ECR #: 12
Title: Trace Lengths and Skew Timings
Release Date: Feb. 10, 1997
Impact: Clarification
Spec Version: A.G.P. 1.0

Summary: This is a clarification of the specification timing allowances for skew. Addition of recommended line lengths for the AGP traces included on the baseboard and add-in cards.

Background: These recommendations are based on the sensitivity analysis simulations which were performed during the development of the AGP interface spec. These analyses included the impact of several interconnect effects, including (but not limited to) impedance variations, impedance discontinuities, loading mismatches, and trace-length mismatches

Change Current Specification as shown:

4.3.5.3. Signal Routing and Layout

A.G.P. signals must be carefully routed on the motherboard to meet the timing and signal quality requirements of this interface specification. The following are some general guidelines that should be followed. Trace lengths included in this section are guidelines only. It is recommended that the board designer simulate the board routing to verify that the specifications are met for flight times and skews due to trace mismatch and crosstalk.

The total flight time allowed for the A.G.P. bus is 3ns. The timing budget for the components of the flight path is identified in table 4-3. The motherboard prop delay budget of 2.15 ns restricts the total trace length on the motherboard to 9 inches or less, depending on trace spacing. See the A.G.P. Design Guide for more details.

The trace lengths for signals within a group must be matched to meet the total mismatch requirement given in **Table** 4-8, of 0.5 ns. This means that the traces within a group on the baseboard must be matched to their respective strobe trace, so that the length of each data trace is either equal in length to the strobe trace or up to 0.5 inches shorter than the strobe trace (The strobe should always be the longest baseboard trace in each group).

Section 4.3.5.6 should be moved to just after 4.3.5.3:

4.3.5.6. Crosstalk Consideration

For 66 and 133 MT/s modes, noise due to crosstalk must be carefully controlled to a minimum. Crosstalk is the key cause of timing skews and is the largest part of the tRMATCH skew parameter. Refer to the A.G.P. Design Guide for typical values.

4.4.3.2. Signal Routing and Layout

A.G.P. signals must be carefully routed on the graphics card to meet the timing and signal quality requirements of this interface specification. The following are some general guidelines that should be followed. Trace lengths included in this section are guidelines only. It is recommended that the board designer simulate the board routing to verify that the specifications are met for flight times and skews due to trace mismatch and crosstalk.

The total flight time allowed for the A.G.P. bus is 3ns. The timing budget for the components of the flight path is identified in Table 4-7. The add-in card prop delay budget of 0.7 ns restricts the total trace length on the add-in card to be approximately 3 inches.

The trace lengths for signals within a group must be matched to meet the total mismatch requirement given in **Table** 4.10, of 0.2 ns. This means that the traces within a group on the add-in card must be matched to their respective strobe trace, so that the length of each data trace in the group is within ±0.5 inch of the strobe length. Refer to Figure 4-19 for add-in card component placement recommendations.

Table 4-8: Interconnect Delay Summary

Symbol	Parameter	Max[1]	Units	Notes
t_{PROP}	Signal propagation	3	ns	2
$t_{PROP-MB}$	Signal propagation, motherboard	2.15	ns	5,9
$t_{PROP-CONN}$	Signal propagation, connector	.15	ns	9
$t_{PROP--CARD}$	Signal propagation, add-in card	.7	ns	6,9
$t_{TRMATCH}$	Total Trace mismatch between Data and Strobe	.7	ns	3,4,7,8,9
$t_{TRMATCH-MB}$	Trace mismatch, motherboard	.5	ns	4,7,9
$t_{TRMATCH-CARD}$	Trace mismatch, card	.2	ns	4,8,9

NOTES:
1. Signal propagation delays are measured as the difference between the driver driving a 10pf lumped load vs. the driver driving an 80ohm transmission line terminated by a 10pf lumped load.
2. Tprop is the sum of all other propagation delays
3. Ttrmatch is the sum of all trace mismatches.
4. Trace mismatch applies between signal groups and their associated strobes: **AD_STB1**->**AD[31::16]**& **C/BE[3::2]#** **AD_STB0**->**AD[15::0]**& **C/BE[1::0]#** **SB_STB**->**SBA[7::0]** The trace mismatch spec only applies between the strobe and data signals within a group, not between data signal within a group or between groups.
5. Recommended Baseboard trace lengths: 1.0 - 9 (inches) depending on trace spacing.
6. Recommended Add-in card trace lengths: 0.0 - 3.0 (inches).
7. Recommended Baseboard matching between any Data trace and its associated **STB#** trace:
      L_data - L_stb = -0.5 to 0.0 (inches).
8. Recommended Add-in card matching between any Data trace and its associated **STB#** trace:
      L_data - L_stb = -0.5 to +0.5 (inches).
9. Trace length and trace length matching are recommendations based on interconnect simulations including a wide variety of transmission line and loading effects. Designers must ensure through simulation or other techniques that the interconnect timing requirements will still be met.

Table 4-10: Motherboard Interconnect Delays

Symbol	Parameter	Max[1]	Units	Notes
$t_{PROP-MB}$	Signal propagation, motherboard	2.15	ns	3,5
$t_{PROP-CONN}$	Signal propagation, connector	.15	ns	5
$t_{TRMATCH-MB}$	Trace mismatch, motherboard	.5	ns	2,4,5

Notes:
1. Signal propagation delays are measured as the difference between the driver driving a 10pf lumped load vs. the driver driving an 80ohm transmission line terminated by a 10pf lumped load.

2. Trace mismatch applies between signal groups and their associated strobes: **AD_STB1**->**AD[31::16]**& **C/BE[3::2]#** **AD_STB0**->**AD[15::0]**& **C/BE[1::0]#** **SB_STB**->**SBA[7::0]** The trace mismatch spec only applies between the strobe and data signals within a group, not between data signal within a group or between groups.
3. Recommended Baseboard trace lengths: 1.0 - 9 (inches) depending on trace spacing.
4. Recommended Baseboard matching between any Data trace and its associated **STB#** trace:
    L_data - L_stb = -0.5 to 0.0 (inches).
5. Trace length and trace length matching are recommendations based on interconnect simulations including a wide variety of transmission line and loading effects. Designers must ensure through simulation or other techniques that the interconnect timing requirements will still be met.

Table 4-12: Add-in Card Interconnect Delays

Symbol	Parameter	Max[1]	Units	Notes
$t_{PROP--CARD}$	Signal propagation, add-in card	.7	ns	3,5
$t_{TRMATCH-CARD}$	Trace mismatch, card	.2	ns	2,4,5

NOTES:
1. Signal propagation delays are measured as the difference between the driver driving a 10pf lumped load vs. the driver driving an 80ohm transmission line terminated by a 10pf lumped load.
2. Trace mismatch applies between signal groups and their associated strobes: **AD_STB1**->**AD[31::16]**& **C/BE[3::2]#** **AD_STB0**->**AD[15::0]**& **C/BE[1::0]#** **SB_STB**->**SBA[7::0]** The trace mismatch spec only applies between the strobe and data signals within a group, not between data signal within a group or between groups.
3. Recommended Add-in card trace lengths: 0.0 - 3.0 (inches).
4. Recommended Add-in card matching between any Data trace and its associated **STB#** trace:
    L_data - L_stb = -0.5 to +0.5 (inches).
5. Trace length and trace length matching are recommendations based on interconnect simulations including a wide variety of transmission line and loading effects. Designers must ensure through simulation or other techniques that the interconnect timing requirements will still be met.