25% Precomp Cutback Level Proposal

SCSI Parallel Working Group
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Nashua, NH

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Seagate Technology
Data Collected

- Test Setup
- First Pulse
- Eye Pattern
- Statistical Data Collection
- Proposed Changes
- Conclusions
Test Setup
Test Setup
Test Setup
Data

- Many environments
  - 87 Cases of Backplanes with various supplied cables
    - 100% required no precomp or AAF
    - 4% had increased margin with 25% cutback
    - 0% had increased margin with 50% cutback
  - First Pulse data – Graph showing histogram of amount of precomp required
  - Statistical data – Graphs showing # of standard deviations from threshold
1st Pulse- Point to Point, 25m Round cable w/o Precomp

Tek Run: 5.00GS/s Sample

Ch2 200mVΩ M 20.0ns Width Ch1

1st Pulse - Point to Point, 25m Round cable, with Precomp

Tek Run: 5.00 GS/s

24 Oct 2000
15:33:42

200mVΩ  M 20.0ns  Width  Ch 1

Ch 2

Ch 3

T10/01 – 136r0

SCSI T10/01-136r0 8
A.B.M. 4/19/01

Seagate
Information the way you want it.
Eye Diagram - Point to Point, 25m Round Cable w/o Precomp
Eye Diagram - Point to Point, 25m Round Cable with Precomp
Statistical Data Collection
Timing Distribution - 80mv

Descriptive Statistics

Variable: -2.76

Anderson-Darling Normality Test
A-Squared: 22.049
P-Value: 0.000

Mean: -3.01047
StDev: 0.21738
Variance: 4.73E-02
Skewness: -1.4E-01
Kurtosis: -6.9E-01
N: 4989

Minimum: -3.64000
1st Quartile: -3.16000
Median: -3.00000
3rd Quartile: -2.84000
Maximum: -2.48000

95% Confidence Interval for Mean
-3.01650
95% Confidence Interval for Median
-3.01047
95% Confidence Interval for Sigma
0.21320
95% Confidence Interval for Median
-3.00000
### Timing Distribution - 130mv

#### Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-2.89924</td>
</tr>
<tr>
<td>StDev</td>
<td>0.21751</td>
</tr>
<tr>
<td>Variance</td>
<td>4.73E-02</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.2E-01</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-7.1E-01</td>
</tr>
<tr>
<td>N</td>
<td>4989</td>
</tr>
<tr>
<td>Minimum</td>
<td>-3.56000</td>
</tr>
<tr>
<td>1st Quartile</td>
<td>-3.08000</td>
</tr>
<tr>
<td>Median</td>
<td>-2.88000</td>
</tr>
<tr>
<td>3rd Quartile</td>
<td>-2.72000</td>
</tr>
<tr>
<td>Maximum</td>
<td>-2.36000</td>
</tr>
<tr>
<td>Minimum</td>
<td>-3.56000</td>
</tr>
<tr>
<td>1st Quartile</td>
<td>-3.08000</td>
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<tr>
<td>Median</td>
<td>-2.88000</td>
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<tr>
<td>3rd Quartile</td>
<td>-2.72000</td>
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<tr>
<td>Maximum</td>
<td>-2.36000</td>
</tr>
<tr>
<td>95% Confidence Interval for Mu</td>
<td>-2.90528, -2.89321</td>
</tr>
<tr>
<td>95% Confidence Interval for Median</td>
<td>0.21332, 0.22186</td>
</tr>
<tr>
<td>95% Confidence Interval for Sigma</td>
<td>-2.92000, -2.88000</td>
</tr>
</tbody>
</table>

#### Anderson-Darling Normality Test
- A-Squared: 22.161
- P-Value: 0.000
Goal is 6 sigma

- Sigma (standard deviation) is a measure of the ‘narrowness’ of the distribution
- 6 Sigma is 3+ failures in 1,000,000,000
Specification Limit and 80 mv Distribution

25% Cutback

<table>
<thead>
<tr>
<th>Mean</th>
<th>-3.01047</th>
</tr>
</thead>
<tbody>
<tr>
<td>StDev</td>
<td>0.21738</td>
</tr>
<tr>
<td>Variance</td>
<td>4.73E-02</td>
</tr>
</tbody>
</table>

Spec limit = -1.5 nsec

\[-3.01047 \ - (-1.5) = -1.51047\]

\[1.51047/0.21738 = 6.95 \text{ sigma}\]
**Specification Limit and 130 mv Distribution**

Spec limit = -1.0 nsec

\[-2.89924 - (-1.0) = -1.89924\]

\[1.89924 / 0.21751 = 8.73 \text{ sigma}\]

25% Cutback

*Mean*

\[-2.89924\]

*StDev*

\[0.21751\]

*Variance*

\[4.73 \times 10^{-2}\]
50% Cutback

Spec limit = -1.5 nsec

\[-3.21257 - (-1.5) = -1.71257\]

\[1.71257 / 0.26086 = 6.57 \text{ sigma (Vs. 6.95)}\]
Specification Limit and 130 mv Distribution

50% Cutback

Spec limit = -1.0 nsec

-3.07909 - (-1.0) = -2.07909

2.07909 / 0.26101 = 7.97 sigma (Vs. 8.73)
Engineering Judgment

- Given a distribution an engineer picks the value which best satisfies the broadest range of cases.
- Of all the cases measured which are actual systems being shipped, none could be found that requires 50% cutback.
- Let us not be myopic and set a level for all cases to that required by one which appears by supposition only, at the detriment of the 99+% of the cases.
Other Issues to Consider

- Power is an issue – Power (heat) relates to reliability
- With 50% cutback, the primary driver is at an extremely high level – even for minimum drive strength.
- Should we risk lowering reliability for the sake of covering a academic case? – NO!
How much ISI is compensated for?

- Table 37 - SCSI Fast-160 timing budget template states:
  “ISI Compensation | 2,0 ns | Assumes 50% of ISI is compensated”
- 50% cutback compensates for 100+% of the ISI
25% Cutback Proposal

- Change Paragraph A.2.1 Driver requirements overview in Annex A to read:

“If precompensation is enabled, the weak driver amplitude shall be a minimum of 50 60% to a maximum of 66 75% of the strong driver amplitude after the first bit of a series of adjacent ones or adjacent zeros.”
Proposal (cont.)

- Change NOTE 49 to read:

- “If a weak driver is driving with the minimum amplitude specified in table A.2, then the 370 mV weak driver translates to a strong driver of 580 493 mV for the 66 75 % case ranging up to 740 616 mV for the 50 60 % case.”
Conclusion

- 25% cutback gives superior performance to 50% cutback
- 50% cutback increases power
- One would be better off (if more power is acceptable) to use 25% cutback and increase average voltage. This increases the mean but keeps standard deviation the same (i.e. increases # of sigmas from mean to specification limit)