

ENGINEERING REPORT	Report Number ER xxxx	
	Report Date 8/14/99	Page 1 of 21
Amphenol Corporation	Aerospace Operations	Sidney, NY 13838
TITLE: Preliminary Results - EM Modeling and SPICE Simulation of 360 Staggered Grid LRM Connector.	Report Type	
	PRELIMINARY	
	Project No.	EWOM

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PRELIMINARY

NOTE: This characterization does not include the parasitic capacitance (1-2 pf typical) associated with surface mount solder pads and vias of PWB's.

Prepared by:	Noted by:	Approved by:

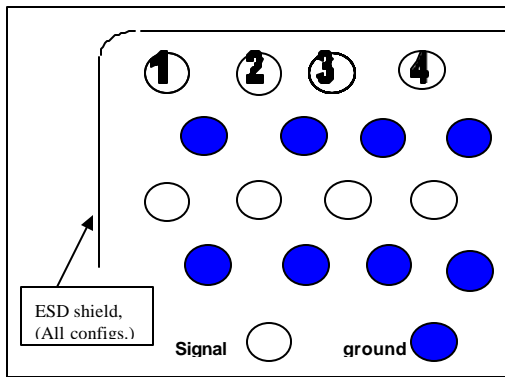
INTRODUCTION:

This report gives preliminary results of electromagnetic modeling and subsequent SPICE simulations of some representative ground - signal arrangements for the 360 Staggered Grid LRM connector. The results will be in the form of inductance / capacitance matrices for the selected patterns, and a lumped L-C SPICE model with both single line and crosstalk results for selected contacts within each pattern.

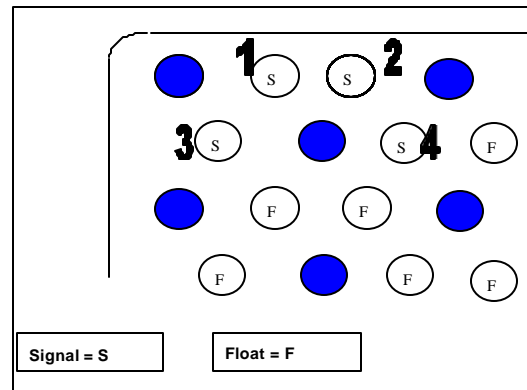
MODELING METHOD:

Electrical models were obtained from a section of the connector encompassing four rows consisting of five contacts per row located in a corner of the connector body. Three ground - signal configurations have been modeled:

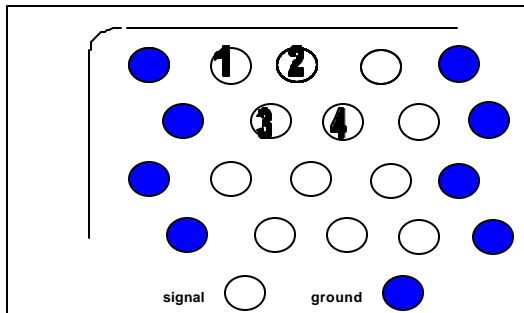
Configuration 1:



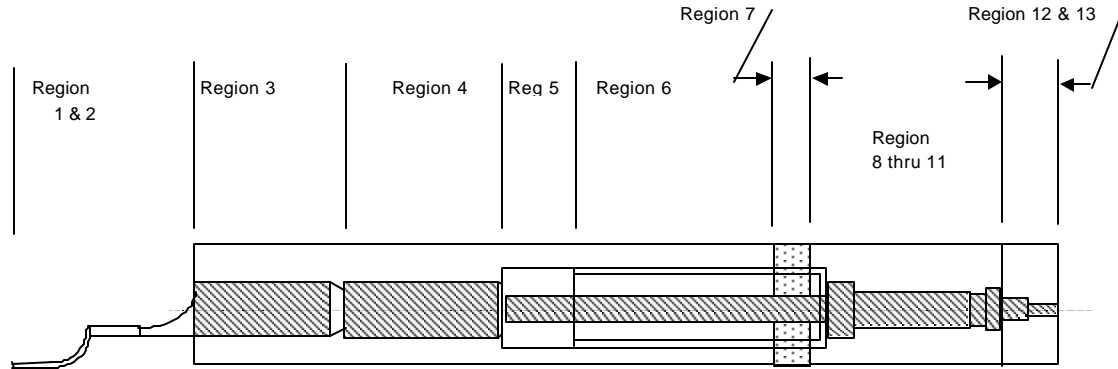
Configuration 2:



Configuration 3:



The connector length is divided into a number of sections, or "slices", each slice representing a major change in cross - sectional geometry of the contacts, as shown in the following figure:



In order to reduce complexity, some of the regions shown above have been combined by using an average contact diameter. Comparisons of averaged and non-averaged results show little or no difference in results. Each "slice" is then modeled using a static 2D electromagnetic field solver to extract the capacitance, inductance, and characteristic impedance for that slice.

The PCB tails have been modeled with a generic PCB with ground plane in place. (Board is 0.037 in. thick.) Surface mount pads are not taken into account.

SPICE MODEL:

Depending on intended signal speed and risetime, various degrees of complexity can be used in creating the SPICE model. For this preliminary study, the more complex model was created in order to best match and compare to actual TDR measurements. Each section (or combined sections) was modeled as SPICE transmission lines in series, each line section being assigned the appropriate impedance and propagation delay (based on electrical length). This model is not reported here, but is available if needed.

By adding up the serial transmission line impedances and delays, a simplified lumped element model for each contact can also be used for slow to medium signal speed simulations. (A good rule of thumb is if propagation delay is less than risetime / 10, the simple lumped element approach will be valid.) Intermediate degrees of complexity between the full transmission line model and the simple L-C model can be derived, but were not used for this study.

VERIFICATION:

The SPICE simulations were setup to mimic a standard bench TDR. A step input with a risetime matching that of the TDR (35 ps in this case) was injected at the PCB tail end of the contact of interest and the resulting reflection was observed at the input end and compared to the actual Lab TDR results. Because of excessive mismatch between the test board traces and the SMA input connectors, previously measured results look much better than the simulated results. Those results will not be presented here. More verification work will be done after the test fixturing mismatches have been reduced or eliminated.

Transmission line models

CONFIG 1 TRANSMISSION LINE MODEL								
8-sub-section model Row 1								
REGION:	1	2	3_4	5	6	7	8_11	12_13
PIN:	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)
	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)
1	194.13	220.93	27.18	105.15	32.11	10.18	31.26	66.96
	11.44	3.67	41.11	6.98	15.00	2.032	23.8	7.00
2	181.19	185.23	27.17	104.90	31.92	10.18	31.26	67.62
	11.44	3.67	41.30	6.98	15.00	2.032	23.8	7.00
3	180.41	186.90	27.19	104.86	31.91	10.18	31.24	68.16
	11.44	3.67	41.30	6.98	15.00	2.032	23.8	7.00
4	181.65	186.46	27.13	104.89	31.81	10.18	31.17	68.16
	11.44	3.67	41.10	6.98	15.00	2.032	23.8	7.00

CONFIG 2 TRANSMISSION LINE MODEL								
8-sub-section model								
REGION:	1	2	3_4	5	6	7	8_11	12_13
PIN:	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)
	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)
1	194.13	220.93	29.50	107.04	34.53	10.18	33.46	69.75
	11.44	3.67	36.6	6.98	15.00	2.032	23.8	7.00
2	181.19	185.23	29.51	106.95	34.52	10.18	33.49	69.72
	11.44	3.67	36.6	6.98	15.00	2.032	23.8	7.00
3	180.41	186.9	27.43	109.45	32.83	10.18	31.84	77.98
	11.44	3.67	36.6	6.98	15.00	2.032	23.8	7.00
4	181.65	186.46	27.42	109.00	32.80	10.18	31.83	78.20
	11.44	3.67	36.6	6.98	15.00	2.032	23.8	7.00

CONFIG 3 TRANSMISSION LINE MODEL								
8-sub-section model								
REGION:	1	2	3_4	5	6	7	8_11	12_13
PIN:	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)	Zo (Ω)
	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)	TP (ps)
1	194.13	220.93	23.19	93.70	26.07	10.18	30.09	71.60
	11.44	3.67	36.6	6.98	15.00	2.032	23.8	7.00
2	273.15	185.23	26.89	100.43	33.32	10.18	34.47	76.76
	11.44	3.67	36.6	6.98	15.00	2.032	23.8	7.00
3	252.86	186.90	31.05	124.23	39.59	10.18	41.31	94.11
	11.44	3.67	36.6	6.98	15.00	2.032	23.8	7.00
4	256.32	186.46	32.58	129.58	41.56	10.18	43.49	98.47
	11.44	3.67	36.6	6.98	15.00	2.032	23.8	7.00

An overall Transmission Line model formed by summing all the inductance and capacitance from the regions is shown below. Zo is the overall impedance for each pin, and Tp is the corresponding prop. delay:

Configuration 1:

ROW 1:		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		46.83	45.85	45.87	45.87
Tp =		1.60E-10	1.57E-10	1.57E-10	1.57E-10
L matrix:	PIN 1	7.48E-09			
	PIN 2		7.21E-09		
	PIN 3			7.22E-09	
	PIN 4				7.21E-09
C matrix:	PIN 1	3.41E-12			
	PIN 2		3.43E-12		
	PIN 3			3.43E-12	
	PIN 4				3.43E-12
ROW 2:		PIN 1	PIN 2	PIN 3	PIN 4

Configuration 2:

ROW 1:		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		47.74	46.73	45.41	45.42
Tp =		1.45E-10	1.42E-10	1.44E-10	1.44E-10
L matrix:	PIN 1	6.92E-09			
	PIN 2		6.64E-09		
	PIN 3			6.53E-09	
	PIN 4				6.54E-09
C matrix:	PIN 1	3.04E-12			
	PIN 2		3.04E-12		
	PIN 3			3.17E-12	
	PIN 4				3.17E-12

Configuration 3:

ROW 1:		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		49.80	54.85	58.33	59.59
Tp =		1.49E-10	1.41E-10	1.48E-10	1.43E-10
L matrix:	PIN 1	7.40E-09			
	PIN 2		7.76E-09		
	PIN 3			8.61E-09	
	PIN 4				8.50E-09
C matrix:	PIN 1	2.98E-12			
	PIN 2		2.58E-12		
	PIN 3			2.53E-12	
	PIN 4				2.39E-12

Inductance and Capacitance Matrices

The Inductance and Capacitance matrices per length are shown for each configuration, and each contact region. Four contacts for each configuration were modeled, generating a 4 by 4 matrix for each region of the three signal - ground configurations.

The main matrix diagonal represents the self-capacitance and inductance of each contact, while the off-diagonals represent the mutual L's and C's. (The coupling parameters)

REGION 1 & 2

CONFIG 1		REGION 1/2			
(region 1)		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		194.1326	181.1869	180.4127	181.6528
TP =					
L matrix:	PIN 1	2.22E-09	-1.15E-10	-3.46E-11	-1.81E-11
	PIN 2	-9.82E-11	2.08E-09	-9.16E-11	-2.65E-11
	PIN 3	-3.13E-11	-9.15E-11	2.07E-09	-9.10E-11
	PIN 4	-1.67E-11	-2.68E-11	-9.11E-11	2.08E-09
C matrix:	PIN 1	5.90E-14	3.31E-15	1.16E-15	6.06E-16
	PIN 2	2.84E-15	6.32E-14	2.89E-15	9.59E-16
	PIN 3	1.04E-15	2.89E-15	6.35E-14	2.83E-15
	PIN 4	5.55E-16	9.68E-16	2.83E-15	6.30E-14

CONFIG 2		REGION 1/2			
		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		226.67	209.47	210.07	207.81
L matrix:	PIN 1	2.66E-09	-8.99E-11	-5.53E-10	-5.35E-11
	PIN 2	-8.70E-11	2.45E-09	-4.84E-11	-5.09E-10
	PIN 3	-5.52E-10	-2.15E-11	2.46E-09	-2.59E-11
	PIN 4	-2.06E-11	-5.11E-10	-2.48E-11	2.43E-09
C matrix:	PIN 1	5.17E-14	2.37E-15	1.17E-14	1.76E-15
	PIN 2	2.28E-15	5.59E-14	1.73E-15	1.18E-14
	PIN 3	1.16E-14	1.14E-15	5.58E-14	1.09E-15
	PIN 4	1.04E-15	1.18E-14	1.03E-15	5.63E-14

GENX_CONFIG_3 Row 1/2 Matrix (Pins 1-2, 1-3, 2-2, 2-3)

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		240.1585	273.1464	252.856	256.3194
L matrix:	PIN 1	2.83E-09	-1.66E-10	-5.28E-10	-1.03E-10
	PIN 2	-2.27E-10	3.31E-09	-7.08E-10	-7.15E-10
	PIN 3	-6.81E-10	-5.95E-10	3.05E-09	-1.81E-10
	PIN 4	-1.37E-10	-6.91E-10	-2.01E-10	3.03E-09
C matrix:	PIN 1	4.91E-14	4.95E-15	9.86E-15	3.43E-15
	PIN 2	7.07E-15	4.44E-14	1.23E-14	1.14E-14
	PIN 3	1.26E-14	1.04E-14	4.78E-14	5.72E-15
	PIN 4	4.66E-15	1.10E-14	6.40E-15	4.62E-14

REGION 3 & 4

GENX_3/4 Row 1 Matrix (Pins 1, 2, 3, & 4) (Row 2 & 4 grounded)

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		21.83105	21.83105	21.81649	21.3675
L matrix:	PIN 1	7.98E-10	-1.66E-10	1.16E-11	-8.07E-13
	PIN 2	-1.65E-10	8.15E-10	-1.65E-10	1.15E-11
	PIN 3	1.15E-11	-1.65E-10	8.14E-10	-1.63E-10
	PIN 4	-7.91E-13	1.13E-11	-1.62E-10	7.81E-10
C matrix:	PIN 1	1.68E-12	3.51E-13	4.86E-14	6.71E-15
	PIN 2	3.48E-13	1.71E-12	3.52E-13	4.86E-14
	PIN 3	4.81E-14	3.51E-13	1.71E-12	3.52E-13
	PIN 4	6.65E-15	4.84E-14	3.51E-13	1.71E-12

CONFIG 2

REGION 3/4

Pin No.		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		22.68	22.66	24.44	23.83
L matrix:	PIN 1	8.67E-10	-1.85E-10	-2.46E-10	2.15E-11
	PIN 2	-1.86E-10	8.65E-10	2.18E-11	-2.42E-10
	PIN 3	-2.55E-10	2.20E-11	9.12E-10	-6.28E-12
	PIN 4	2.15E-11	-2.49E-10	-6.18E-12	8.88E-10
C matrix:	PIN 1	1.68E-12	3.68E-13	4.45E-13	6.26E-14
	PIN 2	3.68E-13	1.69E-12	6.19E-14	4.51E-13
	PIN 3	4.64E-13	6.56E-14	1.53E-12	1.75E-14
	PIN 4	6.56E-14	4.64E-13	1.72E-14	1.56E-12

CONFIG 3

REGION 3_4

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		23.19337	26.89049	31.04675	32.5787
L matrix:	PIN 1	8.83E-10	-1.59E-10	-2.29E-10	3.05E-11
	PIN 2	-1.78E-10	1.06E-09	-2.12E-10	-2.68E-10
	PIN 3	-2.65E-10	-2.45E-10	1.23E-09	-2.47E-10
	PIN 4	1.00E-11	-3.16E-10	-2.67E-10	1.26E-09
C matrix:	PIN 1	1.64E-12	3.69E-13	3.94E-13	1.16E-13
	PIN 2	4.16E-13	1.47E-12	4.14E-13	3.85E-13
	PIN 3	4.74E-13	4.66E-13	1.28E-12	3.39E-13
	PIN 4	1.92E-13	4.66E-13	3.72E-13	1.18E-12

REGION 5

GENX_5 Row 1 Matrix (Pins 1, 2, 3, & 4) (Row 2 & 4 grounded)

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		85.99872	90.39822	90.33503	89.88922
L matrix:	PIN 1	6.00E-10	-6.76E-11	2.63E-13	-1.28E-14
	PIN 2	-6.96E-11	6.33E-10	-7.05E-11	2.97E-13
	PIN 3	2.89E-13	-7.05E-11	6.33E-10	-7.08E-11
	PIN 4	-1.27E-14	3.34E-13	-7.09E-11	6.26E-10
C matrix:	PIN 1	8.11E-14	5.75E-15	5.67E-16	6.06E-17
	PIN 2	6.14E-15	7.75E-14	5.98E-15	5.95E-16
	PIN 3	6.07E-16	5.98E-15	7.75E-14	6.00E-15
	PIN 4	6.49E-17	5.94E-16	6.01E-15	7.74E-14

CONFIG 2

REGION 5

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		52.01	52.07	58.77	60.22
L matrix:	PIN 1	6.50E-10	-6.28E-11	-9.47E-11	-4.11E-12
	PIN 2	-6.27E-11	6.50E-10	-4.18E-12	-9.49E-11
	PIN 3	-1.07E-10	-4.93E-12	7.36E-10	-4.02E-12
	PIN 4	-5.00E-12	-1.08E-10	-4.12E-12	7.43E-10
C matrix:	PIN 1	2.40E-13	1.68E-14	2.23E-14	3.86E-15
	PIN 2	1.68E-14	2.40E-13	4.12E-15	2.13E-14
	PIN 3	2.67E-14	4.99E-15	2.13E-13	2.44E-15
	PIN 4	5.08E-15	2.73E-14	2.70E-15	2.05E-13

GENX_CONFIG_3 Row 1/2 Matrix

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		93.69843	100.4261	124.2272	129.5831
L matrix:	PIN 1	6.64E-10	-6.77E-11	-9.42E-11	-8.33E-12
	PIN 2	-7.28E-11	7.34E-10	-1.06E-10	-1.14E-10
	PIN 3	-1.24E-10	-1.35E-10	9.12E-10	-1.46E-10
	PIN 4	-1.43E-11	-1.56E-10	-1.59E-10	9.49E-10
C matrix:	PIN 1	7.56E-14	6.56E-15	6.42E-15	2.39E-15
	PIN 2	6.90E-15	7.28E-14	7.65E-15	7.14E-15
	PIN 3	9.60E-15	1.09E-14	5.91E-14	8.38E-15
	PIN 4	3.76E-15	1.10E-14	9.08E-15	5.65E-14

REGION 6

CONFIG 1

Region 6

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		27.31	27.42	27.37	26.87
L matrix:	PIN 1	4.11E-10	-8.17E-11	4.94E-12	-2.94E-13
	PIN 2	-8.09E-11	4.18E-10	-8.06E-11	4.79E-12
	PIN 3	4.89E-12	-8.07E-11	4.17E-10	-7.96E-11
	PIN 4	-2.91E-13	4.81E-12	-7.97E-11	4.02E-10
C matrix:	PIN 1	5.51E-13	9.00E-14	1.13E-14	1.41E-15
	PIN 2	9.06E-14	5.56E-13	9.26E-14	1.16E-14
	PIN 3	1.14E-14	9.27E-14	5.57E-13	9.26E-14
	PIN 4	1.42E-15	1.16E-14	9.26E-14	5.57E-13

CONFIG_2

Region 6

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		28.31	28.24	31.24	30.67
L matrix:	PIN 1	4.38E-10	-8.45E-11	-1.13E-10	7.30E-12
	PIN 2	-8.45E-11	4.37E-10	7.39E-12	-1.11E-10
	PIN 3	-1.18E-10	7.51E-12	4.64E-10	-2.11E-12
	PIN 4	7.31E-12	-1.15E-10	-2.04E-12	4.52E-10
C matrix:	PIN 1	5.46E-13	9.21E-14	1.11E-13	1.42E-14
	PIN 2	9.20E-14	5.48E-13	1.43E-14	1.11E-13
	PIN 3	1.19E-13	1.56E-14	4.75E-13	3.72E-15
	PIN 4	1.55E-14	1.19E-13	3.68E-15	4.81E-13

CONFIG_3

Region 6

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		29.07	33.32	39.59	41.56
L matrix:	PIN 1	4.52E-10	-7.90E-11	-1.12E-10	1.28E-11
	PIN 2	-8.82E-11	5.43E-10	-1.06E-10	-1.31E-10
	PIN 3	-1.31E-10	-1.23E-10	6.27E-10	-1.21E-10
	PIN 4	2.31E-12	-1.57E-10	-1.31E-10	6.42E-10
C matrix:	PIN 1	5.35E-13	1.03E-13	1.04E-13	3.09E-14
	PIN 2	1.14E-13	4.89E-13	1.12E-13	1.04E-13
	PIN 3	1.31E-13	1.36E-13	4.00E-13	9.72E-14
	PIN 4	5.11E-14	1.36E-13	1.07E-13	3.72E-13

REGION 7:

GENX_7 Row 1 Matrix (Pins 1, 2, 3, & 4) (Row 2 & 4 grounded)

L = 2.0687E-11

C = 1.9959E-13

Zo = 10.18

Note:

Since each contact in Region 7 is surrounded by the ESD shield, there are no mutual inductances or capacitances, hence no matrix.

REGION 8 - 11

CONFIG_1		Region8 thru 11 Row 1 Matrix			
		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		27.6965	28.43895	28.44213	27.96623
L matrix:	PIN 1	6.60E-10	-1.20E-10	6.47E-12	-4.00E-13
	PIN 2	-1.21E-10	6.89E-10	-1.30E-10	8.03E-12
	PIN 3	6.19E-12	-1.22E-10	6.91E-10	-1.29E-10
	PIN 4	-3.81E-13	7.53E-12	-1.29E-10	6.68E-10
C matrix:	PIN 1	8.60E-13	1.53E-13	2.13E-14	2.77E-15
	PIN 2	1.54E-13	8.52E-13	1.63E-13	2.12E-14
	PIN 3	2.01E-14	1.53E-13	8.54E-13	8.54E-13
	PIN 4	2.62E-15	2.00E-14	1.63E-13	8.54E-13

GENX_CONFIG_2 Row 1/2
 Matrix

Zo =		29.27	29.26	32.55	32.07
		PIN 1	PIN 2	PIN 3	PIN 4
L matrix:	PIN 1	5.67E-10	-1.01E-10	-1.39E-10	7.66E-12
	PIN 2	-1.02E-10	5.67E-10	7.78E-12	-1.37E-10
	PIN 3	-1.46E-10	7.83E-12	6.20E-10	-2.48E-12
	PIN 4	7.82E-12	-1.45E-10	-2.45E-12	6.11E-10
C matrix:	PIN 1	6.62E-13	1.21E-13	1.47E-13	1.96E-14
	PIN 2	1.22E-13	6.62E-13	1.95E-14	1.47E-13
	PIN 3	1.55E-13	2.09E-14	5.85E-13	5.13E-15
	PIN 4	2.09E-14	1.55E-13	5.07E-15	5.94E-13

GENX_CONFIG_3 Row 1/2
 Matrix

Zo =		30.09	34.47	41.31	43.49
		PIN 1	PIN 2	PIN 3	PIN 4
L matrix:	PIN 1	7.43E-10	-1.23E-10	-1.79E-10	1.98E-11
	PIN 2	-1.37E-10	8.84E-10	-1.71E-10	-2.10E-10
	PIN 3	-2.12E-10	-2.05E-10	1.06E-09	-2.17E-10
	PIN 4	8.15E-12	-2.59E-10	-2.36E-10	1.09E-09
C matrix:	PIN 1	8.21E-13	1.70E-13	1.77E-13	5.28E-14
	PIN 2	1.89E-13	7.44E-13	1.90E-13	1.77E-13
	PIN 3	2.17E-13	2.23E-13	6.24E-13	1.62E-13
	PIN 4	8.55E-14	2.23E-13	1.78E-13	5.79E-13

REGION 12 & 13

CONFIG_1

Regions 12 & 13

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		68.13	73.85	74.15	73.80
L matrix:	PIN 1	4.77E-10	-5.50E-11	-4.22E-12	-6.67E-13
	PIN 2	-5.97E-11	5.23E-10	-6.12E-11	-4.92E-12
	PIN 3	-4.63E-12	-6.15E-11	5.26E-10	-6.22E-11
	PIN 4	-7.38E-13	-4.97E-12	-6.24E-11	5.20E-10
C matrix:	PIN 1	1.03E-13	7.63E-15	1.49E-15	3.48E-16
	PIN 2	8.44E-15	9.59E-14	8.10E-15	1.62E-15
	PIN 3	1.66E-15	8.15E-15	9.56E-14	8.11E-15
	PIN 4	3.91E-16	1.64E-15	8.15E-15	9.54E-14

CONFIG_2

Regions 12 & 13

		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		70.58	70.62	80.11	81.18
L matrix:	PIN 1	4.95E-10	-4.34E-11	-6.39E-11	-3.47E-12
	PIN 2	-4.32E-11	4.95E-10	-3.49E-12	-6.41E-11
	PIN 3	-7.31E-11	-4.25E-12	5.63E-10	-2.87E-12
	PIN 4	-4.26E-12	-7.42E-11	-2.97E-12	5.68E-10
C matrix:	PIN 1	9.93E-14	6.52E-15	8.10E-15	1.45E-15
	PIN 2	6.51E-15	9.92E-14	1.49E-15	7.96E-15
	PIN 3	9.76E-15	1.84E-15	8.77E-14	8.72E-16
	PIN 4	1.86E-15	9.90E-15	9.20E-16	8.61E-14

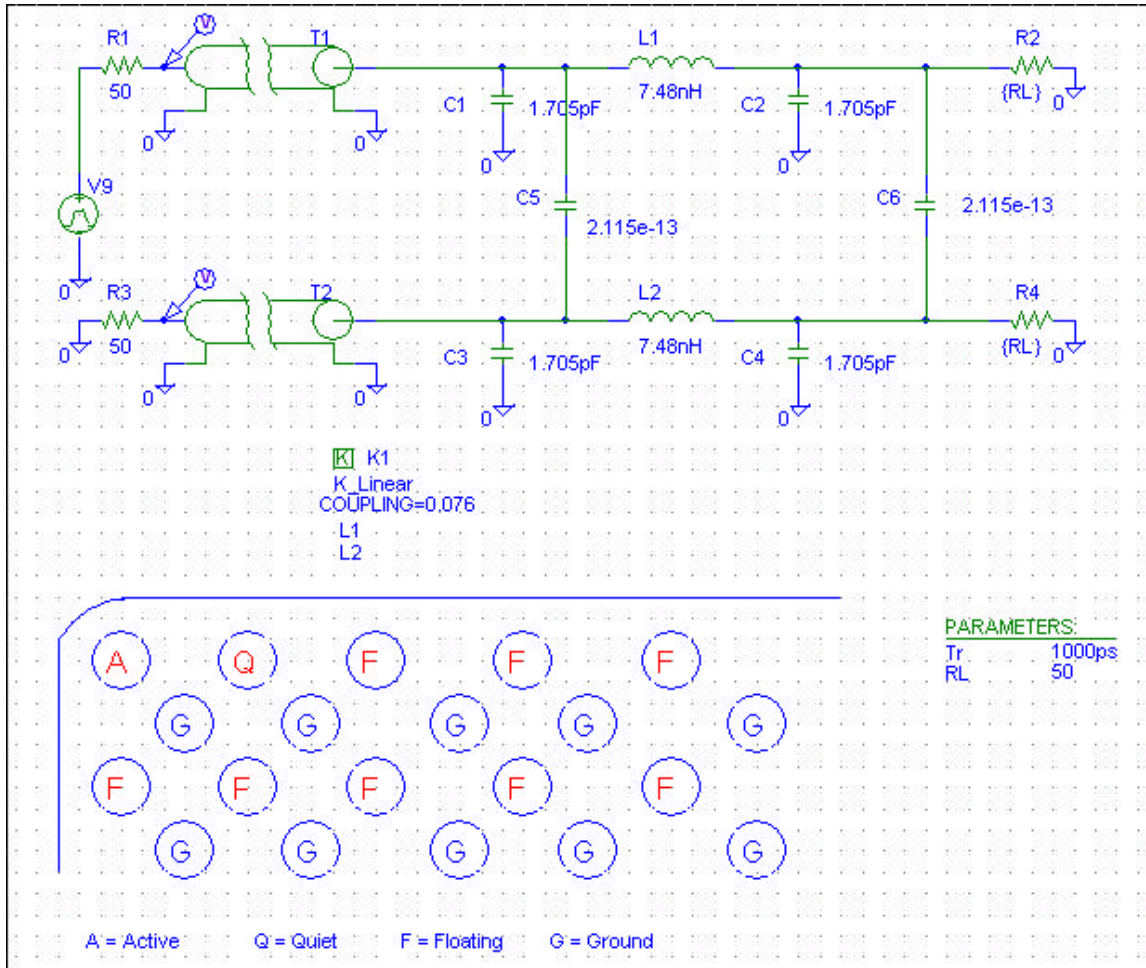
CONFIG_3

Regions 12 & 13

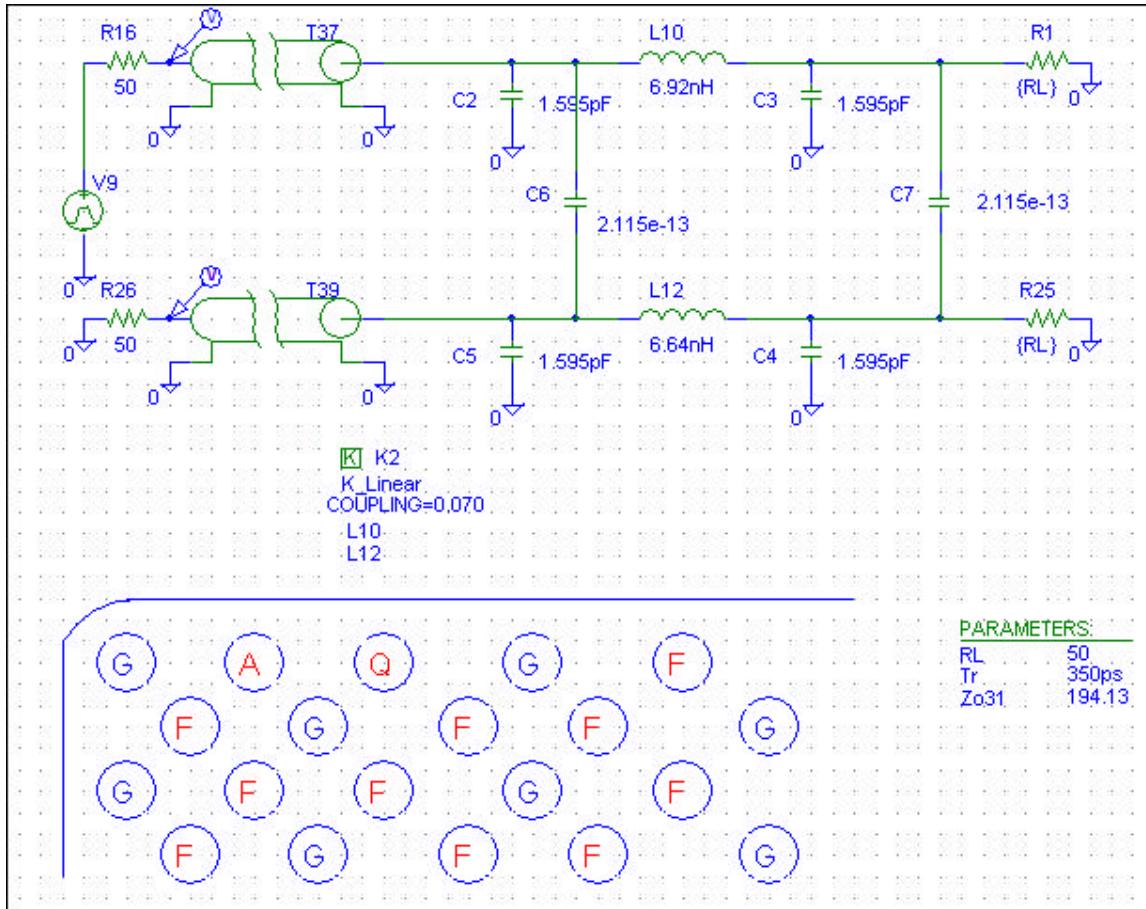
		PIN 1	PIN 2	PIN 3	PIN 4
Zo =		71.60	76.76	94.11	98.47
L matrix:	PIN 1	5.04E-10	-4.72E-11	-6.27E-11	-7.72E-12
	PIN 2	-5.14E-11	5.54E-10	-7.14E-11	-7.50E-11
	PIN 3	-8.57E-11	-9.35E-11	6.87E-10	-9.61E-11
	PIN 4	-1.32E-11	-1.09E-10	-1.05E-10	7.17E-10
C matrix:	PIN 1	9.84E-14	7.78E-15	7.43E-15	2.68E-15
	PIN 2	8.38E-15	9.40E-14	8.73E-15	8.07E-15
	PIN 3	1.11E-14	1.22E-14	7.75E-14	8.92E-15
	PIN 4	4.42E-15	1.25E-14	9.80E-15	7.40E-14

SPICE Schematics and sample results:

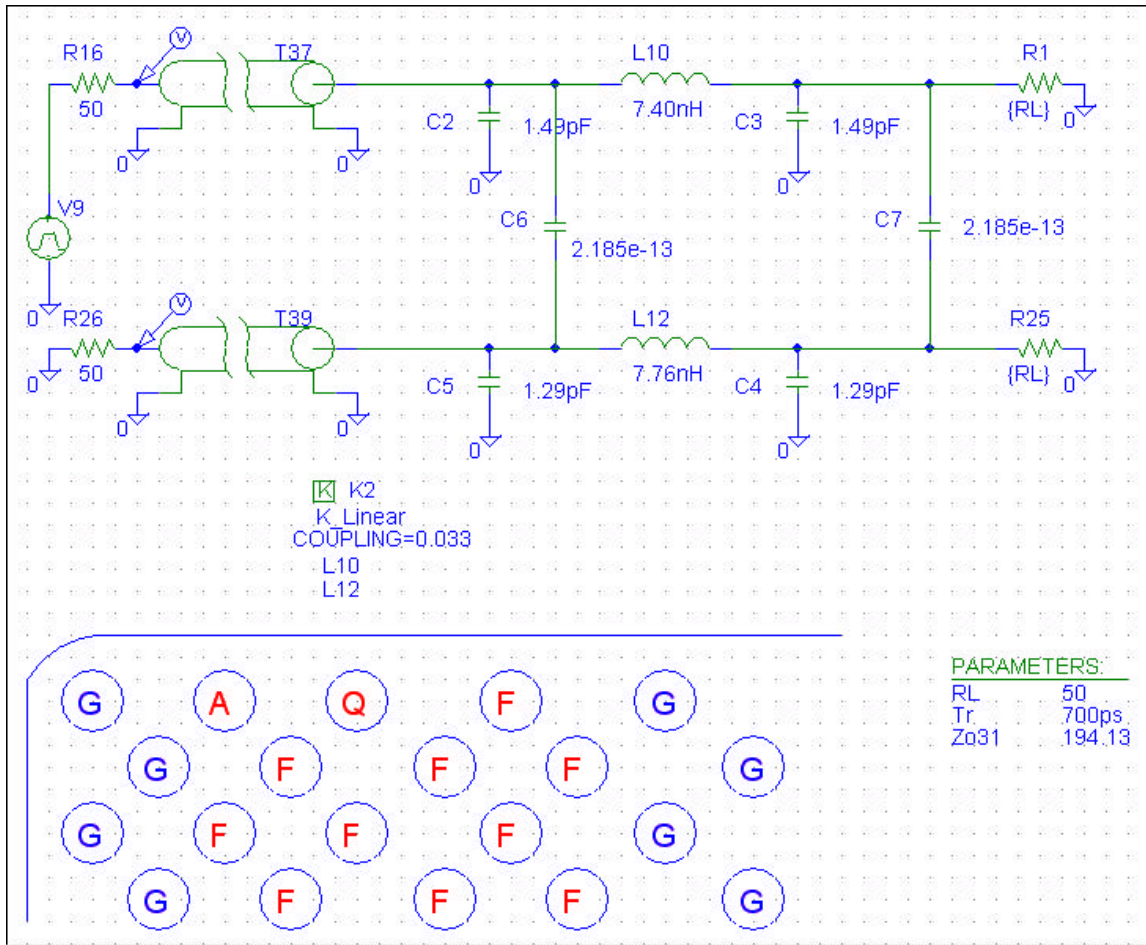
SPICE Schematic, Configuration. 1, Row 1, Pin 1:



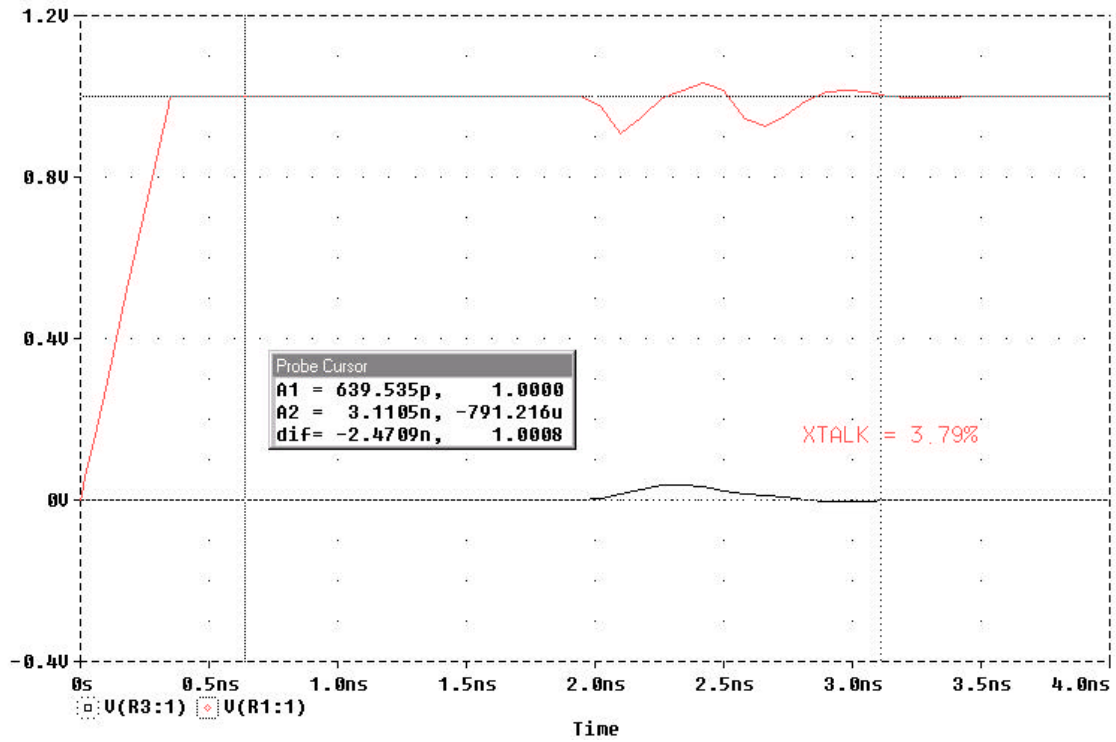
SPICE Schematic, Configuration. 2, Row 1, Pin 1:



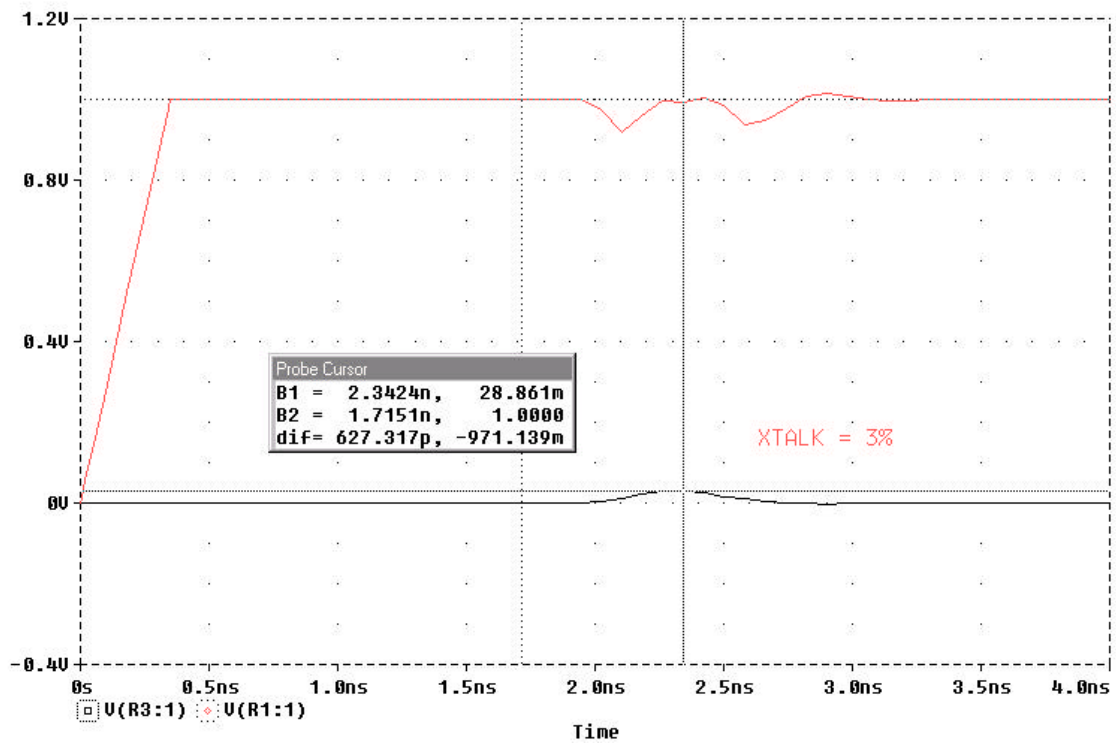
SPICE Schematic, Configuration 3, Row 1, Pin 1:



SPICE Output: 350 ps input step. (Simulated TDR input and response.)
This is PIN 1 of Configuration 1. The upper trace is Pin 1, and the lower trace is the near end crosstalk on Pin 2. At 350 ps risetime, the crosstalk is about 4%.



SPICE results, Config. 2, Pin 1 & 2 (1 active, 2 quiet):
(350 psec risetime)



SPICE results, Config 3, Pin1 & 2 (1 active, 2 quiet):
(350 psec risetime)

