

## Joy Signal 180pin ZIF Connector

Test 514 Rev. D

Catalin Muntean, Signal Integrity Engineering

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### Purpose

To determine attenuation, crosstalk and impedance profiles for the Joy 180pin ZIF connector and cable assembly using two different board layouts (microstrip and stripline with vias backdrilled). In addition to different board layouts, two different contact pad configurations were used, 50mil centers with one ground between signals and 75mil centers with two grounds between centers.

### Samples Tested

Joy 180pin ZIF cable assembly, 13" long with 30awg coax  
(Joy coax catalog number 014)

Joy 180pin ZIF cable assembly, 6" long with 30awg coax  
(Joy coax catalog number 014)

### Test Results

Connector Impedance: 9 ohm deviation using a risetime of 60 psec (20-80%); 6.2 ohm deviation using a risetime of 500 psec (20-80%) and a 4 ohm deviation using a risetime of 1 nsec (20-80%)

Attenuation: The 13 inch assemblies exhibit 3 dB of loss at 3.8 GHz when attached to the microstrip boards. The stripline boards show increased attenuation over the microstrip boards because the vias are included in the measurements. The 3dB point for the 13 inch assemblies is at 2.4 GHz for the stripline backdrilled top layer vias and at 1.7 GHz for the bottom layer vias. The 3dB point for the 6 inch assemblies is at 4.2 GHz for the microstrip top layer traces and at 2.4 GHz for the top layer stripline traces with backdrilled vias.

Crosstalk (NEXT): The crosstalk is only increased slightly when comparing the stripline boards to the microstrip boards. When comparing top layer traces to bottom layer traces, the vias increase the crosstalk approximately 4 fold. The signal/ground configuration has a significant effect on crosstalk. The double grounds between signals decrease crosstalk by 40 to 60%.

The design of the printed circuit board has a large impact on the electrical performance of the connector. If it is necessary to use vias, their electrical impact is a function of their length, their proximity to other vias and the amount of "stub", the part of the via that is not in the signal path. The impedance of the via is a function of its diameter and its relationship to ground planes and their associated antipads and its stub. These boards were laid out to minimize the effects of stubs. The microstrip board has no stubs and the stripline board has the vias backdrilled to within a few thousandths of the signal trace so as to leave a very small stub. As can be seen in the impedance results, the

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vias can cause large impedance mis-matches. In the microstrip case, on the order of 20 ohms. This can be reduced by better via/antipad design. These impedance “spikes” adversely affect attenuation and return loss. As shown in the crosstalk results, the closeness of aggressor vias can increase the crosstalk 4 fold.

### **Test Boards**

Two types of test boards were used in this testing. They are as follows:

Meritec Microstrip Test Boards PN:1359-01201 labeled M1 and M4

Meritec Stripline Test Boards PN:1359-01203 labeled SB1 and SB4

All boards are 0.187 inches thick. The microstrip boards have 14 mil traces on the top surface where the connector is mounted and on the bottom surface. The bottom surface 14 mil traces go through 0.010 in. dia. vias located at the connector pads to reach the top surface. The stripline boards have 14 mil traces 0.021 in. below the top surface where the connector is mounted and 14 mil traces 0.021 in. above the bottom surface. The stripline traces go through 0.010 in. dia. vias located at the connector pads to reach the top surface. In the case of the stripline traces near the top of the board, the vias are backdrilled to eliminate most of the via stubs (the part of the via that is below the trace).

### **Test Equipment**

Tektronix CSA8200 Digital Sampling Oscilloscope with 80E04 TDR sampling heads

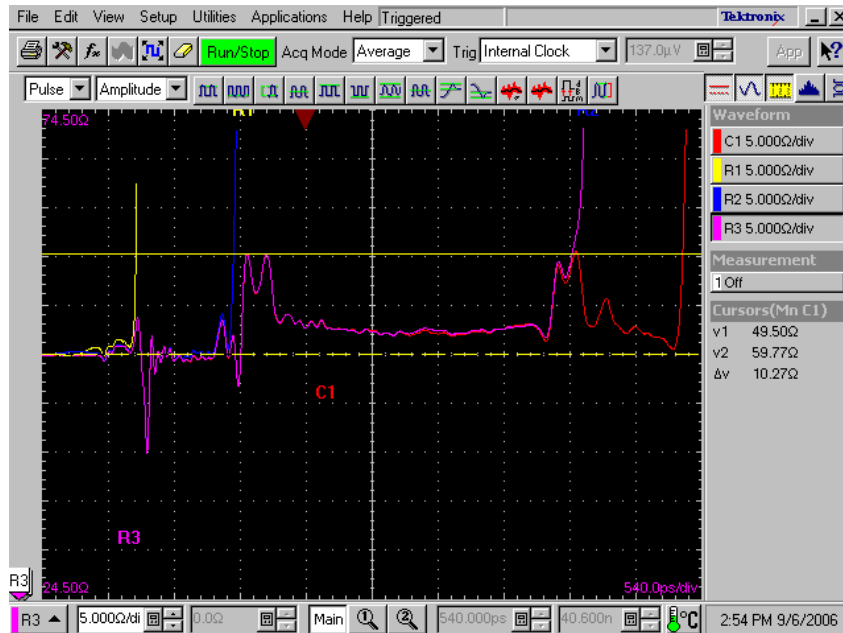
Joy 180pin female ZIF connector PN: 9-904094

atSpeed's *Oculus*<sup>™</sup> for S-parameter extraction from TDR measurements

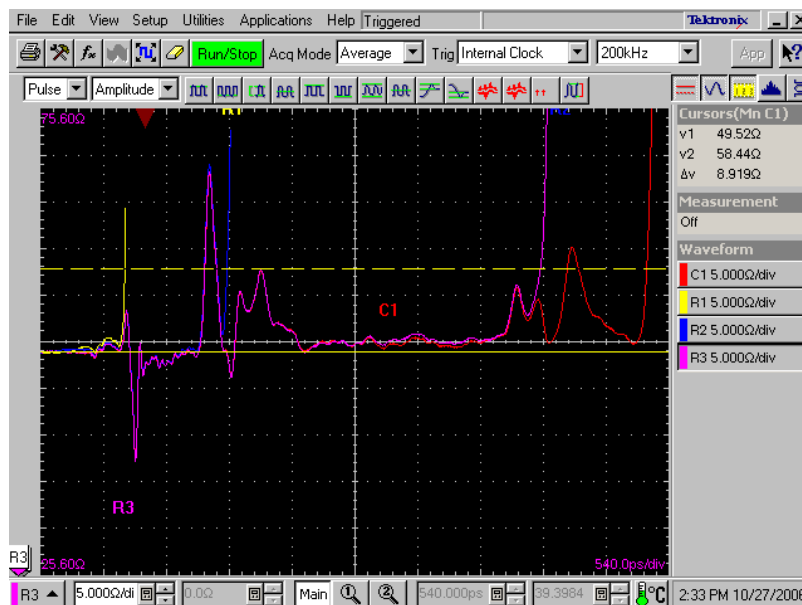
### **Notes**

All of the impedance traces in this report are measured at a risetime of 60 psec (20-80%) using the 75mil spacing, except where noted in Figures 4 and 5. The spacing does not affect the impedance.

### Impedance profiles of 13 inch assembly taken from both the top and bottom of microstrip boards

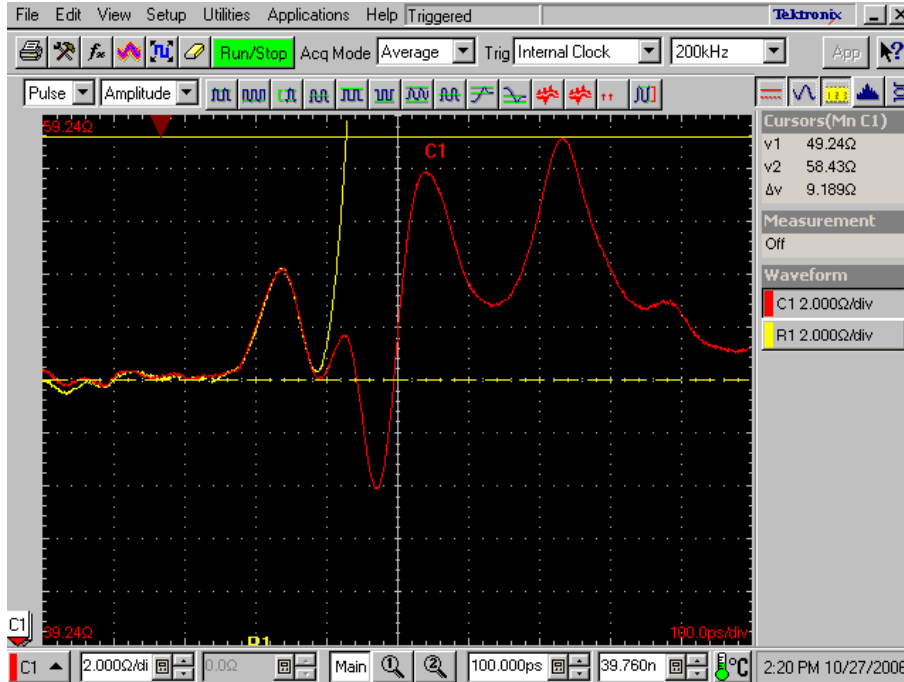


**Figure 1)** Impedance of 13 inch double-ended cable assembly and top trace on microstrip test boards taken from end of test lead to end of SMA on second board. First open (yellow) is the end of test lead. Second open (blue) is the end of female ZIF connector on the first board. Third open (purple) is the end of the cable assembly disconnected from the second test board, and fourth open (red) is the end of the second board (at the SMA)

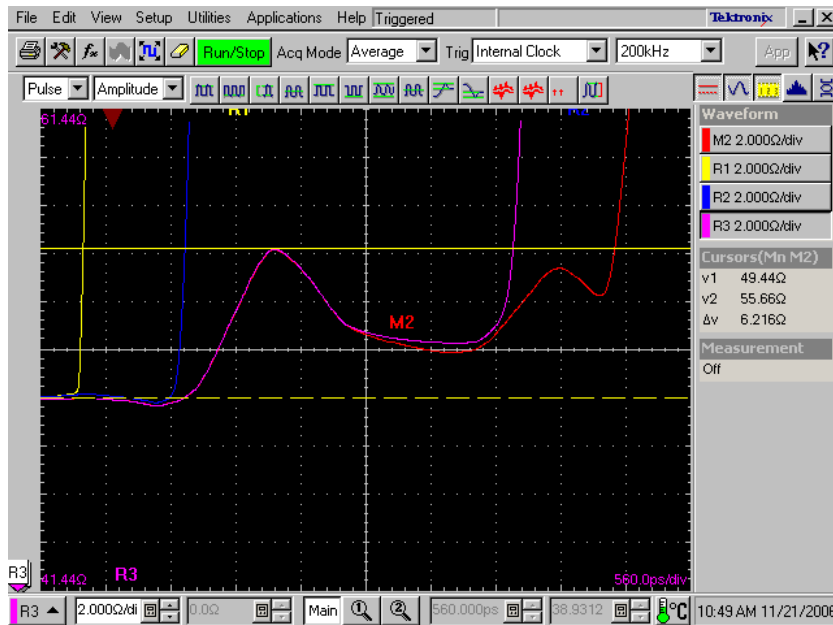


**Figure 2)** Impedance of 13 inch assembly measured from the bottom trace on the microstrip boards (via going through the thickness of the board as can be seen as the positive spike in purple)

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**Figure 3)** Impedance profile of the female-to-male connection on the microstrip board as shown in Figure 1. The yellow (positive 4Ω spike from the ideal 50Ω) is the female connector to board connection. The 9Ω red spikes from the ideal 50Ω are the male connector and the cable connection

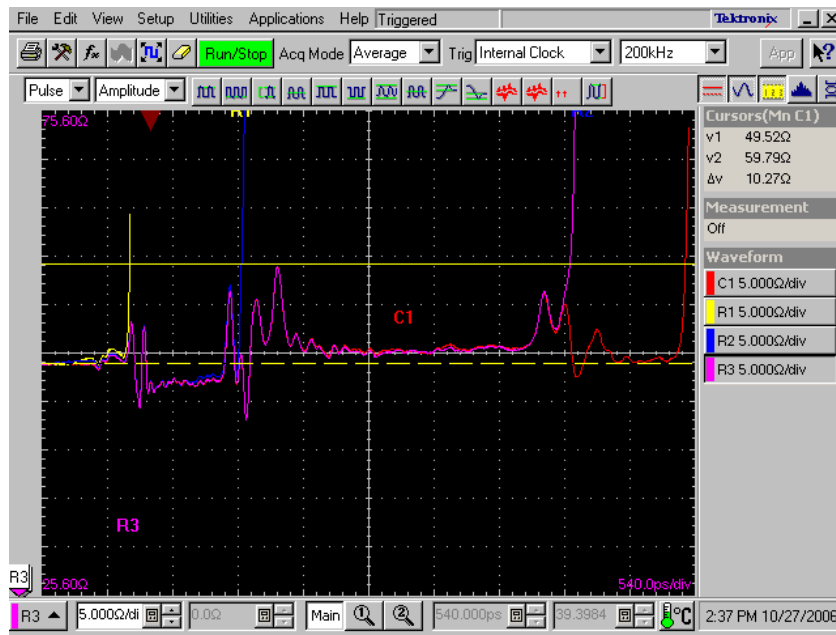


**Figure 4)** Same trace as Figure 1 except with a 500ps risetime (20-80%) filter applied. The vertical scale has been enlarged showing an impedance variation of 6.2 ohms.

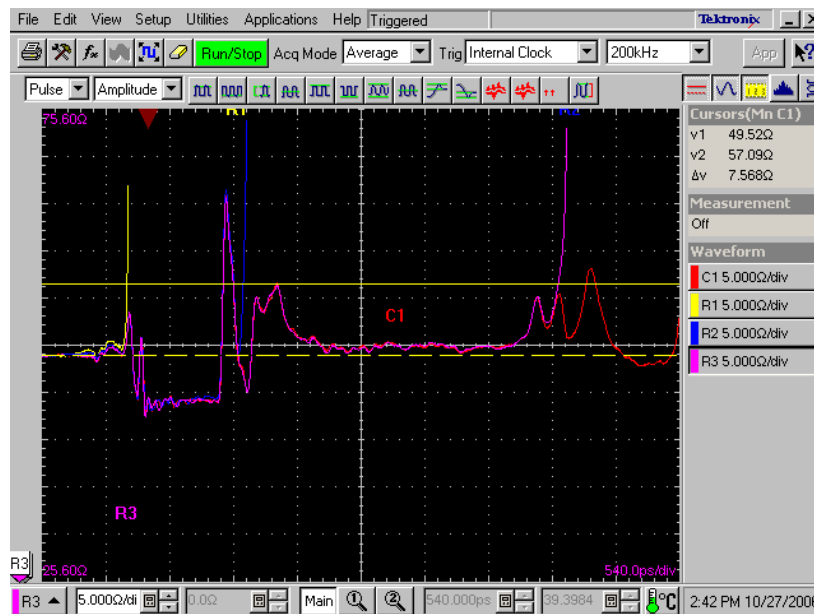


**Figure 5)** Same trace as Figure 1 except with a 1ns risetime (20-80%) filter applied. The vertical scale has been enlarged showing an impedance variation of 4 ohms.

## Impedance profiles of 13 inch assembly taken from both the top and bottom of stripline boards



**Figure 6)** Impedance of 13 inch double-ended cable assembly and top trace on stripline test boards taken from end of test lead to end of SMA on second board. First open (yellow) is the end of test lead. Second open (blue) is the end of female ZIF connector on the first board. Third open (purple) is the end of the cable assembly disconnected from the second test board, and fourth open (red) is the end of the second board (at the SMA)

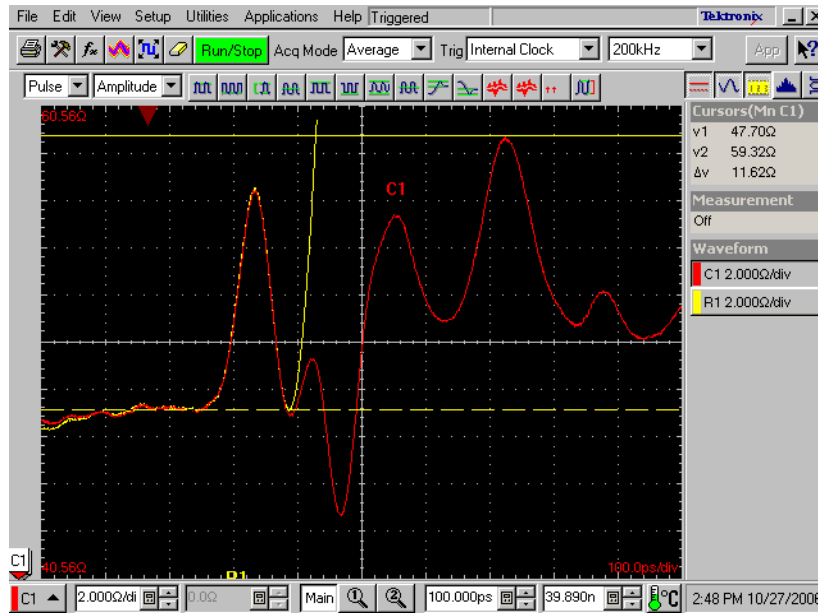


**Figure 7)** Impedance of 13 inch assembly measured from the bottom stripline trace on the board (via going through the thickness of the board as can be seen as the positive spike in purple)

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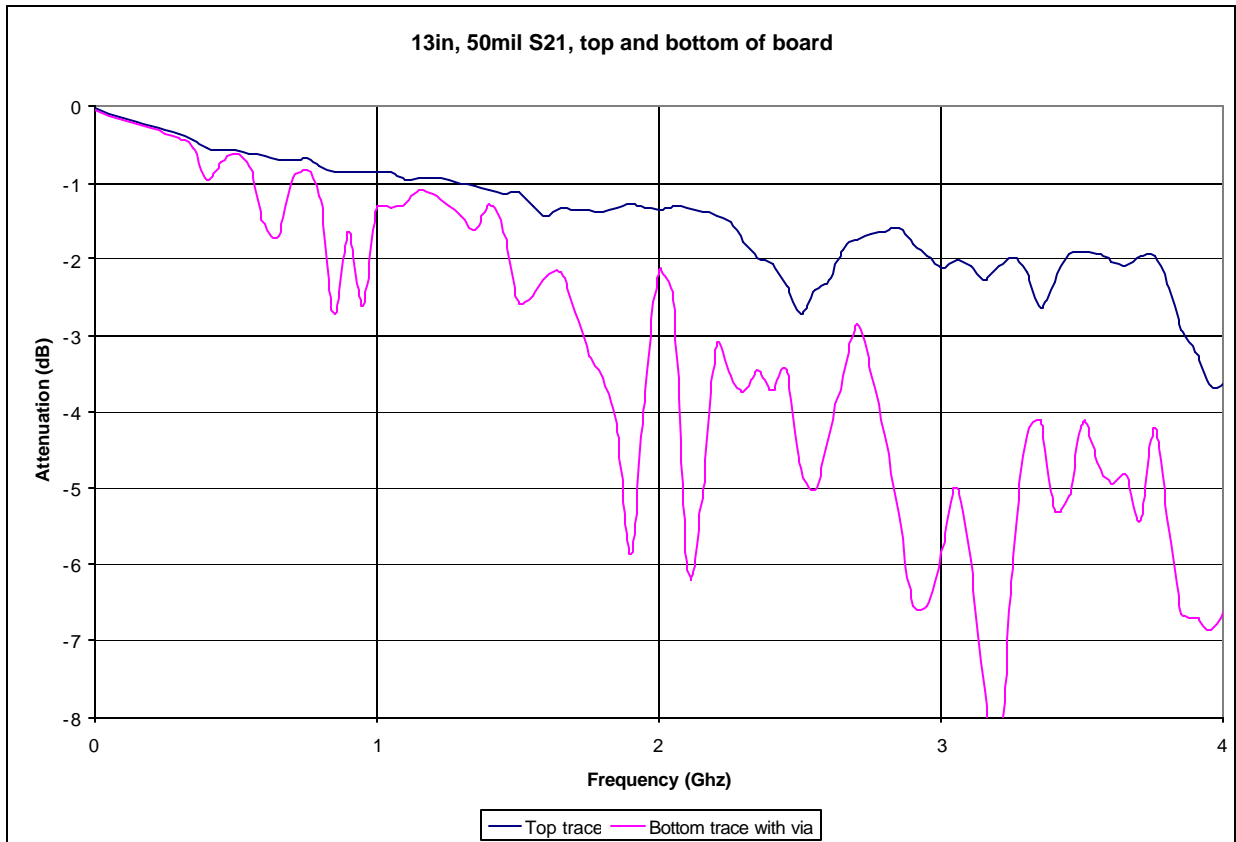
**Figure 8)** Impedance profile of the female-to-male connection on the stripline board top trace as shown in Figure 6. The yellow (positive 8Ω spike from the ideal 50Ω) is the female connector to board connection. The 11.5Ω red spikes from the ideal 50Ω are the male connector and the cable connection

## Impedance profile of 6 inch cable assembly taken on top of microstrip board



**Figure 9)** Impedance of 6 inch double-ended cable assembly and top trace on the microstrip test boards taken from end of test lead to end of SMA on second board. First open (yellow) is the end of test lead. Second open (blue) is the end of female ZIF connector on the first board. Third open (purple) is the end of the cable assembly disconnected from the second test board, and fourth open (red) is the end of the second board (at the SMA)

**13 inch assembly, microstrip boards, 50mil spacing (one ground between signal lines)**



**Figure 10)** Attenuation of the 13 inch assembly with 50mil spacing, traces on both top and bottom of board. Bottom of board includes the via through the 0.187" thickness of the board. 3dB loss point for the top trace (no vias) is at 3.8GHz

**13 inch assembly, microstrip boards, 50mil spacing (one ground between signal lines)**

**Crosstalk**

All results are reported as worst case absolute values

Pulse Risetime (20-80%)	Same side NEXT (%)			Across NEXT (%)		
	1st neighbor	2nd neighbor	3rd neighbor	1st neighbor	2nd neighbor	3rd neighbor
60ps	3.20	0.82	0.48	0.30	0.22	0.12
100ps	2.14	0.60	0.36	0.20	0.15	0.09
250ps	1.84	0.41	0.24	0.11	0.09	0.07
500ps	1.26	0.30	0.18	0.08	0.06	0.05

**Table 1)** NEXT for 50mil spacing on the same side of the connector and across the connector.

**Multiple aggressors**

Pulse Risetime (20-80%)	NEXT (%)			
	Config 1	Config 2	Config 3	Config 4
60ps	4.02	4.50	0.52	0.64
100ps	2.74	3.10	0.35	0.44
250ps	2.25	2.49	0.20	0.27
500ps	1.29	1.47	0.13	0.18

**Table 2)** NEXT for 50mil spacing with multiple aggressors (see tables for configuration) Config 1 and 2 are same side with two and 3 nearest neighbor aggressors. Config 3 and 4 are across the connector with two and three aggressors

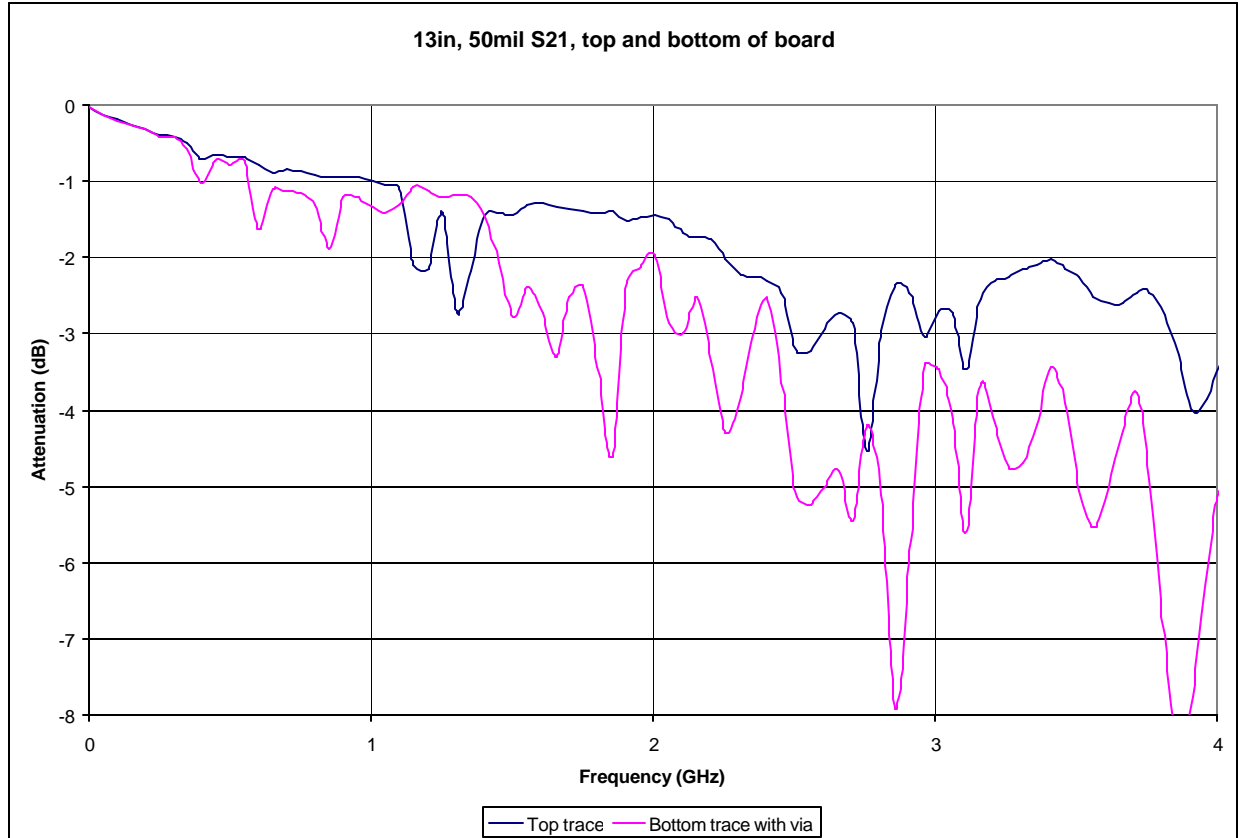
**NEXT measured from the bottom of the board**

(includes effects of via through the thickness of the board)

Pulse Risetime (20-80%)	Same side NEXT (%)	Across NEXT (%)
	1st neighbor	1st neighbor
60ps	11.08	0.54
100ps	8.97	0.45
250ps	5.35	0.29
500ps	3.40	0.19

**Table 3)** NEXT for 50mil spacing measured from the bottom of the board

**13 inch assembly, stripline boards, 50mil spacing (one ground between signal lines)**



**Figure 11)** Attenuation of the 13 inch assembly with 50mil spacing, traces near both top and bottom of board. Bottom of board includes vias through the 0.187" thickness of the board. 3dB loss point for the top trace (short vias) is at 2.4GHz

**13 inch assembly, stripline boards, 50mil spacing (one ground between signal lines)**

**Crosstalk**

All results are reported as worst case absolute values

Pulse 20-80% Risetime	Same side NEXT (%)			Across NEXT (%)		
	1st neighbor	2nd neighbor	3rd neighbor	1st neighbor	2nd neighbor	3rd neighbor
60ps	3.20	0.91	0.63	0.29	0.23	0.17
100ps	2.79	0.65	0.39	0.23	0.17	0.11
250ps	2.23	0.46	0.25	0.16	0.13	0.09
500ps	1.51	0.37	0.20	0.10	0.08	0.05

**Table 4)** NEXT for 50mil spacing on the same side of the connector and across the connector.

**Multiple aggressors**

Pulse Risetime (20-80%)	NEXT (%)				
		Config 1	Config 2	Config 3	Config 4
60ps	4.11	4.74	0.52	0.69	
100ps	3.44	3.82	0.40	0.51	
250ps	2.68	2.93	0.29	0.38	
500ps	1.88	2.08	0.18	0.22	

**Table 5)** NEXT for 50mil spacing with multiple aggressors (see tables for configuration) Config 1 and 2 are same side with two and 3 nearest neighbor aggressors. Config 3 and 4 are across the connector with two and three aggressors

**NEXT measured from the bottom of the board**

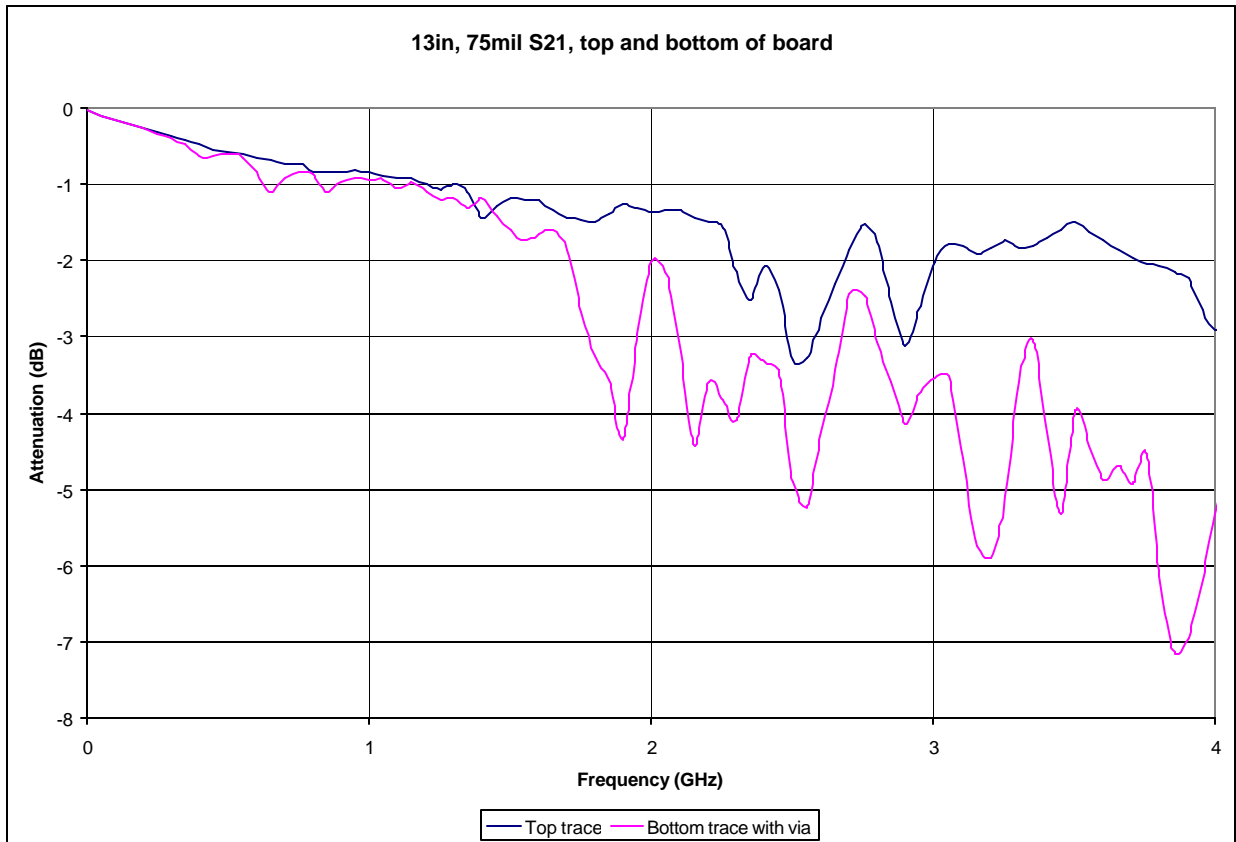
(includes effects of via through the thickness of the board)

Pulse Risetime (20-80%)	Same side	Across
	NEXT (%)	NEXT (%)
	1st neighbor	1st neighbor
60ps	11.68	0.32
100ps	8.32	0.26
250ps	4.65	0.16
500ps	2.84	0.08

**Table 6)** NEXT for 50mil spacing measured from the bottom of the board

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**13 inch assembly, microstrip boards, 75mil spacing (two grounds between signal lines)**



**Figure 12)** Attenuation of the 13 inch assembly with 75mil spacing, traces on both top and bottom of board. Bottom of board includes vias through the 0.187” thickness of the board. 3dB loss point for the top trace (no vias) is at 2.4GHz

**13 inch assembly, microstrip boards, 75mil spacing (two grounds between signal lines)**

**Crosstalk**

All results are reported as worst case absolute values

Pulse Risetime (20-80%)	Same side NEXT (%)			Across NEXT (%)		
	1st neighbor	2nd neighbor	3rd neighbor	1st neighbor	2nd neighbor	3rd neighbor
60ps	1.88	0.53	0.31	0.47	0.17	0.16
100ps	1.10	0.35	0.24	0.20	0.12	0.12
250ps	0.80	0.23	0.14	0.15	0.10	0.08
500ps	0.52	0.16	0.10	0.08	0.06	0.04

**Table 7)** NEXT for 75mil spacing on the same side of the connector and across the connector.

**Multiple aggressors**

Pulse Risetime (20-80%)	NEXT %				
	Config 1	Config 2	Config 3	Config 4	
60ps	2.41	2.72	0.64	0.80	
100ps	1.46	1.69	0.31	0.43	
250ps	1.03	1.17	0.24	0.32	
500ps	0.68	0.78	0.14	0.18	

**Table 8)** NEXT for 75mil spacing with multiple aggressors (see tables for configuration) Config 1 and 2 are same side with two and 3 nearest neighbor aggressors. Config 3 and 4 are across the connector with two and three aggressors

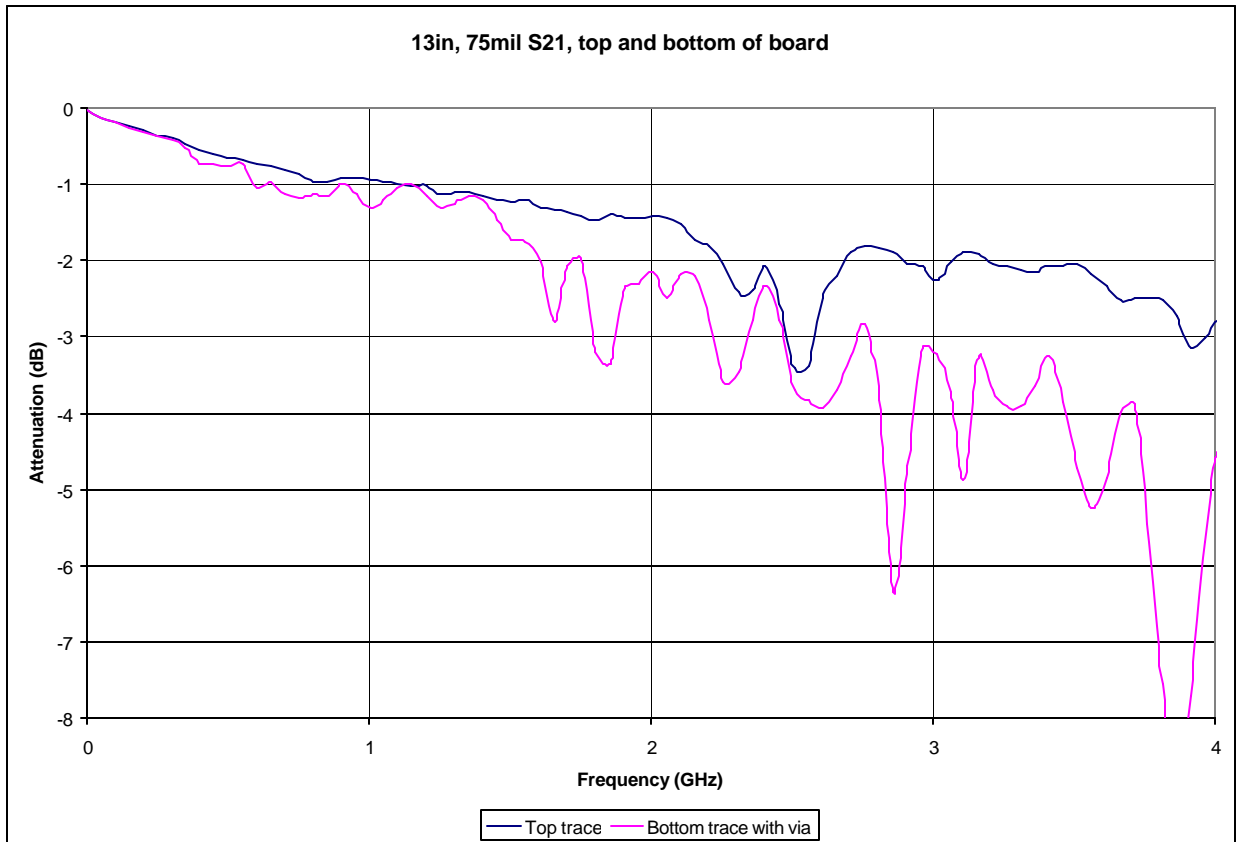
**NEXT measured from the bottom of the board**

(includes effects of via through the thickness of the board)

Pulse Risetime (20-80%)	Same side NEXT (%)	Across NEXT (%)
	1st neighbor	1st neighbor
60ps	7.46	0.24
100ps	5.84	0.20
250ps	2.97	0.14
500ps	1.62	0.09

**Table 9)** NEXT for 75mil spacing measured from the bottom of the board

**13 inch assembly, stripline boards, 75mil spacing (two grounds between signal lines)**



**Figure 13)** Attenuation of the 13 inch assembly with 75mil spacing, traces near top and bottom of board. Bottom of board includes vias and stubs through the 0.187" thickness of the board. 3dB loss point for the top trace (short vias) is at 2.4GHz

**13 inch assembly, stripline boards, 75mil spacing (two grounds between signal lines)**

**Crosstalk**

All results are reported as worst case absolute values

Pulse Risetime (20-80%)	Same side NEXT (%)			Across NEXT (%)		
	1st neighbor	2nd neighbor	3rd neighbor	1st neighbor	2nd neighbor	3rd neighbor
60ps	1.46	0.74	0.48	0.30	0.18	0.14
100ps	1.08	0.41	0.26	0.19	0.11	0.11
250ps	0.79	0.22	0.14	0.14	0.09	0.07
500ps	0.58	0.16	0.10	0.07	0.04	0.03

**Table 10)** NEXT for 75mil spacing on the same side of the connector and across the connector.

**Multiple aggressors**

Pulse Risetime (20-80%)	NEXT %			
	Config 1	Config 2	Config 3	Config 4
60ps	2.20	2.67	0.48	0.62
100ps	1.49	1.75	0.30	0.41
250ps	1.00	1.14	0.22	0.30
500ps	0.75	0.84	0.12	0.14

**Table 11)** NEXT for 75mil spacing with multiple aggressors (see tables for configuration) Config 1 and 2 are same side with two and 3 nearest neighbor aggressors. Config 3 and 4 are across the connector with two and three aggressors

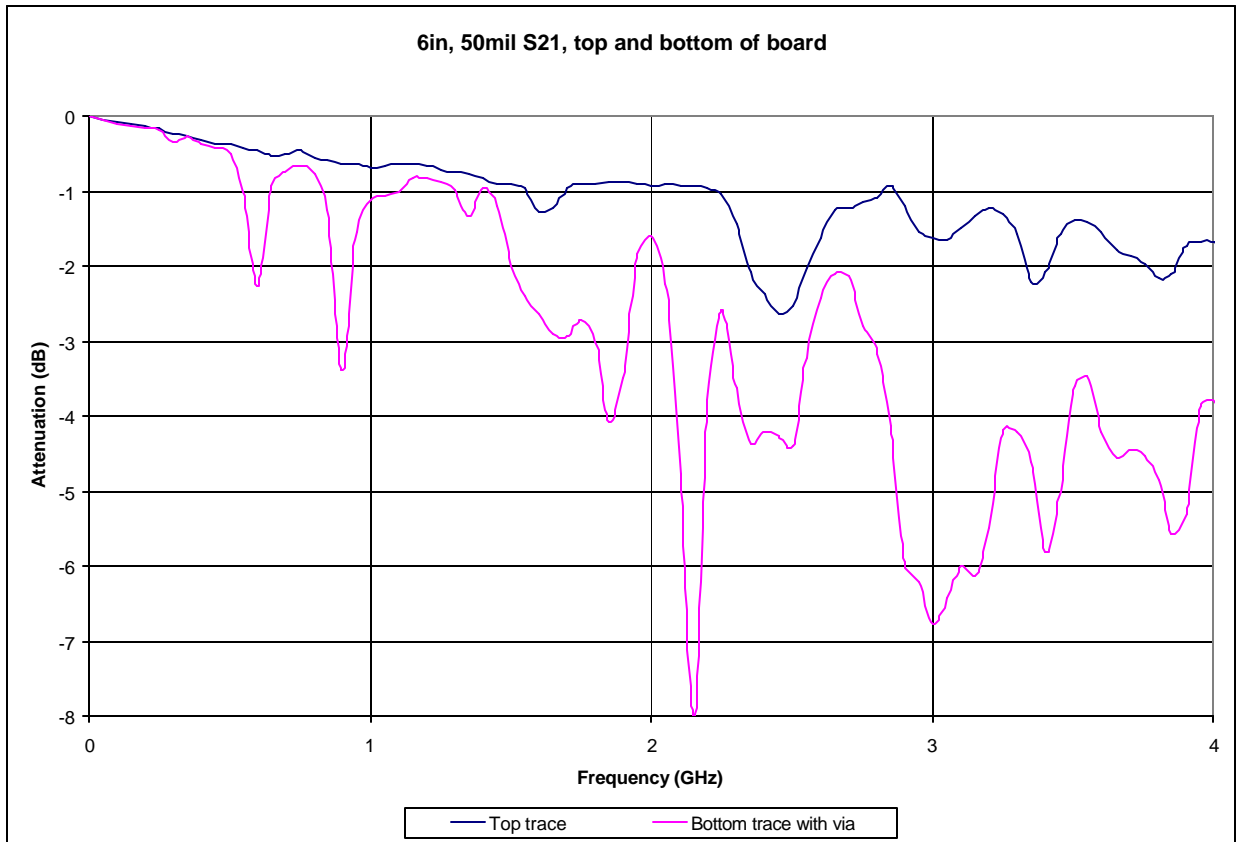
**NEXT measured from the bottom of the board**

(includes effects of via through the thickness of the board)

Pulse Risetime (20-80%)	Same side NEXT (%)	Across NEXT (%)
	1st neighbor	1st neighbor
60ps	7.62	0.212
100ps	5.46	0.184
250ps	2.65	0.112
500ps	1.46	0.064

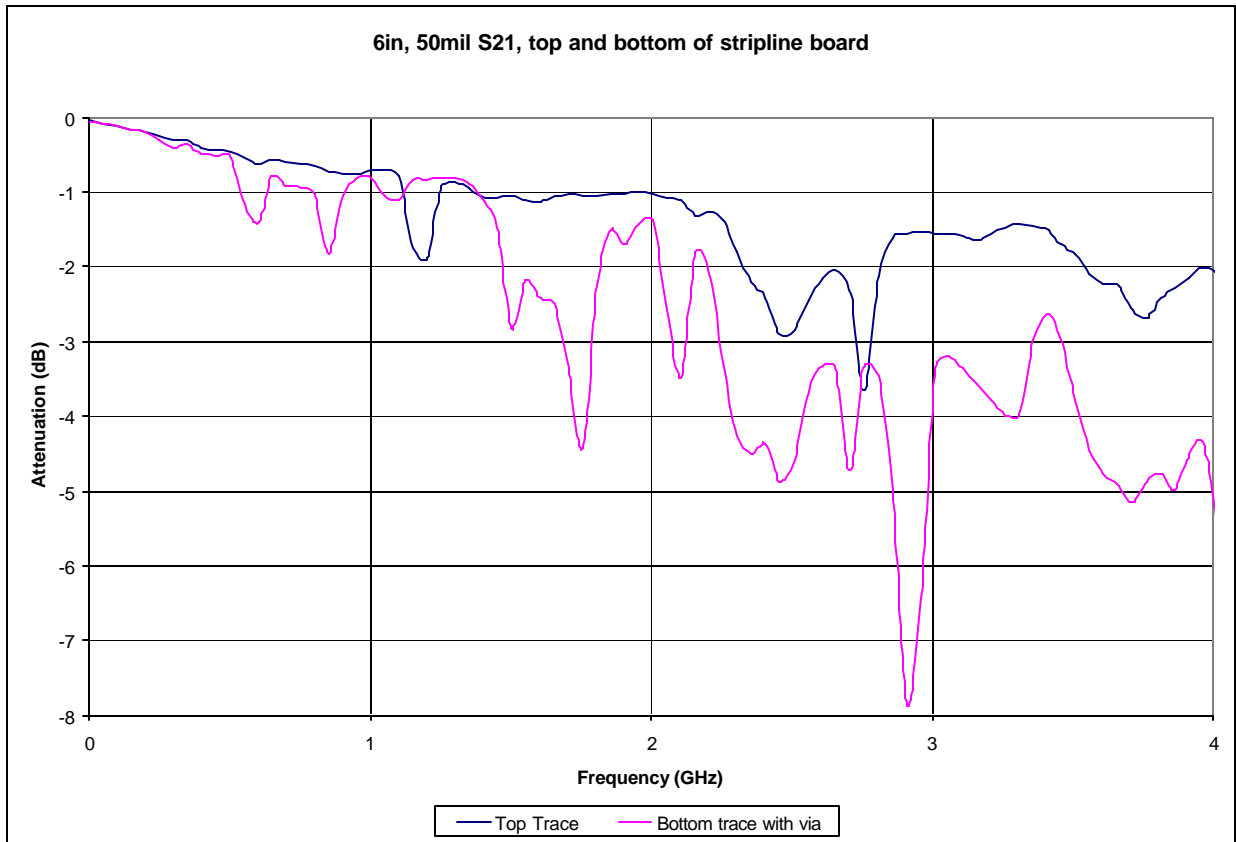
**Table 12)** NEXT for 75mil spacing measured from the bottom of the board

**6 inch assembly, microstrip boards, 50mil spacing (one ground between signal lines)**



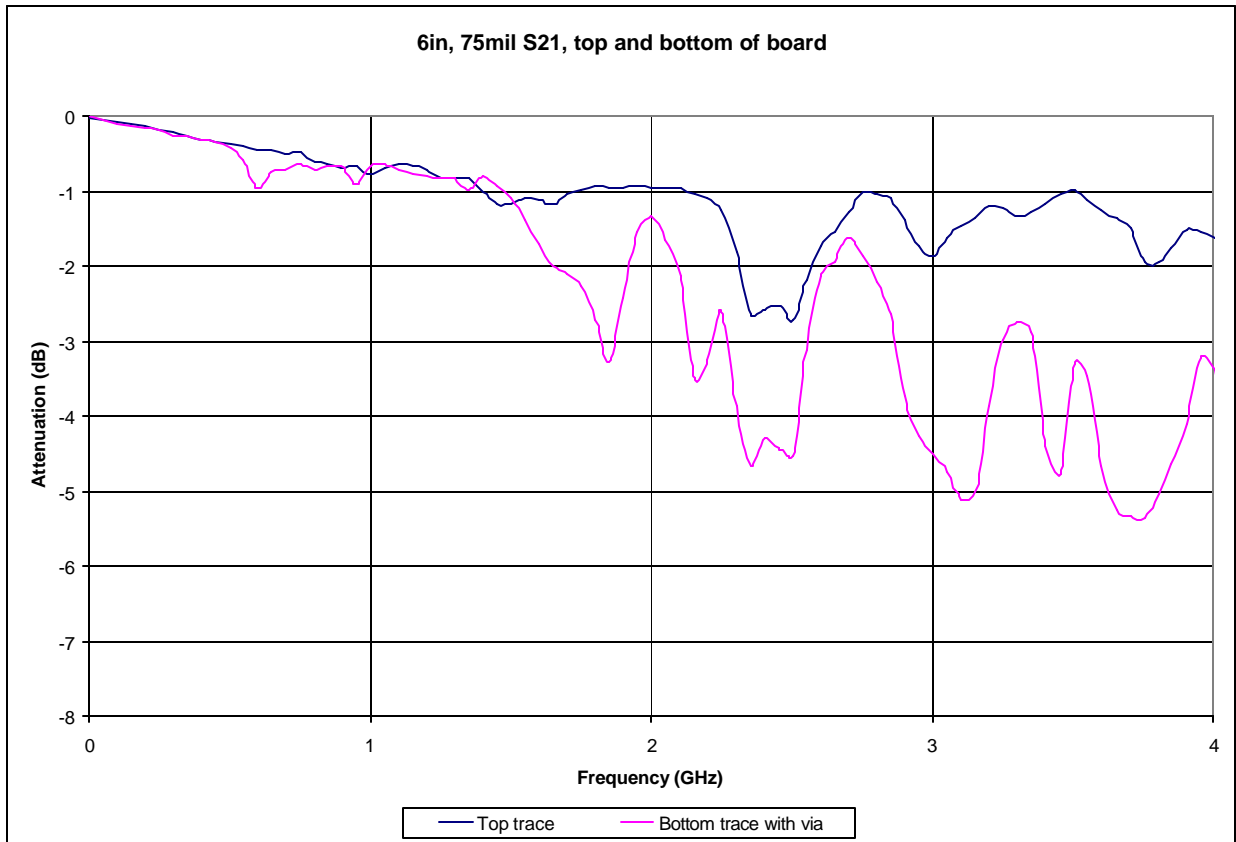
**Figure 14)** Attenuation of the 6 inch assembly with 50mil spacing, traces on both top and bottom of board. Bottom of board includes vias through the 0.187” thickness of the board. 3dB loss point for the top trace (no vias) is at 4.2GHz

**6 inch assembly, stripline boards, 50mil spacing (one ground between signal lines)**



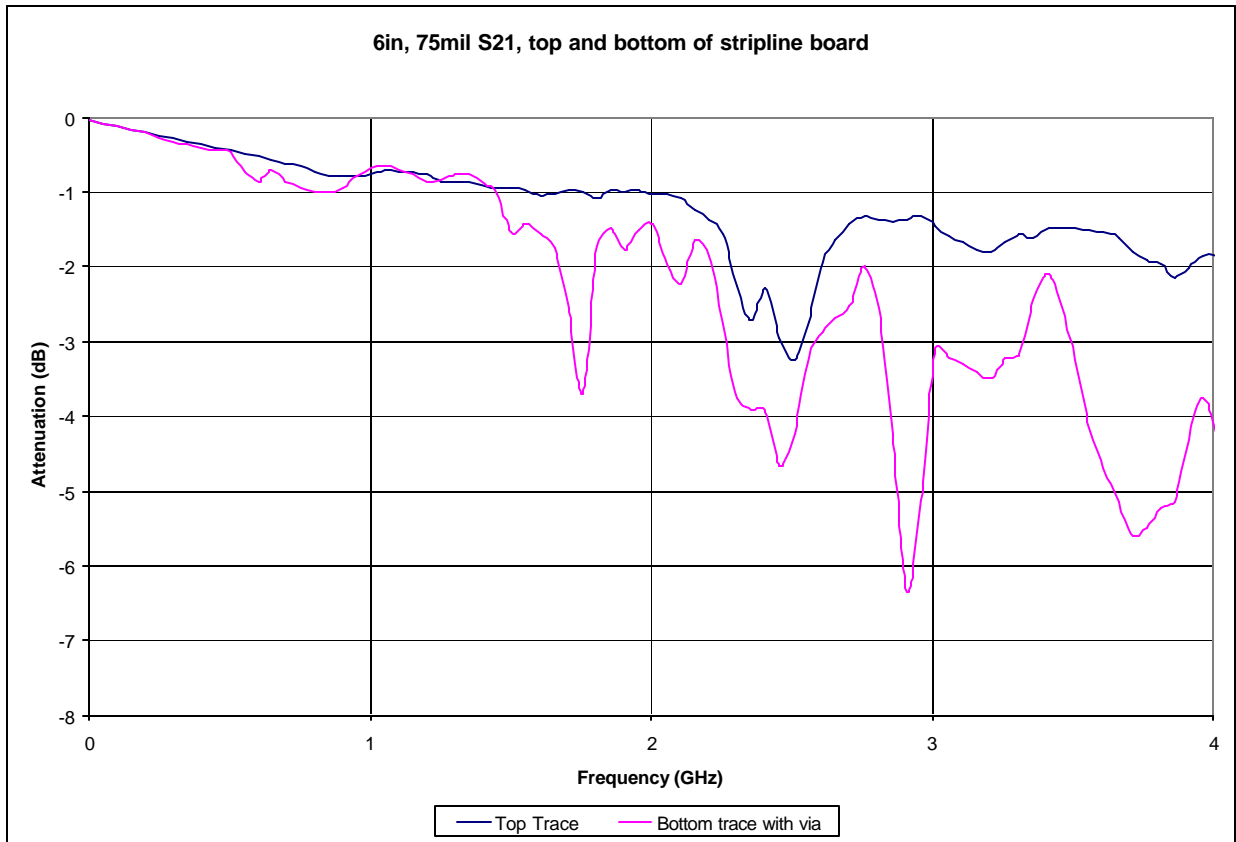
**Figure 15)** Attenuation of the 6 inch assembly with 50mil spacing, traces near both top and bottom of board. Bottom of board includes vias and stubs through the 0.187” thickness of the board. 3dB loss point for the top trace (short vias) is at 2.7GHz

**6 inch assembly, microstrip boards, 75mil spacing (two grounds between signal lines)**



**Figure 16)** Attenuation of the 6 inch assembly with 75mil spacing, traces on both top and bottom of board. Bottom of board includes vias through the 0.187" thickness of the board. 3dB loss point for the top trace (short vias) is at 4.2GHz

**6 inch assembly, stripline boards, 75mil spacing (two grounds between signal lines)**



**Figure 17)** Attenuation of the 6 inch assembly with 75mil spacing, traces near top and bottom of board. Bottom of board includes vias and stubs through the 0.187" thickness of the board. 3dB loss point for the top trace (short vias) is at 2.4GHz.

## Crosstalk Configurations 50 mil Spacing

<b>Same side of connector</b>					
1 <sup>st</sup> Neighbor		2 <sup>nd</sup> Neighbor		3 <sup>rd</sup> Neighbor	
Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
<b>A</b>	X	<b>A</b>	X	<b>A</b>	X
G	G	G	G	G	G
<b>Q</b>	X	X	X	X	X
G	G	G	G	G	G
X	X	<b>Q</b>	X	X	X
G	G	G	G	G	G
X	X	X	X	<b>Q</b>	X

**Table 1a)** Connections for NEXT on the same side of the connector

<b>Across the connector</b>					
1 <sup>st</sup> Neighbor		2 <sup>nd</sup> Neighbor		3 <sup>rd</sup> Neighbor	
Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
<b>A</b>	<b>Q</b>	<b>A</b>	X	<b>A</b>	X
G	G	G	G	G	G
X	X	X	<b>Q</b>	X	X
G	G	G	G	G	G
X	X	X	X	X	<b>Q</b>
G	G	G	G	G	G
X	X	X	X	X	X

**Table 2a)** Connections for NEXT across the connector

A is the active line (aggressor)

Q is the quiet line (victim)

G are the ground pins

X are the lines terminated in 50Ω

All lines on the far-end of cable assembly are terminated in 50Ω.

## Crosstalk Configurations 75 mil Spacing

<b>Same side of connector</b>					
1 <sup>st</sup> Neighbor		2 <sup>nd</sup> Neighbor		3 <sup>rd</sup> neighbor	
Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
<b>A</b>	X	<b>A</b>	X	<b>A</b>	X
G	G	G	G	G	G
G	G	G	G	G	G
<b>Q</b>	X	X	X	X	X
G	G	G	G	G	G
G	G	G	G	G	G
X	X	<b>Q</b>	X	X	X
G	G	G	G	G	G
G	G	G	G	G	G
X	X	X	X	<b>Q</b>	X

**Table 3a)** Connections for NEXT on the same side of the connector

<b>Across the connector</b>					
1 <sup>st</sup> Neighbor		2 <sup>nd</sup> Neighbor		3 <sup>rd</sup> Neighbor	
Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
<b>A</b>	<b>Q</b>	<b>A</b>	X	<b>A</b>	X
G	G	G	G	G	G
G	G	G	G	G	G
X	X	X	<b>Q</b>	X	X
G	G	G	G	G	G
G	G	G	G	G	G
X	X	X	X	X	<b>Q</b>
G	G	G	G	G	G
G	G	G	G	G	G
X	X	X	X	X	X

**Table 4a)** Connections for NEXT across the connector

A is the active line (aggressor)

Q is the quiet line (victim)

G are the ground pins

X are the lines terminated in 50Ω

All lines on the far-end of cable assembly are terminated in 50Ω

## Multiple Aggressor Crosstalk Configurations 50 mil Spacing

Same side of connector			
Config 1		Config 2	
Side 1	Side 2	Side 1	Side 2
<b>A</b>	X	<b>A</b>	X
G	G	G	G
<b>A</b>	X	<b>A</b>	X
G	G	G	G
<b>Q</b>	X	<b>A</b>	X
G	G	G	G
X	X	<b>Q</b>	X

**Table 5a)** Connections for NEXT on the same side of the connector

Across the connector			
Config 3		Config 4	
Side 1	Side 2	Side 1	Side 2
<b>A</b>	X	<b>A</b>	X
G	G	G	G
<b>A</b>	<b>Q</b>	<b>A</b>	X
G	G	G	G
X	X	<b>A</b>	<b>Q</b>
G	G	G	G
X	X	X	X

**Table 6a)** Connections for NEXT across the connector

A is the active line (aggressor)

Q is the quiet line (victim)

G are the ground pins

X are the lines terminated in 50Ω

All lines on the far-end of cable assembly are terminated in 50Ω.

## Multiple Aggressor Crosstalk Configurations 75 mil Spacing

Same side of connector			
Config 1		Config 2	
Side 1	Side 2	Side 1	Side 2
<b>A</b>	X	<b>A</b>	X
G	G	G	G
G	G	G	G
<b>A</b>	X	<b>A</b>	X
G	G	G	G
G	G	G	G
<b>Q</b>	X	<b>A</b>	X
G	G	G	G
G	G	G	G
X	X	<b>Q</b>	X

**Table 7a)** Connections for NEXT on the same side of the connector

Across the connector			
Config 3		Config 4	
Side 1	Side 2	Side 1	Side 2
<b>A</b>	X	<b>A</b>	X
G	G	G	G
G	G	G	G
<b>A</b>	<b>Q</b>	<b>A</b>	X
G	G	G	G
G	G	G	G
X	X	<b>A</b>	<b>Q</b>
G	G	G	G
G	G	G	G
X	X	X	X

**Table 8a)** Connections for NEXT across the connector

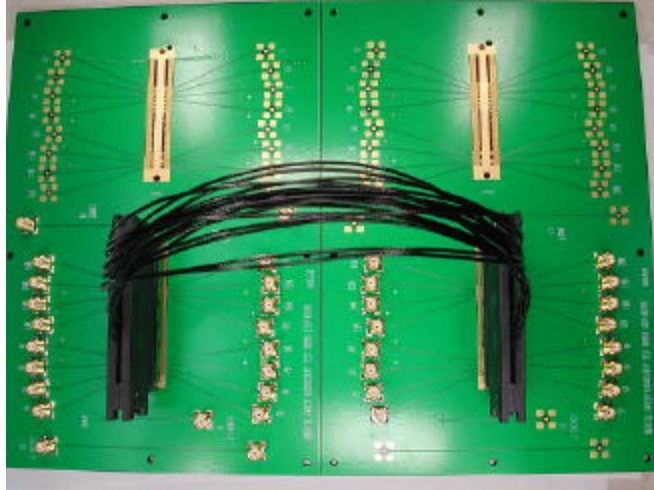
A is the active line (aggressor)

Q is the quiet line (victim)

G are the ground pins

X are the lines terminated in 50Ω

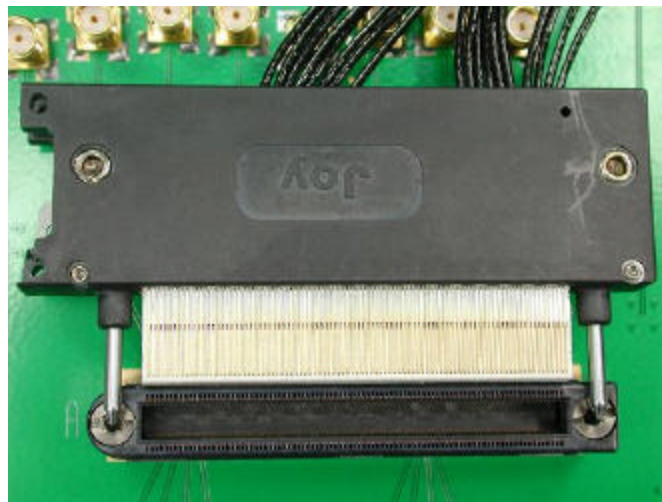
All lines on the far-end of cable assembly are terminated in 50Ω



**Figure 1a)** Test boards and assembly connected



**Figure 2a)** Close-up of male-to-female connection



**Figure 3a)** Close-up of male and female connectors

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