk scale factors to the base Xtalk voltage to generate effective interference at voltages of interest

- Simulate with these factors to determine the BER floor factor
- BER floor below e-12 is a failed EIT at the respective voltage

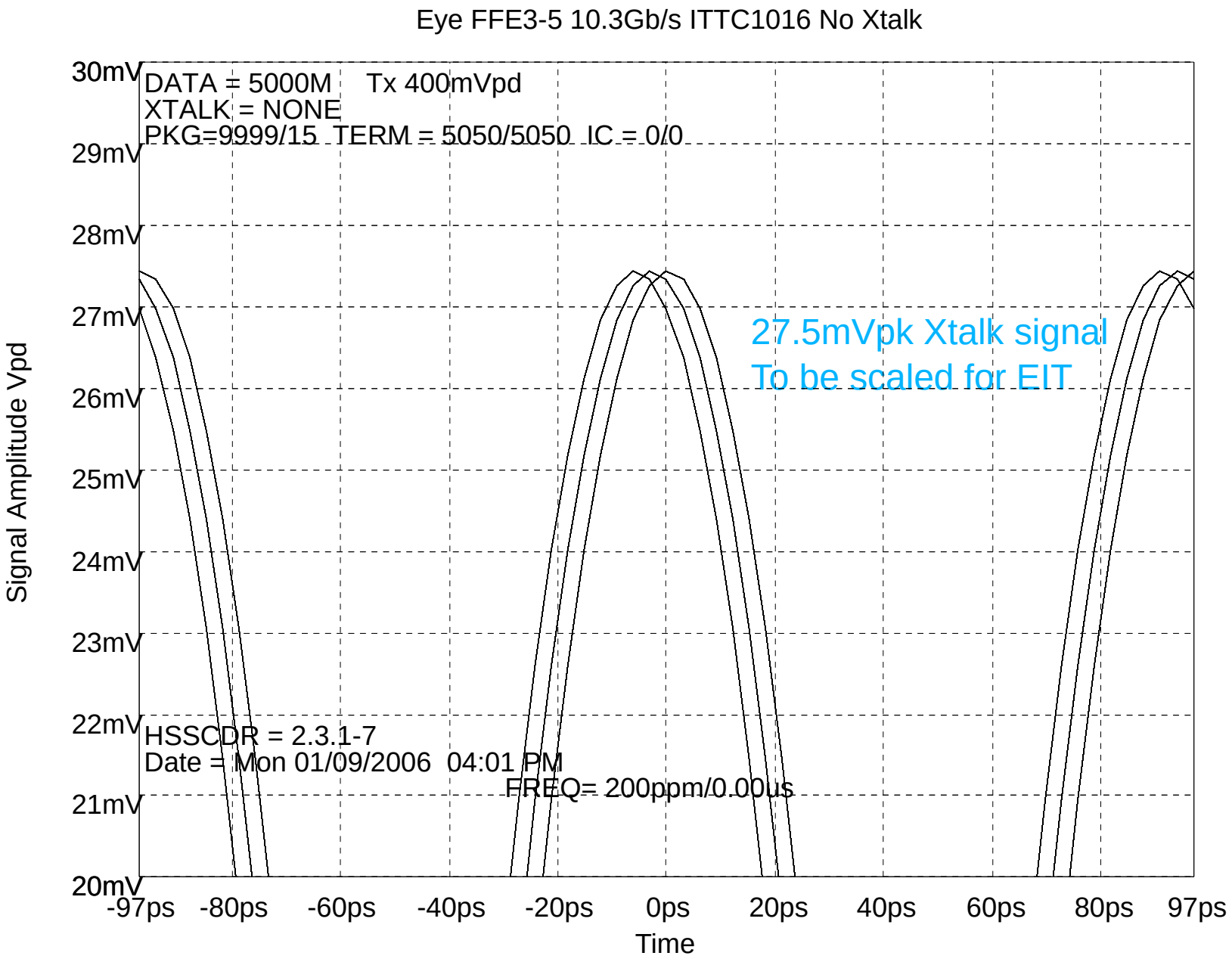
Repeat above with additional Xtalk data patterns to evaluate lower frequencies

- 1100 (2.5GHz)
- 111000 (3.3 GHz)
- .....
- Due to time limitations, results only generated for max frequency (5GHz)

Resulting Xtalk Signal using Agilent1016 Channel



Expanded Eye



Simulation Results

Agilent ITTC1016 channel (%eye opening @ BER 10^{-12})	DCD (UIpp)		
	0	3.13%	6.25%
Through channel only	7.2	5.1	0
5mV EIT	6.1	4.8	0
10mV EIT	0.1	0.2	0
15mV EIT	0	0	0

Agilent TC measured channel (%eye opening @ BER 10^{-12}	DCD (UIpp)		
	0	3.13%	6.25%
Through channel only	17.0	14.4	0
5mV EIT	13.2	11.1	0
10mV EIT	5.4	1.1	0
15mV EIT	0.5	0.01	0

Conclusion

Current channel model pushes individual attributes to the limit

- Attenuation
- Xtalk
- Ripple
- etc.

DCD is a significant performance detractor on highly attenuated channels

- Tx DCD needs to be limited
- Recommend using same values specified by CEI
  - Max 0.05UIpp Tx DCD
  - This is a component of total DJ

There is not margin in the definition of the test channel to drive all attributes to the limit

- Recommend dropping the test channel definition by a set amount (TBD, but on order of 3dB) to enable realistic interference testing
- Else, only test receiver operation against max channel attenuation without any interference (i.e. EIT baseline for KR = 0).

Likewise, there is not margin in the interconnect reference model to drive all attributes to the limit

- There should be a note in Annex69B advising that limits are defined for individual attributes, and that driving all attributes to their worst case limits can exceed the intended bounds of the standard.
- Also include a note in Annex69B stating that system level simulation to evaluate the combined impact of the individual attributes is highly recommended.