HPM-5 Performance Testing

Test 234  JF Sawdy 7/3/02

Samples:
Double-ended 2mm cable assemblies: 3, 6 and 8 meters end-to-end, using Meritec’s 700219-01 28 awg twinax cable and Meritec’s HPM-5 connectors wired GSSGSSG.

Test Equipment and Software:
Tektronix CSA-803 Digital Sampling Oscilloscope with SD-24 TDR /Sampling Heads
Microwave Logic Gigabert-660TX 700MHz Eye Pattern Generator (used to verify 622MHz eye diagram extractions)
Hewlett Packard HP-8753C, 300 KHz to 6 GHz Network Analyzer
Anzac Differential Baluns, 2Mhz to 2GHz
TDA Systems’ IConnectTM Version 2.0.3 interconnect and lossy cable characterization software
2mm 5+2 AMP male connectors
0.085” dia. semirigid 50 ohm coax “probes”
Meritec’s Test Board #1159-00102
Flexible 50 ohm coax interface cables
Differential Eye Diagrams at 622Mhz, 1.2 Ghz and 2.4 GHz
extracted from TDR measurements using IConnect™ software

3 Meter Assembly (unequalized)

622MHz

1.2GHz

2.4GHz
Differential Eye Diagrams at 622Mhz, 1.2 Ghz and 2.4 GHz extracted from TDR measurements using IConnect™ software

6 Meter Assembly (unequalized)

622MHz

1.2GHz

2.4GHz

10 Meter Assembly (unequalized)

622MHz

1.2GHz

2.4GHz
Attenuation through cable (S21)
Measured from 500MHz to 3GHz
Smoothing set at 20% (500Mhz)
Used differential baluns rated to maximum frequency of 2 GHz (results indicate baluns are valid to 3GHz)
Fixture and connectors were de-embedded; results reflect cable attenuation

Summary of results:

<table>
<thead>
<tr>
<th>Frequency</th>
<th>3 meters</th>
<th>6 meters</th>
<th>10 meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 MHz</td>
<td>-2.65</td>
<td>-5.89</td>
<td>-10.17</td>
</tr>
<tr>
<td>1GHz</td>
<td>-3.74</td>
<td>-8.36</td>
<td>-14.36</td>
</tr>
<tr>
<td>2GHz</td>
<td>-5.52</td>
<td>-12.04</td>
<td>-20.77</td>
</tr>
<tr>
<td>3Ghz</td>
<td>-6.96</td>
<td>-15.18</td>
<td>-26.02</td>
</tr>
</tbody>
</table>

28 awg Attenuation

![Graph showing 28 awg attenuation over frequency (MHz)]
Attenuation through cable (S21) (continued)

Network Analyzer Traces

<table>
<thead>
<tr>
<th>CH1 S</th>
<th>log MAG</th>
<th>3 dB/</th>
<th>REF 0 dB</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>S21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cor

SMOOTHING APERTURE

20 % SPAN

500 MHz

<table>
<thead>
<tr>
<th></th>
<th>START 500.000 000 MHz</th>
<th>STOP 3 000.000 000 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>500.000 000 MHz</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1 GHz</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2 GHz</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3 GHz</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1 _t: -2.6519 dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2 _t: -3.7414 dB</td>
</tr>
<tr>
<td>3</td>
<td>3 _t: -5.5237 dB</td>
</tr>
<tr>
<td>4</td>
<td>4 _t: -6.9565 dB</td>
</tr>
</tbody>
</table>

Measured on 3 meter cable
### Attenuation through cable (S21) (continued)

**Network Analyzer Traces**

<table>
<thead>
<tr>
<th>CH1</th>
<th>S21</th>
<th>log MAG</th>
<th>3 dB/</th>
<th>REF 0 dB</th>
<th>500.000 000 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (-5.8851) dB</td>
</tr>
<tr>
<td>CH1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 (-8.3557) dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 (-12.038) dB</td>
</tr>
<tr>
<td>CH1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 (-15.176) dB</td>
</tr>
</tbody>
</table>

**SMOOTHING APERTURE**

- **20% SPAN**
  - 500 MHz
  - 2 GHz
  - 2 GHz
  - 3 GHz

Measured on 6 meter cable.
Attenuation through cable (S21) (continued)

Network Analyzer Traces

Measured on 10 meter cable
### Risetime Degradation

Risetime measured at 20-80%  
Fixture – 71 psec (black trace)  
5 inch assy – 88 psec (red trace)  
3 meter assy – 550 psec (purple)  
6 meter assy – 1400 psec (black)  
10 meter assy – 3400 psec (green)

Risetime degradation = Measured risetime minus fixture risetime  
5 inch assy – 17 psec  
3 meter assy – 480 psec  
6 meter assy – 1330 psec  
10 meter assy – 3330 psec

<table>
<thead>
<tr>
<th></th>
<th>Measurement</th>
<th>Distal</th>
<th>Proximal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rise</td>
<td>70.04 psec</td>
<td>500 ns</td>
<td>42.6 ns</td>
</tr>
</tbody>
</table>

**Legend:**  
- Fix Reference
- 5 inch assy
- 3 meter assy
- 6 meter assy
- 10 meter assy

**Figure:**

- Graph showing risetime degradation across different lengths.
- X-axis: Length (meters)
- Y-axis: Rise time (psec)
- Data points for each assembly length.
Skew

Traces show skew as measured on 3 meter assembly

Near end - purple and green
Far end - red and black

3 meter assembly – 84 psec
6 meter assembly – 110 psec
10 meter assembly – 220 psec
Average –
21.8 psec/meter (6.7 psec/foot)
Electrical Length

Traces show electrical length as measured on 3 meter assembly

Near end - purple and green

Far end - red and black

3 meter assembly – 13.296 nsec
6 meter assembly – 26.518 nsec
10 meter assembly – 44.320 nsec
Average –
4.43 nsec/meter (1.36 nsec/foot)
Differential Impedance at Connector

Differential impedance through header (including via) and connector – left to right (risetime filtered to 200 psec)
Minimum – 96 ohms
Maximum – 109.6 ohms
Appendix A
Compare TDA Extracted Eyes to Actual Eye Measurements at 622MHz
(Measured results include effects of test pc board shown below, whereas extracted results do not include test PC board)

Test PC Board

<table>
<thead>
<tr>
<th>Measured</th>
<th>Extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current 1: 195.5BmV</td>
<td>Current 1: 195.5BmV</td>
</tr>
<tr>
<td>Horizontal 2: -198.5BmV</td>
<td>Horizontal 2: -198.5BmV</td>
</tr>
<tr>
<td>Bar 3: -300.0BmV</td>
<td>Bar 3: -300.0BmV</td>
</tr>
<tr>
<td>300ns/div</td>
<td>300ns/div</td>
</tr>
</tbody>
</table>

3 Meter Assembly

<table>
<thead>
<tr>
<th>Measured</th>
<th>Extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current 1: 168.5BmV</td>
<td>Current 1: 168.5BmV</td>
</tr>
<tr>
<td>Horizontal 2: -155.0BmV</td>
<td>Horizontal 2: -155.0BmV</td>
</tr>
<tr>
<td>Bar 3: -315.0BmV</td>
<td>Bar 3: -315.0BmV</td>
</tr>
<tr>
<td>300ns/div</td>
<td>300ns/div</td>
</tr>
</tbody>
</table>

Extracted
Appendix A (continued)

6 Meter Assembly

Measured

Extracted

10 Meter Assembly

Measured

Extracted