

# **Presentation to IEEE P802.3ap Backplane Ethernet Task Force Channel ad-hoc Working Session**

**Title:** EIT Simulation Results

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# Simulation setup for EIT



## Simulation model base setup

- Configuration
  - Launch amplitude set to minimum
  - Transmitter DJ set to give total TJ = 0.28UI
  - Transmitter RJ set to maximum
  - Tx/Rx termination set to nominal (ideal)
  - Receiver DJ
  - Receiver RJ set to maximum
  - Data rate
  - Receiver offset
  - Data pattern (through channel)
  - Random noise
  - Minimum latch overdrive
  - Package
  - Simulation time
- NRZ FFE3/DFE5  
800 mVpp  
0.13 UIpp  
0.0107 UIrms (0.15UIpp @  $10^{-12}$  BER)  
5050/5050 ohms  
0.10 UIpp  
0.0107 UIrms (0.15UIpp @  $10^{-12}$  BER)  
10.3 Gbps  
200 ppm  
PRBS23  
1.46mV rms  
10mV  
Spec\_RL\_cap\_like  
10M bits

# Simulation Cases

## EIT Simulations

- ▶ Avago ITTC\_20dB\_returnloss through channel
  - Also replicated as xtalk channel and calibrated for known amount of interference
- ▶ Conditions (in addition to base setup on previous page)
  - PRBS23 data pattern
  - 1010 xtalk pattern
  - Xtalk scaled to apply varying interference levels at receiver input

## Reference Channel Comparison Simulations

- ▶ Channels Simulated:
  - Tyco Case 7
    - Tyco Xtalk channels: 7N1, 7N2, 7F
  - m\_80\_ripple\_90
    - Tyco Xtalk channels: 7N1, 7N2, 7F
  - m\_60\_ripple\_98
    - Molex Xtalk channels: INnext 23/33/43/53, INfext 23/43
- ▶ Conditions (in addition to base setup on previous page)
  - PRBS23 data pattern
  - PRBS23 xtalk pattern
  - No xtalk scaling (1x factor)

## Results run with varying % of DCD

- ▶ 0%, 3.13%, 4.67, 6.25% Ulpp DCD
- ▶ Amount of Tx DJ (SJ) appropriately reduced by % DCD to keep a constant TJ

# Simulation Results - EIT with ITTC20dB



## Upper range of EIT baseline using ITTC20dB\_returnloss channel:

- ▶ 25 to 30 mV with no Tx DCD during test
- ▶ 15 to 20 mV with 5% Tx DCD during test

| ITTC20dB RL channel<br>(%eye opening @ BER $10^{-12}$ ) | DCD (UIpp) |       |       |       |
|---|------------|-------|-------|-------|
|   | 0          | 3.13% | 4.69% | 6.25% |
| Through channel only                                    | 27.0       | 26.2  | 17.8  | 10.2  |
| 10mV EIT  | 18.8       | 15.8  | 10.0  | 0     |
| 15mV EIT  | 13.0       | 12.1  | 5.1   | 0     |
| 20mV EIT  | 9.2        | 6.6   | 0     | 0     |
| 25mV EIT  | 5.7        | 1.3   | 0     | 0     |
| 30mV EIT  | 1.3        | 0     | 0     | 0     |

| ITTC20dB RL channel<br>(mVpk opening @ BER $10^{-12}$ ) | DCD (UIpp) |       |       |       |
|---|------------|-------|-------|-------|
|   | 0          | 3.13% | 4.69% | 6.25% |
| Through channel only                                    | 47.4       | 38.0  | 24.7  | 12.2  |
| 10mV EIT  | 34.5       | 22.4  | 13.0  | 0     |
| 15mV EIT  | 25.0       | 16.8  | 7.1   | 0     |
| 20mV EIT  | 16.8       | 10.3  | 0.4   | 0     |
| 25mV EIT  | 10.1       | 2.3   | 0     | 0     |
| 30mV EIT  | 2.9        | 0     | 0     | 0     |

# Simulation Results - EIT with ITTC20dB

## Impact of 5% DCD is approximately equivalent to 10mV EIT!

- ▶ This is a significant portion of EIT budget
- ▶ Procedure should allow testing with DCD to credit vendors with receiver designs mitigating it's effects

| ITTC20dB RL channel<br>(%eye opening @ BER 10 <sup>-12</sup> ) | DCD (UIpp) |       |       |       |
|--|------------|-------|-------|-------|
|  | 0          | 3.13% | 4.69% | 6.25% |
| Through channel only   | 27.0       | 26.2  | 17.8  | 10.2  |
| 10mV EIT   | 18.8       | 15.8  | 10.0  | 0     |
| 15mV EIT   | 13.0       | 12.1  | 5.1   | 0     |
| 20mV EIT   | 9.2        | 6.6   | 0     | 0     |
| 25mV EIT   | 5.7        | 1.3   | 0     | 0     |
| 30mV EIT   | 1.3        | 0     | 0     | 0     |

| ITTC20dB RL channel<br>(mVpk opening @ BER 10 <sup>-12</sup> ) | DCD (UIpp) |       |       |       |
|--|------------|-------|-------|-------|
|  | 0          | 3.13% | 4.69% | 6.25% |
| Through channel only   | 47.4       | 38.0  | 24.7  | 12.2  |
| 10mV EIT   | 34.5       | 22.4  | 13.0  | 0     |
| 15mV EIT   | 25.0       | 16.8  | 7.1   | 0     |
| 20mV EIT   | 16.8       | 10.3  | 0.4   | 0     |
| 25mV EIT   | 10.1       | 2.3   | 0     | 0     |
| 30mV EIT   | 2.9        | 0     | 0     | 0     |

# Simulation Results - Reference Channels



## EIT baseline from reference channel simulations:

- ▶ Tyco Case7 is well within a 15mV EIT baseline
- ▶ M60Ripple98 is at border of 15mV EIT baseline
- ▶ M82Ripple90 breaks it....
  - in range of 25 to 30mV EIT

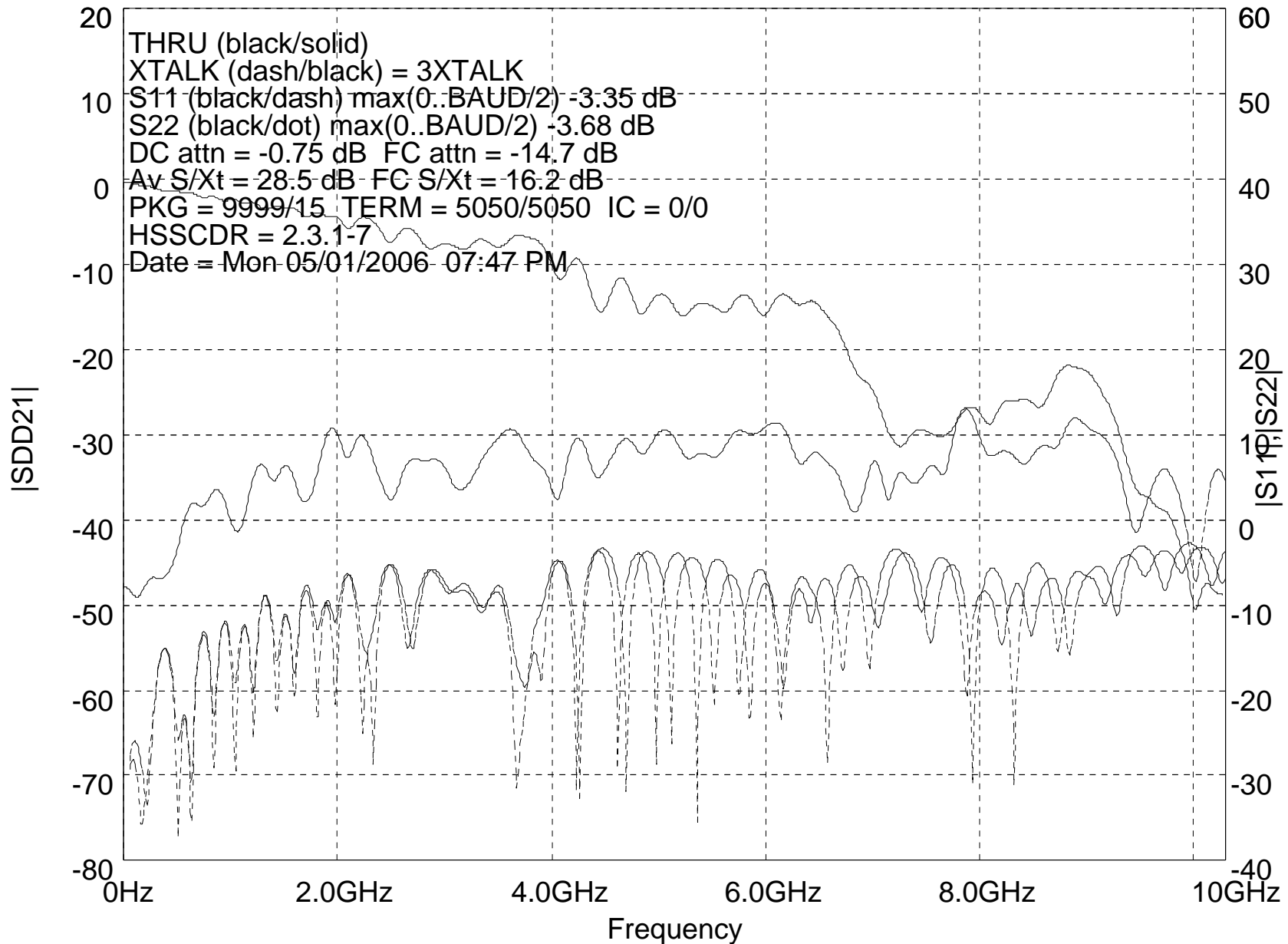
|   | DCD (UIpp) |       |       |       |
|---|------------|-------|-------|-------|
| (%eye opening @ BER 10 <sup>-12</sup> ) | 0          | 3.13% | 4.69% | 6.25% |
| ITTC20dB - 15mV EIT                     | 13.0       | 12.1  | 5.1   | 0     |
| Tyco Case7                              | 10.8       | 12.0  | 12.7  | 12.1  |
| M60Ripple98                             | 11.9       | 9.3   | 4.6   | 0     |
| M82Ripple90                             | 3.0        | 0     | 0     | 0     |

|   | DCD (UIpp) |       |       |       |
|---|------------|-------|-------|-------|
| (mVpk opening @ BER 10 <sup>-12</sup> ) | 0          | 3.13% | 4.69% | 6.25% |
| ITTC20dB - 15mV EIT                     | 25.0       | 16.8  | 7.1   | 0     |
| Tyco Case7                              | 26.2       | 22.1  | 28.0  | 24.9  |
| M60Ripple98                             | 23.5       | 17.5  | 7.2   | 0.2   |
| M82Ripple90                             | 4.0        | 0     | 0     | 0     |

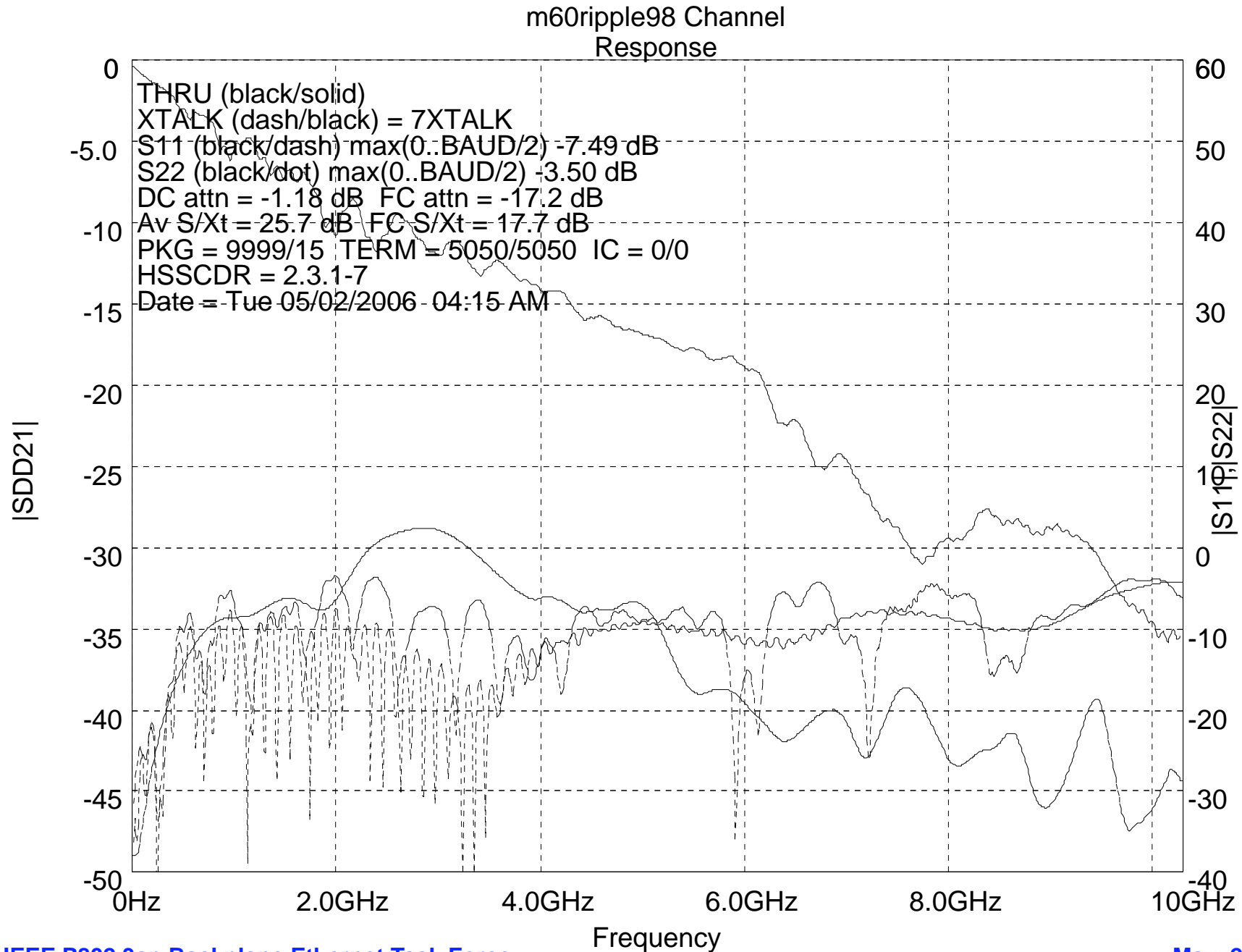
# Tyco Case7 Channel Response



Tyco\_Case7 Channel Response



# M60Ripple98 Channel Response

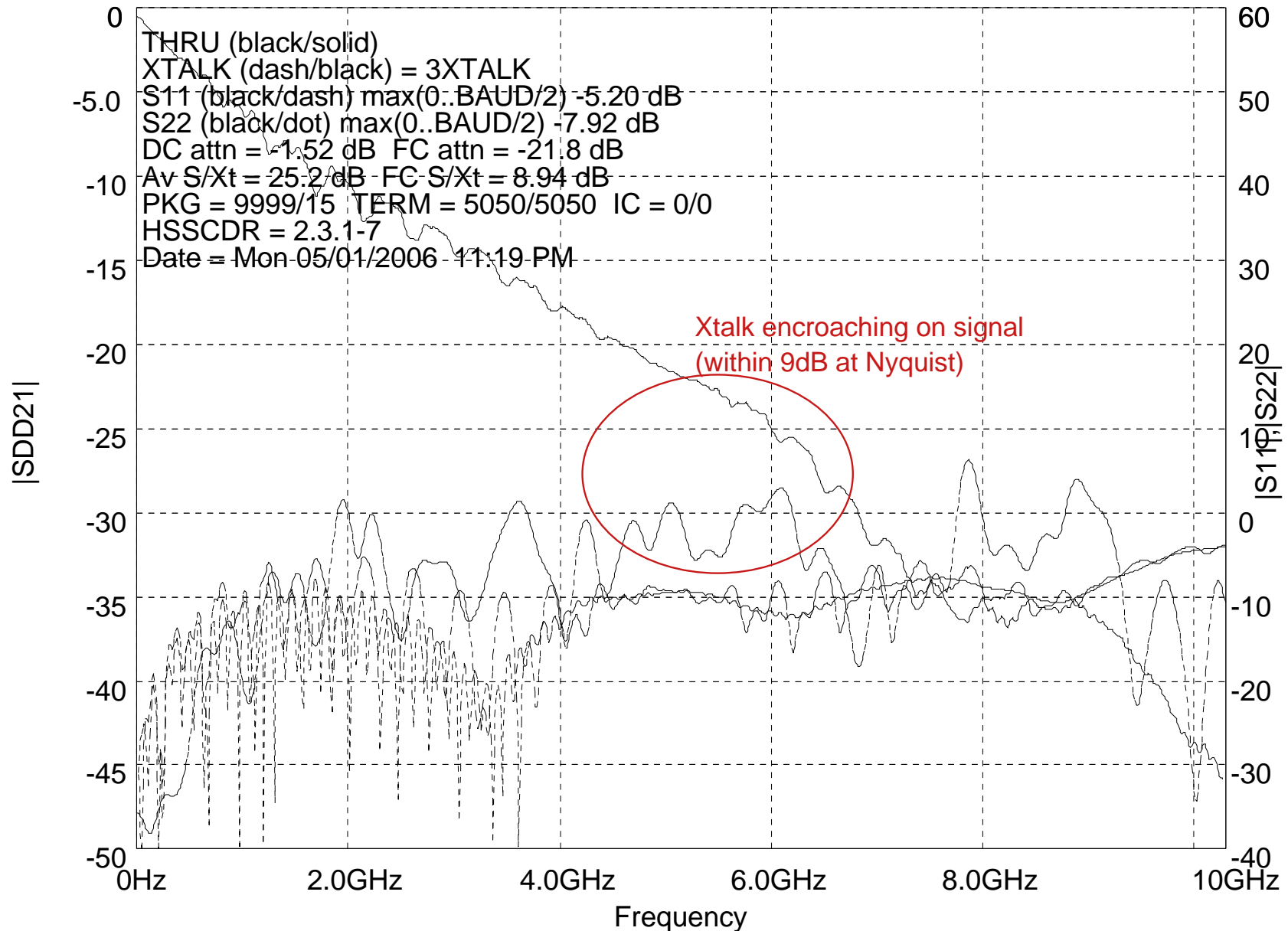




# M82Ripple90 Channel Response



m82ripple90 Channel Response



# Conclusion

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## EIT test results are highly dependent on Tx DCD

- ▶ Approximately 10mV EIT impact when going from 0% DCD to 5% DCD
  - This is a significant portion of the expected EIT budget

## Some receiver designs can mitigate the impact of DCD

- ▶ The EIT procedure should allow these designs to test with the additional function
- ▶ Recommend defining a baseline value for a test with 0% DCD as well as 5% DCD

## Recommended EIT Baseline value for KR:

- ▶ Using results from Tyco Case7 and M60Ripple 98 reference channels:
  - An EIT value of 26mV for tests with no DCD
  - An EIT value of 16mV for tests with 5% DCD

## Channel model considerations:

- ▶ Results from M82Ripple90 reference channel are well outside recommended EIT baseline values
- ▶ A possible cause is signal to Xtalk ratio significantly decreasing near Nyquist frequency
  - May want to consider additional restrictions in this area