

MEG-ARRAY[®] 8 mm Comparison Results Broad Side Coupled versus Edge Side Coupled from a Larger 6x6 Model

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Staff Signal Integrity Engineer

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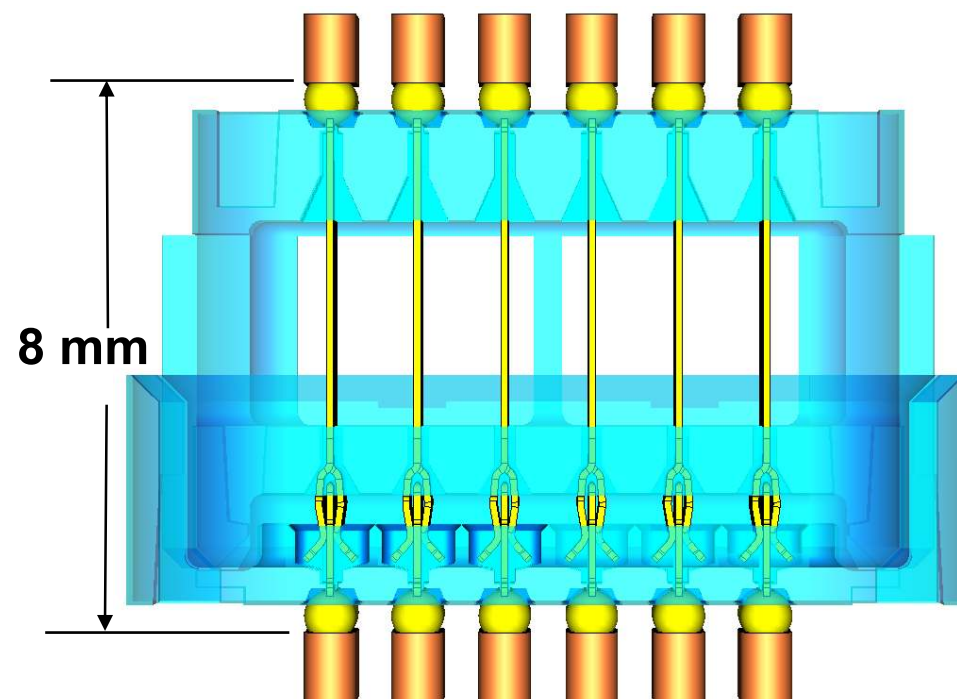
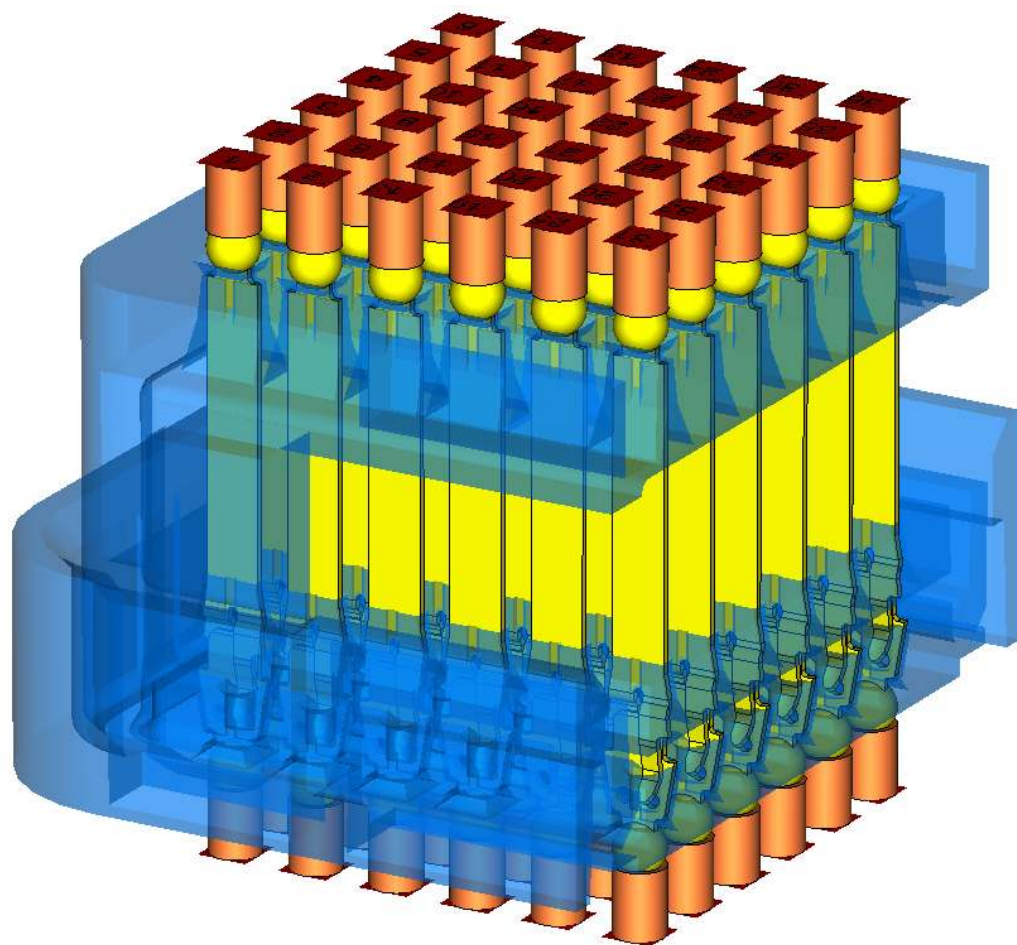
Senior Signal Integrity Engineer

January 20, 2009

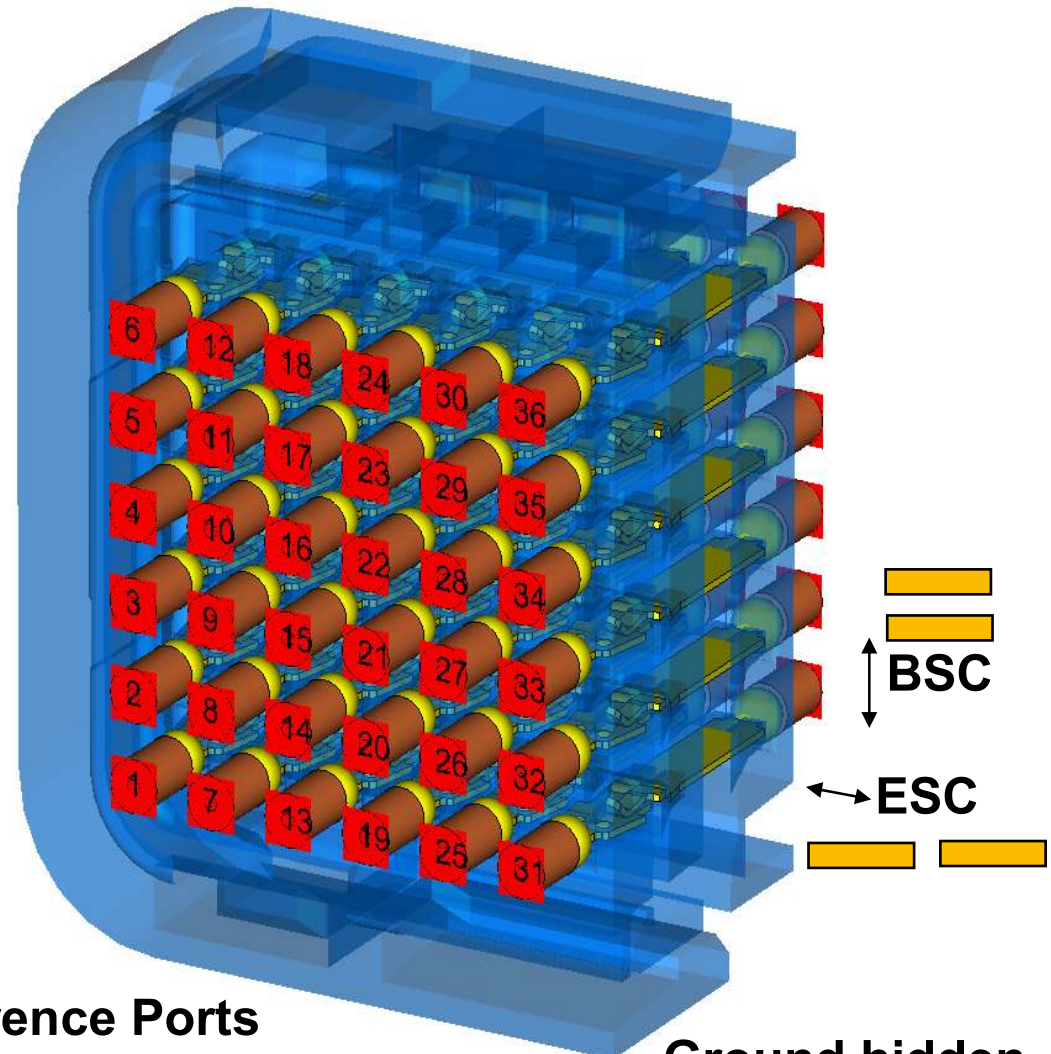
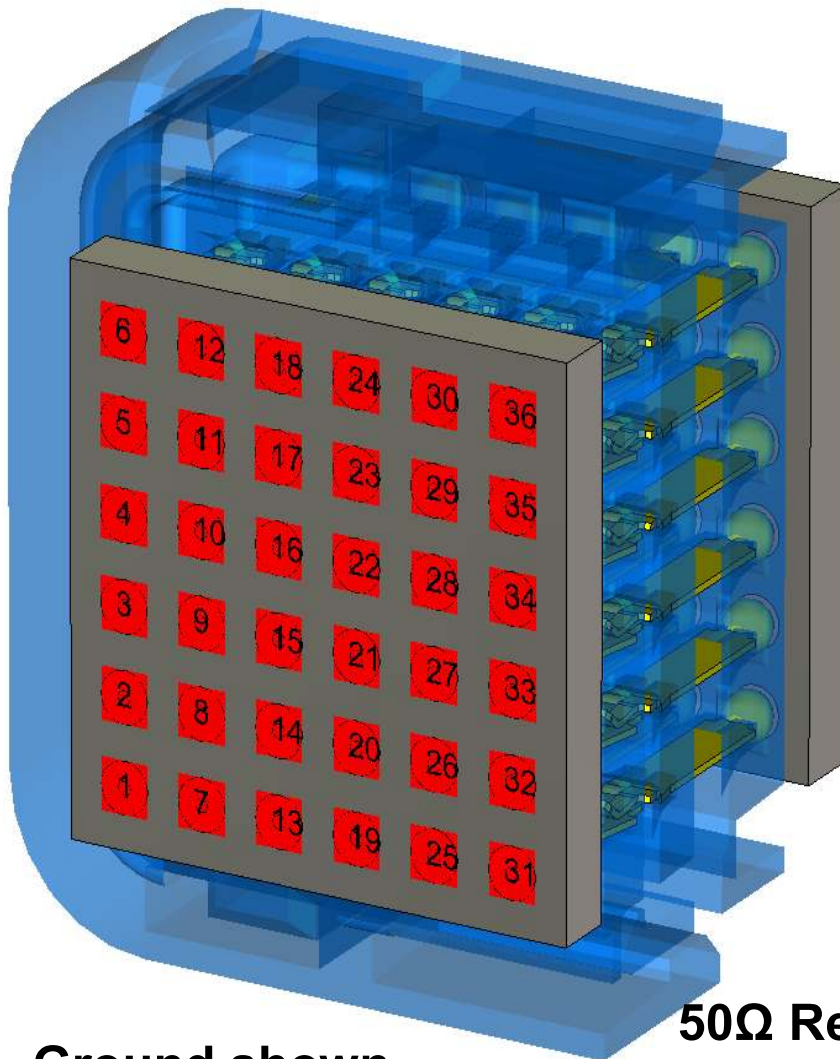
MEG-ARRAY® 8 mm Geometry



Views of 8 mm Part



3D View Showing Ports



Ground shown
(6mm part)

50Ω Reference Ports

Ground hidden
(6mm part)

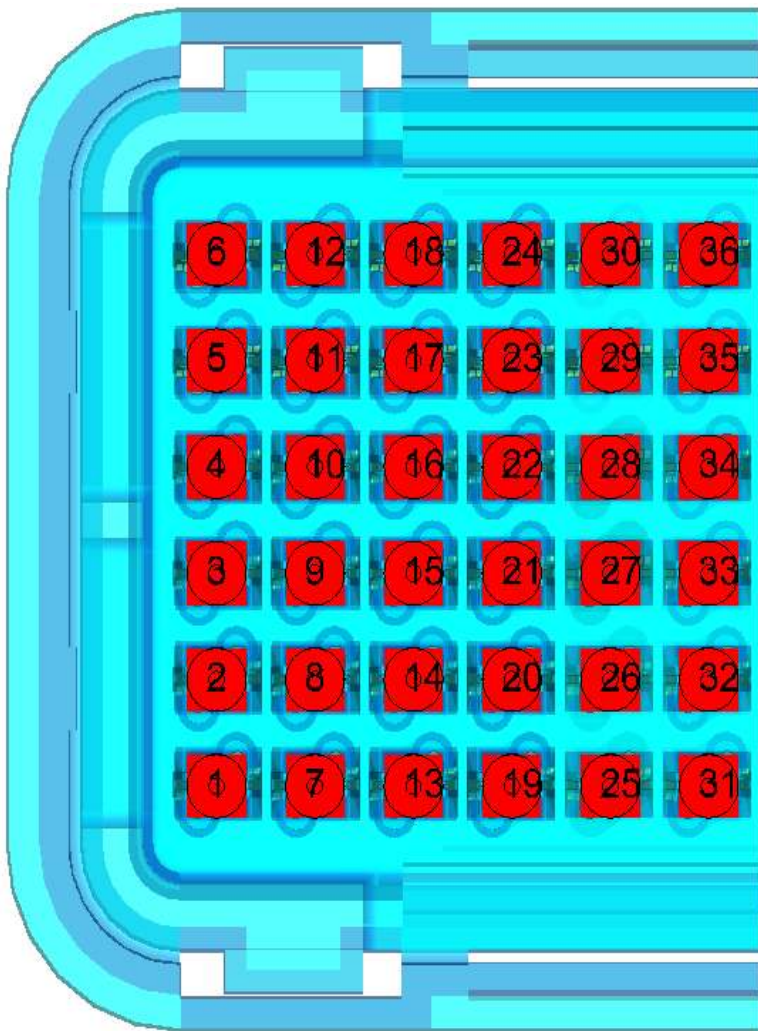
Port 1 connects to port 37, etc.,
Model is BGA to BGA, no vias or pads

MEG-ARRAY[®] 8 mm Geometry



Same Base Model, Various Pin Out Options

White pins are grounded, other pins show pairs.
 Pair numbers indicated on edges, some are indented.



BSC Isolated

	2	4	6	
6	12	18	24	30 36
5	11	17	23	29 35
4	10	16	22	28 34
3	9	15	21	27 33
2	8	14	20	26 32
1	7	13	19	25 31
	1	3	5	

BSC Corner Coupled

	2	5	8			
6	12	18	24	30 36		
5	11	17	23	29 35		
4	10	16	22	28 34		
3	9	15	21	27 33		
2	8	14	20	26 32		
1	7	13	19	25 31		
	1	3	4	6	7	9

BSC Overlap

	2	4	6	8	10	12
6	12	18	24	30	36	
5	11	17	23	29	35	
4	10	16	22	28	34	
3	9	15	21	27	33	
2	8	14	20	26	32	
1	7	13	19	25	31	
	1	3	5	7	9	11

ESC Isolated

	6	12	18	24	30	36	
3	5	11	17	23	29	35	6
2	4	10	16	22	28	34	5
1	3	9	15	21	27	33	4
	2	8	14	20	26	32	3
	1	7	13	19	25	31	2
							1

ESC Corner Coupled

	6	12	18	24	30	36	
6	5	11	17	23	29	35	9
3	4	10	16	22	28	34	6
5	3	9	15	21	27	33	8
2	2	8	14	20	26	32	7
4	1	7	13	19	25	31	5
1							4

ESC Overlap

	12	6	18	24	30	36	12
6	11	17	23	29	35	9	12
3	10	16	22	28	34	11	9
5	9	15	21	27	33	8	11
2	8	14	20	26	32	10	8
4	7	13	19	25	31	7	10
1							7

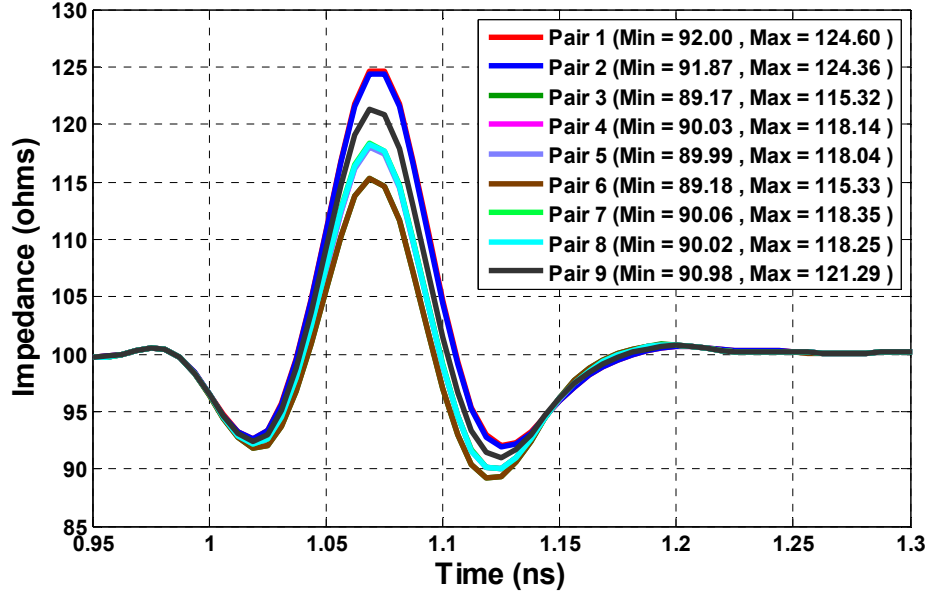
Red ovals show pair for cross talk values

NOTE: Pairs with pins along edge (no grounds) have different results, typically cross talk values will be higher on these pins.

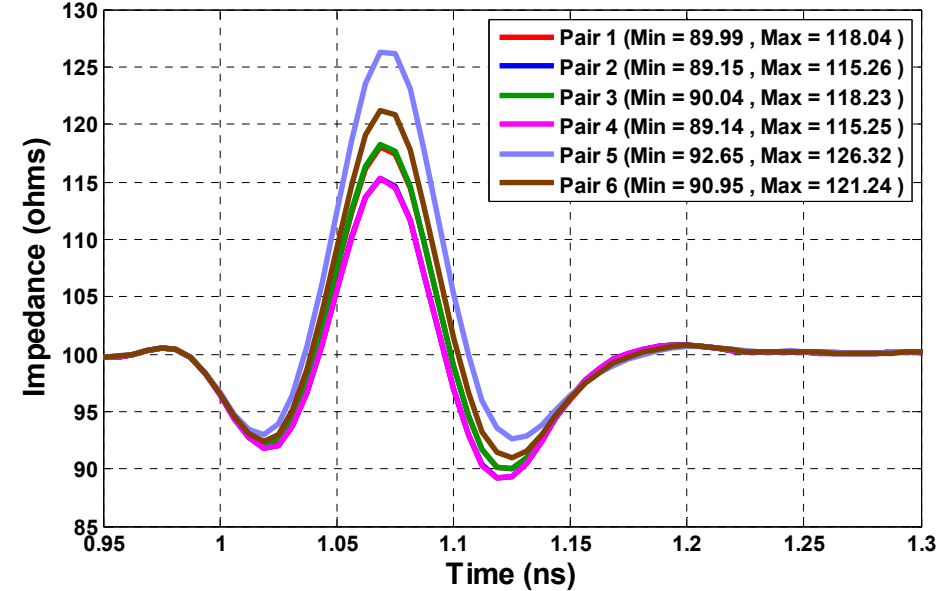
MEG-ARRAY[®] 8 mm Differential Impedance



MA 8mm BSC Corners - DIFF IMPEDANCE - Edge 50ps (10-90%)



MA 8mm BSC Isolated - DIFF IMPEDANCE - Edge 50ps (10-90%)

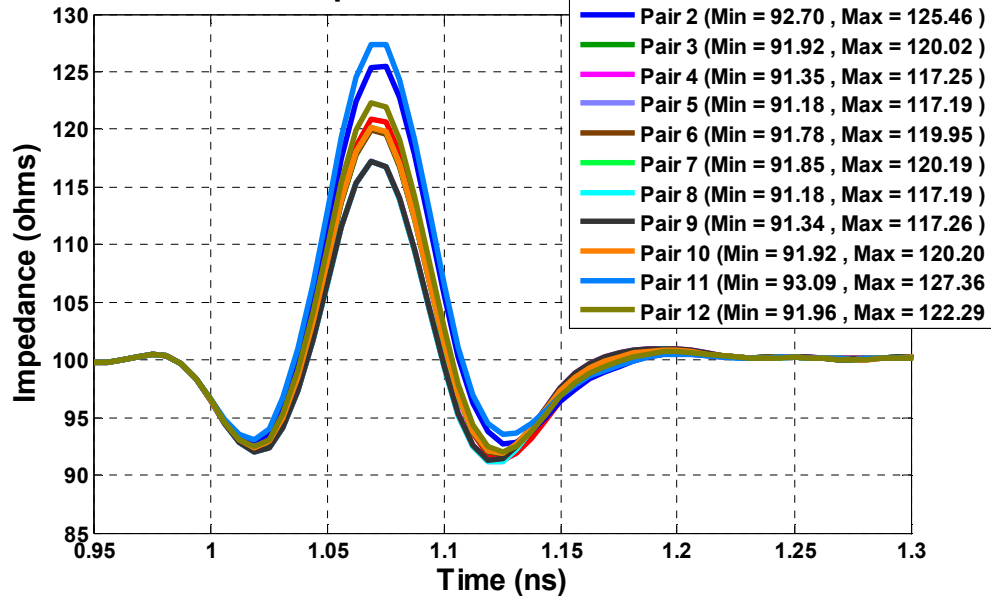


↑
BSC Isolated

↑
BSC Corner Coupled

BSC Overlap →

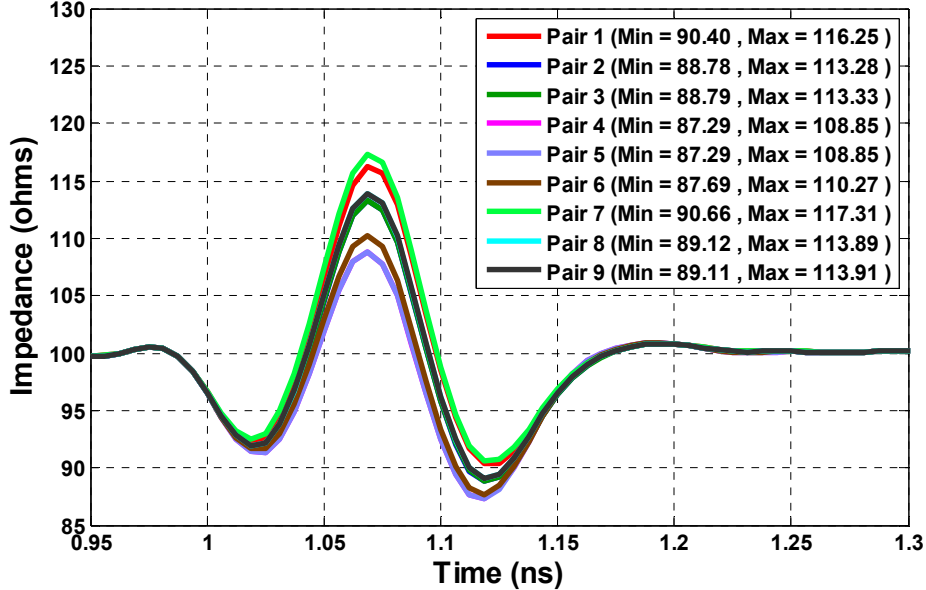
MA 8mm BSC Overlap - DIFF IMPED



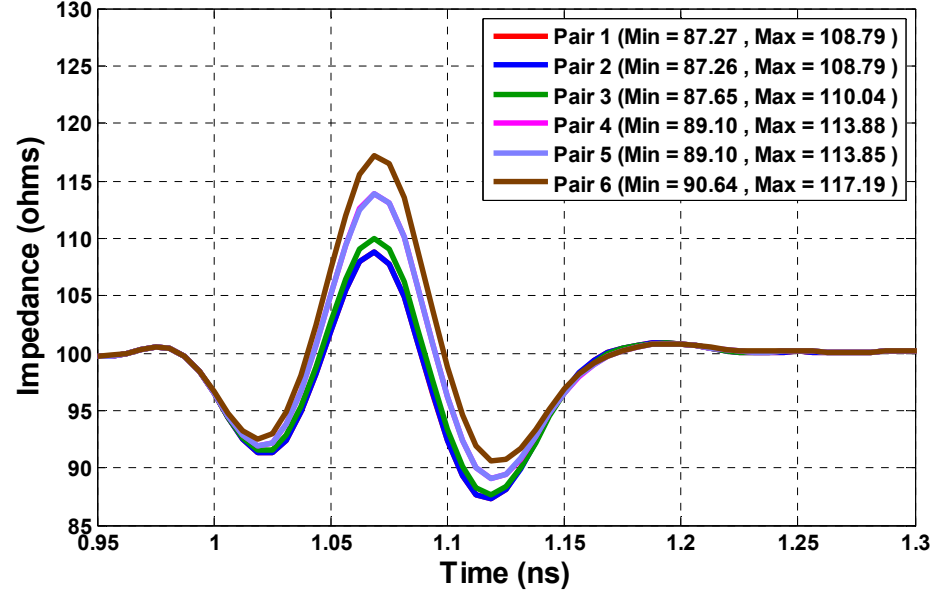
MEG-ARRAY[®] 8 mm Differential Impedance



MA 8mm ESC Corners - DIFF IMPEDANCE - Edge 50ps (10-90%)



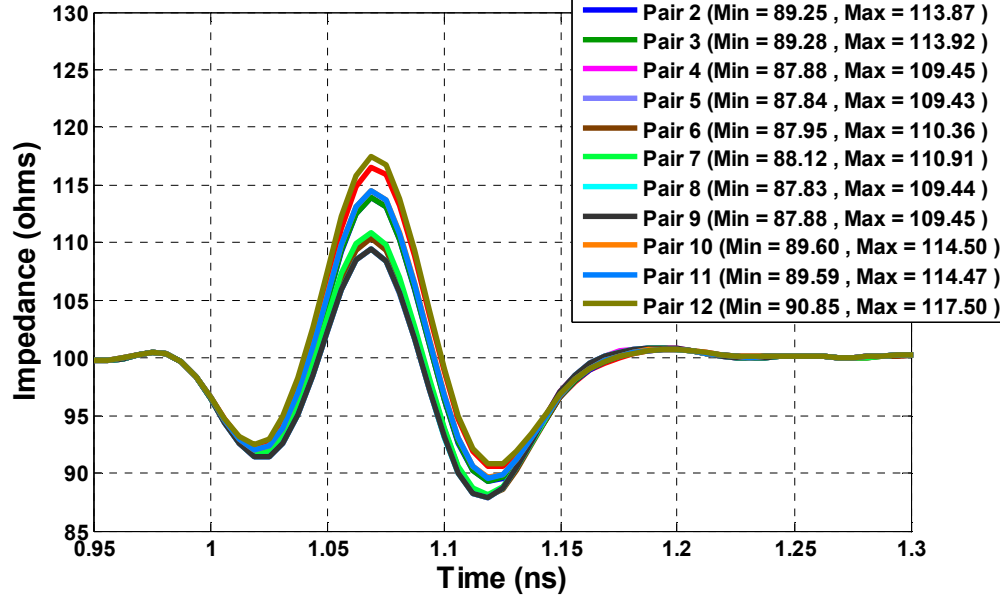
MA 8mm ESC Isolated - DIFF IMPEDANCE - Edge 50ps (10-90%)



↑
ESC Isolated

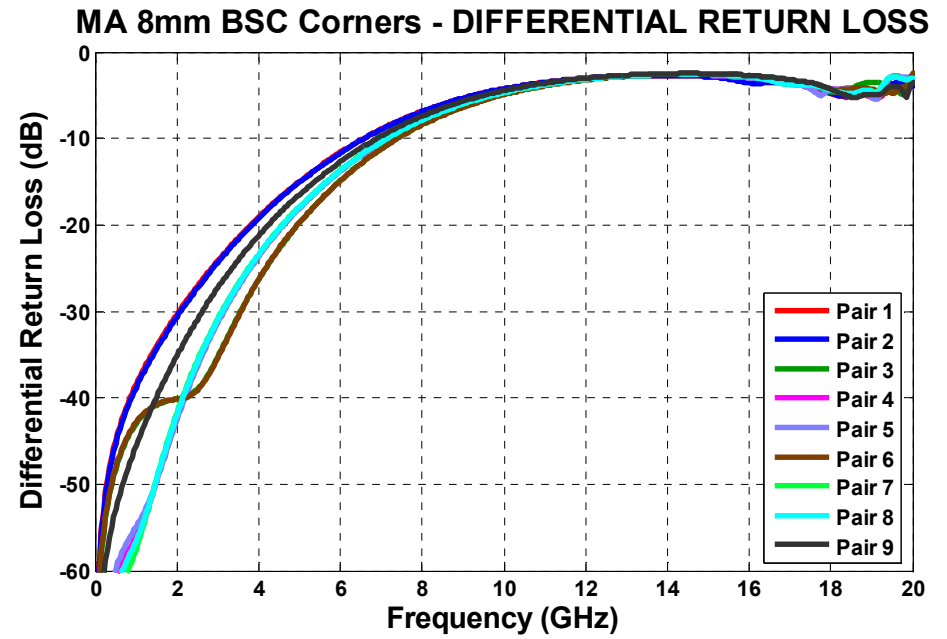
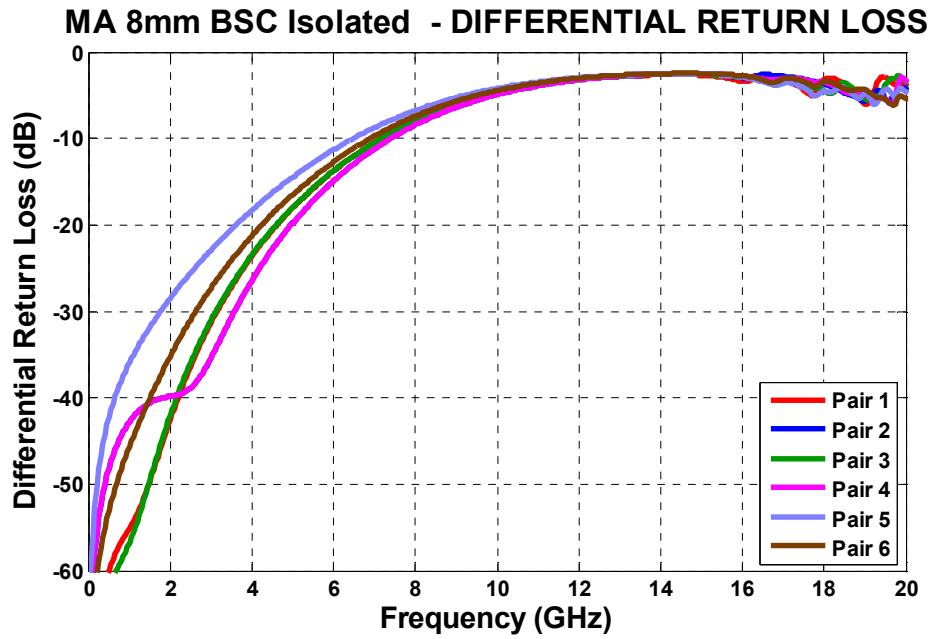
ESC Overlap →

MA 8mm ESC Overlap - DIFF IMPED



↑
ESC Corner Coupled

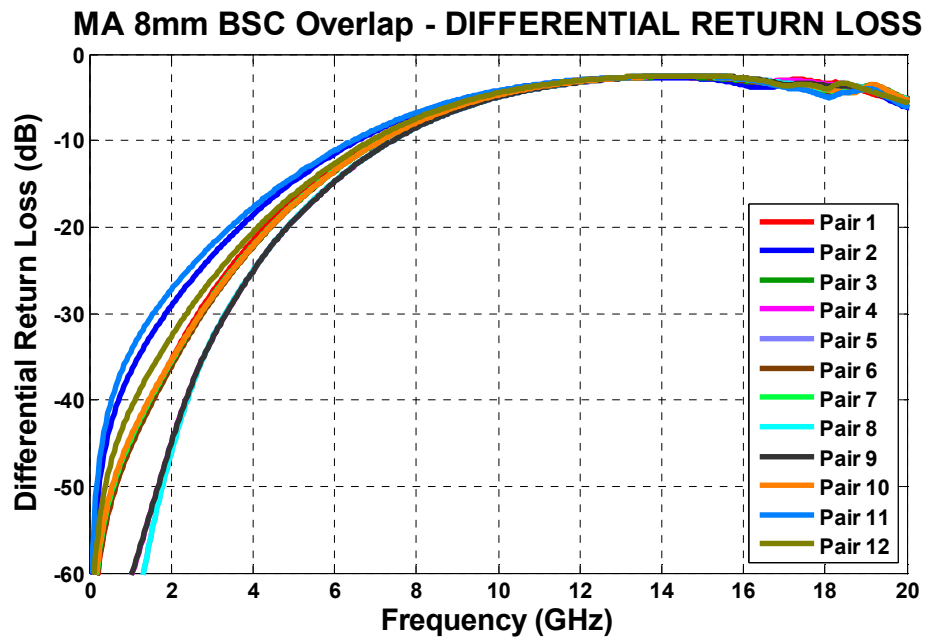
MEG-ARRAY[®] 8 mm Diff. Return Loss



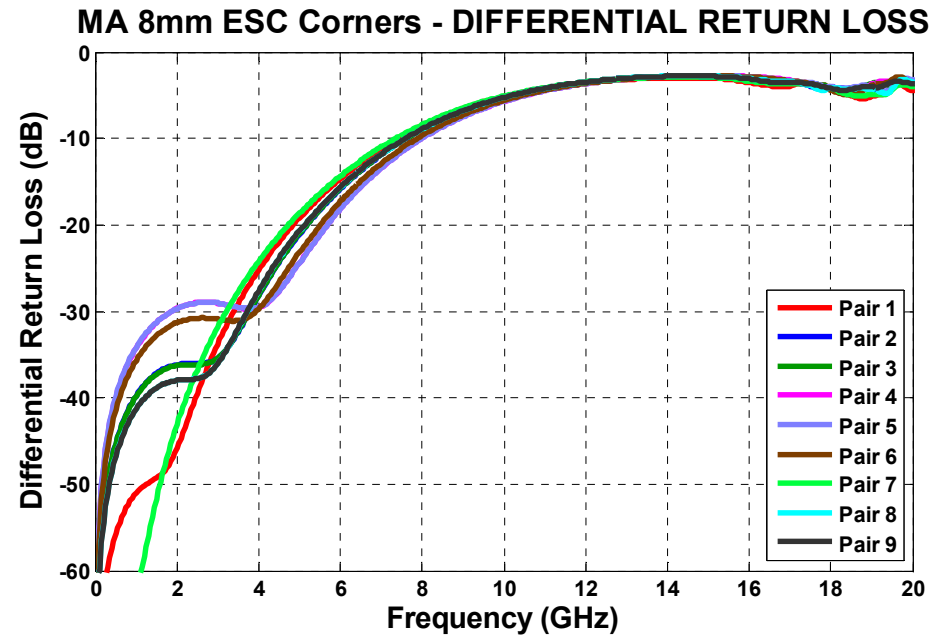
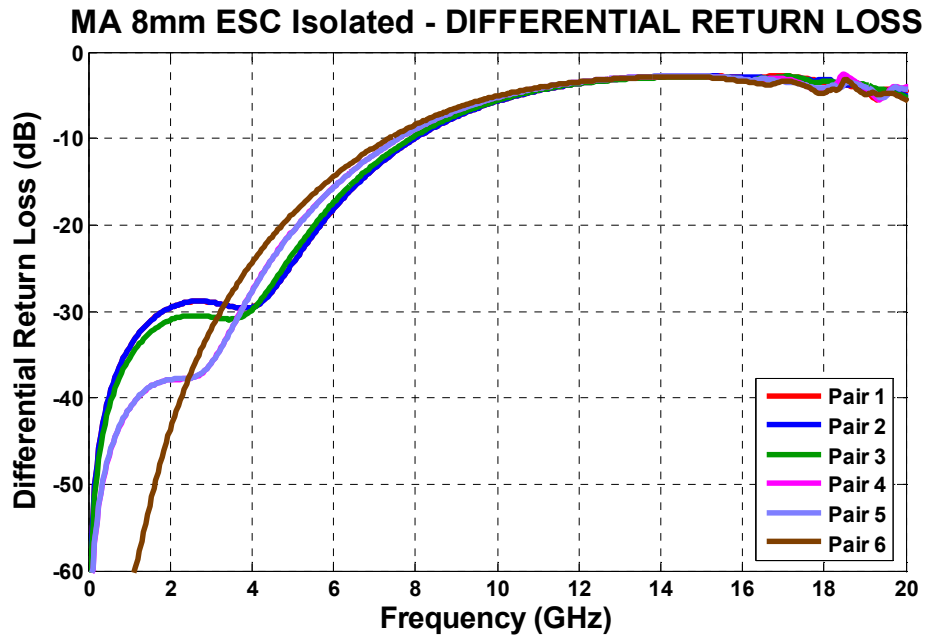
↑
BSC Isolated

↑
BSC Corner Coupled

BSC Overlap →



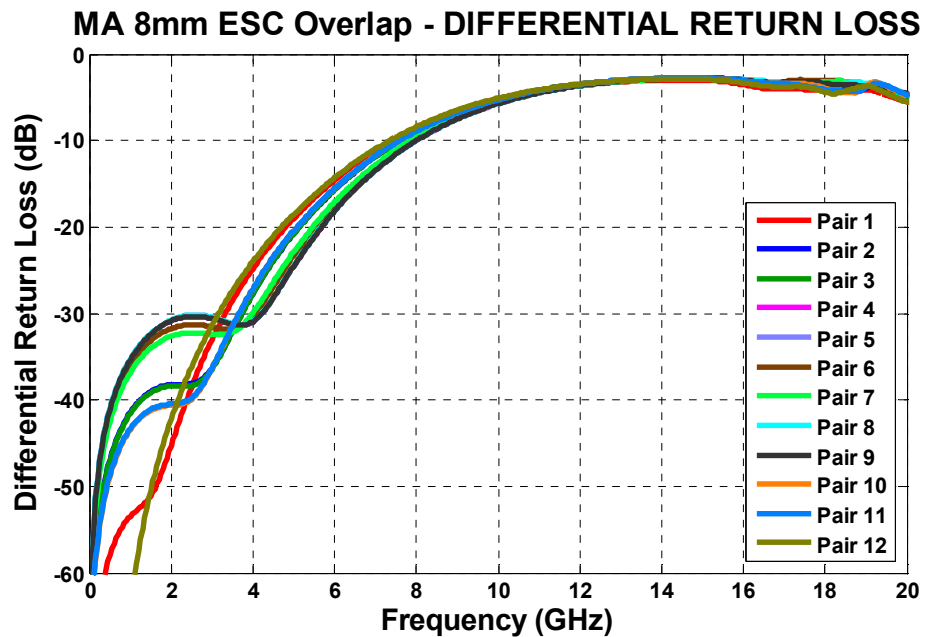
MEG-ARRAY[®] 8 mm Diff. Return Loss



↑
ESC Isolated

↑
ESC Corner Coupled

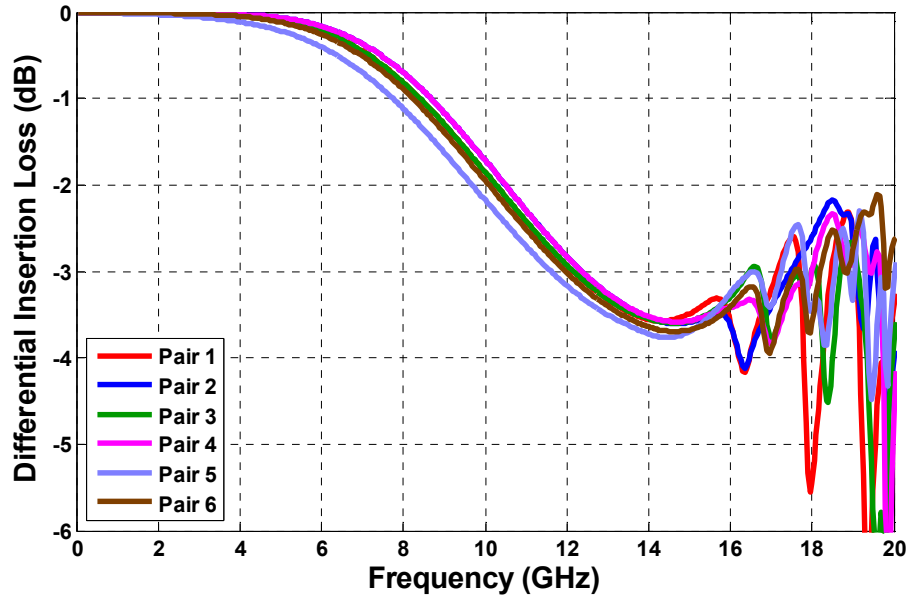
ESC Overlap →



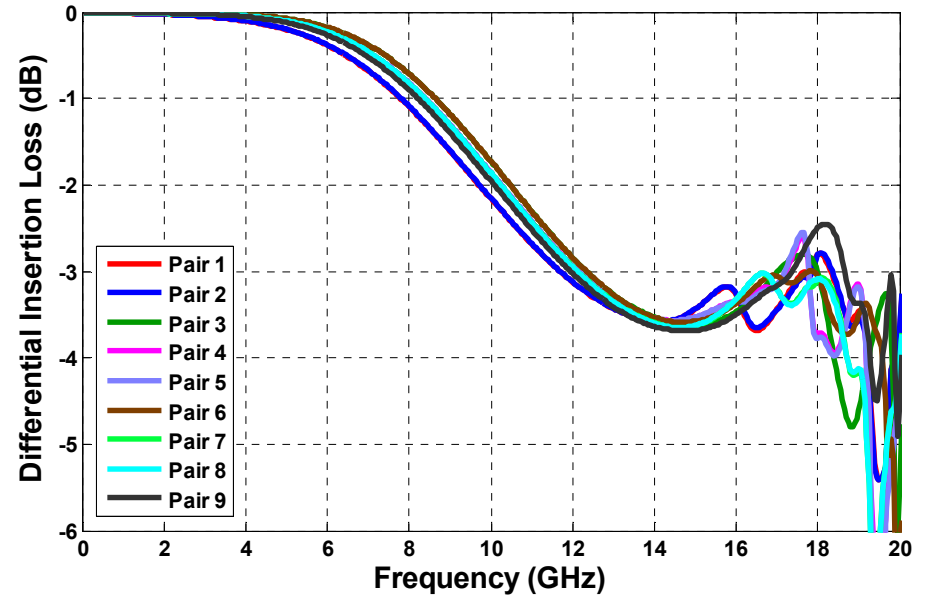
MEG-ARRAY[®] 8 mm Diff. Insertion Loss



MA 8mm BSC Isolated - DIFFERENTIAL INSERTION LOSS



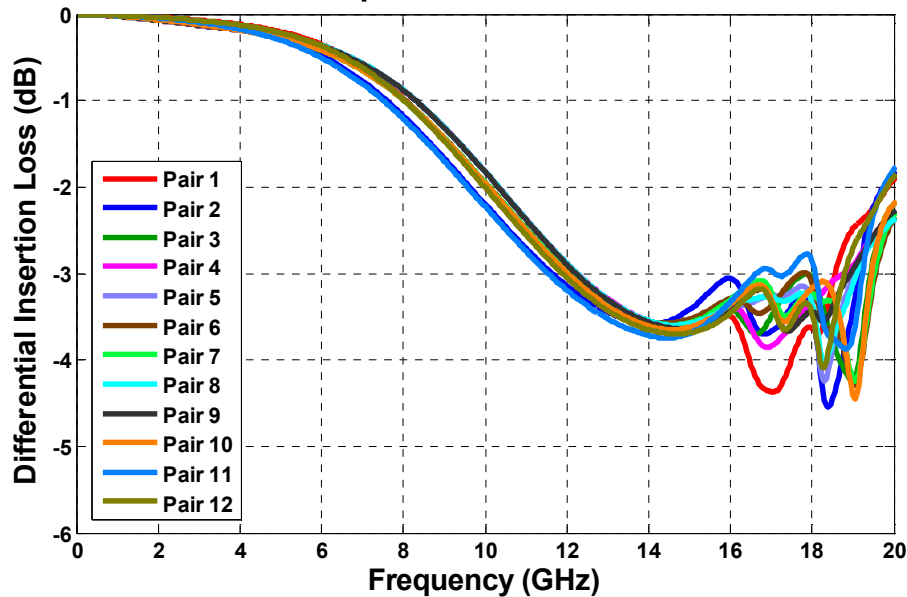
MA 8mm BSC Corners - DIFFERENTIAL INSERTION LOSS



BSC Isolated

BSC Overlap

MA 8mm BSC Overlap - DIFFERENTIAL INSERTION LOSS

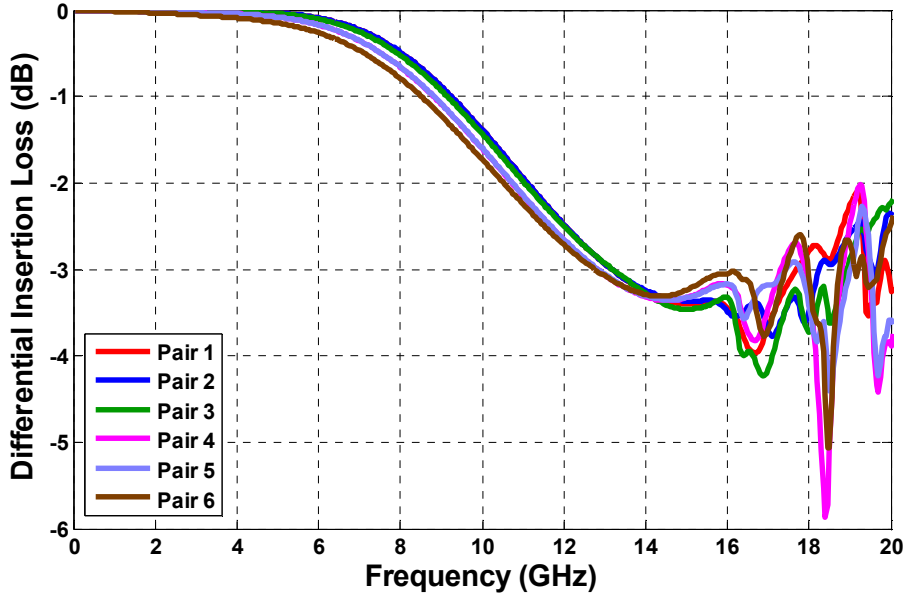


BSC Corner Coupled

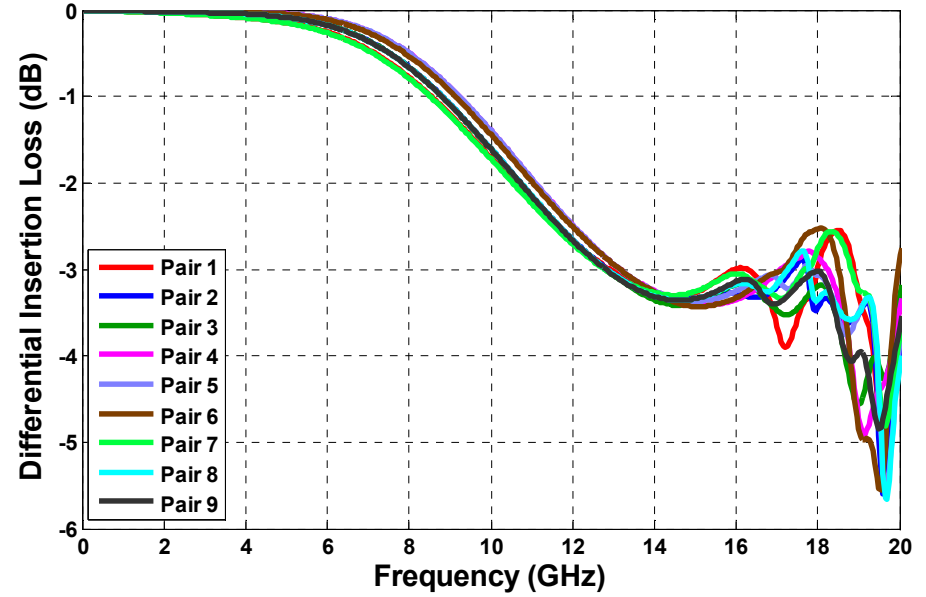
MEG-ARRAY[®] 8 mm Diff. Insertion Loss



MA 8mm ESC Isolated - DIFFERENTIAL INSERTION LOSS



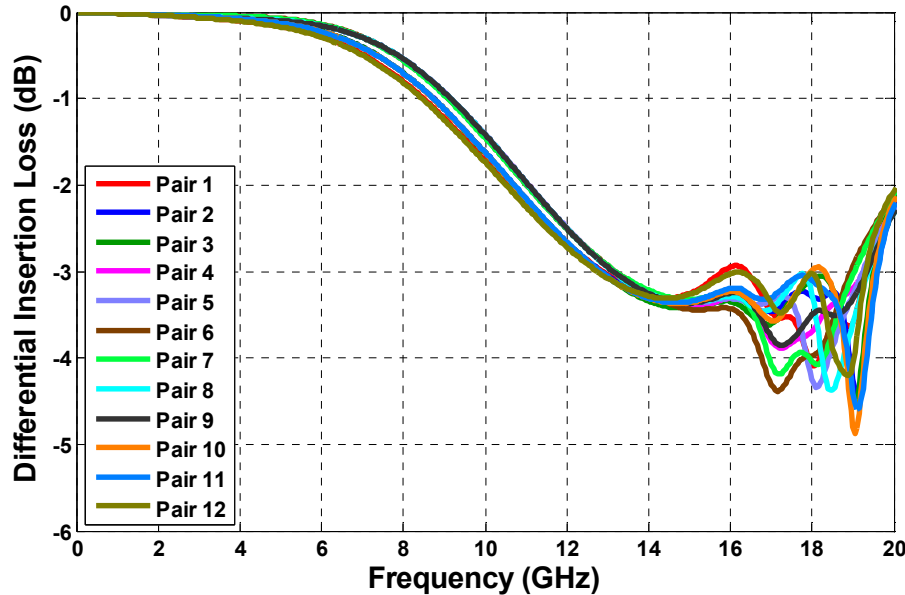
MA 8mm ESC Corners - DIFFERENTIAL INSERTION LOSS



↑
ESC Isolated

↑
ESC Corner Coupled

MA 8mm ESC Overlap - DIFFERENTIAL INSERTION LOSS



ESC Overlap →

MEG-ARRAY[®] 8 mm Differential X-talk



BSC Isolated

BSC Corner Coupled

NEXT[%] - Total NEXT : 0.36 0.23 0.10%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 4	Pair 1	-0.01	-0.01	-0.00
Pair 4	Pair 2	-0.14	-0.09	-0.04
Pair 4	Pair 3	0.04	0.03	0.01
Pair 4	Pair 5	-0.01	-0.01	-0.00
Pair 4	Pair 6	-0.15	-0.10	-0.04

NEXT[%] - Total NEXT : 3.29 2.03 0.85%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 6	Pair 1	0.01	0.01	0.01
Pair 6	Pair 2	0.01	0.01	0.01
Pair 6	Pair 3	-0.12	-0.08	-0.03
Pair 6	Pair 4	-0.70	-0.43	-0.18
Pair 6	Pair 5	-0.80	-0.49	-0.21
Pair 6	Pair 7	-0.80	-0.49	-0.21
Pair 6	Pair 8	-0.70	-0.43	-0.18
Pair 6	Pair 9	-0.14	-0.08	-0.04

FEXT[%] - Total FEXT : 0.69 0.42 0.18%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 4	Pair 7	0.01	0.01	0.00
Pair 4	Pair 8	0.28	0.17	0.07
Pair 4	Pair 9	-0.09	-0.06	-0.02
Pair 4	Pair 11	0.02	0.01	0.01
Pair 4	Pair 12	0.29	0.18	0.07

FEXT[%] - Total FEXT : 0.96 0.48 0.21%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 6	Pair 10	-0.02	-0.01	-0.01
Pair 6	Pair 11	-0.02	-0.01	-0.01
Pair 6	Pair 12	0.26	0.15	0.06
Pair 6	Pair 13	-0.10	-0.03	-0.02
Pair 6	Pair 14	-0.10	-0.04	-0.02
Pair 6	Pair 16	-0.10	-0.04	-0.02
Pair 6	Pair 17	-0.10	-0.03	-0.02
Pair 6	Pair 18	0.28	0.16	0.07

Circled % values are for 50 ps edge rates

BSC Overlap

NEXT[%] - Total NEXT : 9.11 6.14 2.71%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 5	Pair 1	0.50	0.39	0.19
Pair 5	Pair 2	-0.02	-0.01	-0.01
Pair 5	Pair 3	-3.31	-2.19	-0.96
Pair 5	Pair 4	-0.82	-0.51	-0.21
Pair 5	Pair 6	-0.02	0.01	0.00
Pair 5	Pair 7	-3.07	-2.05	-0.90
Pair 5	Pair 8	-0.72	-0.44	-0.18
Pair 5	Pair 9	0.50	0.40	0.19
Pair 5	Pair 10	0.01	0.01	0.01
Pair 5	Pair 11	-0.13	-0.10	-0.05
Pair 5	Pair 12	0.01	-0.02	-0.01

FEXT[%] - Total FEXT : 4.59 2.87 1.25%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 5	Pair 13	-0.55	-0.37	-0.16
Pair 5	Pair 14	0.03	0.02	0.01
Pair 5	Pair 15	1.51	0.93	0.41
Pair 5	Pair 16	0.10	-0.03	-0.01
Pair 5	Pair 18	-0.08	-0.05	-0.01
Pair 5	Pair 19	1.51	0.93	0.40
Pair 5	Pair 20	0.09	-0.03	0.02
Pair 5	Pair 21	-0.55	-0.38	-0.17
Pair 5	Pair 22	0.02	0.01	-0.00
Pair 5	Pair 23	0.13	0.11	0.05
Pair 5	Pair 24	0.02	0.02	0.01

MEG-ARRAY[®] 8 mm Differential X-talk



ESC Isolated

ESC Corner Coupled

NEXT[%] - Total NEXT : 0.17 0.11 0.05%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 2	Pair 1	-0.05	-0.03	-0.01
Pair 2	Pair 3	-0.05	-0.03	-0.01
Pair 2	Pair 4	-0.01	-0.01	-0.00
Pair 2	Pair 5	0.06	0.04	0.02
Pair 2	Pair 6	0.01	-0.01	-0.00

NEXT[%] - Total NEXT : 2.73 1.68 0.70%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 5	Pair 1	0.02	0.01	0.01
Pair 5	Pair 2	-0.62	-0.38	-0.16
Pair 5	Pair 3	-0.70	-0.43	-0.18
Pair 5	Pair 4	-0.03	-0.02	-0.01
Pair 5	Pair 6	-0.03	-0.02	-0.01
Pair 5	Pair 7	0.01	0.01	0.01
Pair 5	Pair 8	-0.70	-0.43	-0.18
Pair 5	Pair 9	-0.62	-0.38	-0.16

FEXT[%] - Total FEXT : 0.37 0.24 0.10%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 2	Pair 7	0.09	0.05	0.02
Pair 2	Pair 9	0.09	0.06	0.02
Pair 2	Pair 10	-0.01	0.01	0.00
Pair 2	Pair 11	-0.17	-0.11	-0.04
Pair 2	Pair 12	0.01	-0.01	0.00

FEXT[%] - Total FEXT : 0.51 0.28 0.13%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 5	Pair 10	-0.02	-0.01	-0.01
Pair 5	Pair 11	-0.08	-0.04	-0.02
Pair 5	Pair 12	-0.09	-0.04	-0.02
Pair 5	Pair 13	0.07	0.05	0.02
Pair 5	Pair 15	0.07	0.05	0.02
Pair 5	Pair 16	-0.02	-0.01	-0.01
Pair 5	Pair 17	-0.08	-0.04	-0.02
Pair 5	Pair 18	-0.08	-0.04	-0.02

Circled % values are for 50 ps edge rates

ESC Overlap

NEXT[%] - Total NEXT : 4.27 2.87 1.23%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 8	Pair 1	-0.02	-0.01	-0.01
Pair 8	Pair 2	0.04	0.02	0.01
Pair 8	Pair 3	-0.02	-0.01	-0.01
Pair 8	Pair 4	-0.64	-0.40	-0.17
Pair 8	Pair 5	-0.72	-0.45	-0.19
Pair 8	Pair 6	0.01	-0.01	-0.00
Pair 8	Pair 7	0.15	0.12	0.06
Pair 8	Pair 9	0.15	0.12	0.06
Pair 8	Pair 10	-1.15	-0.79	-0.34
Pair 8	Pair 11	-1.35	-0.91	-0.39
Pair 8	Pair 12	-0.02	-0.01	-0.01

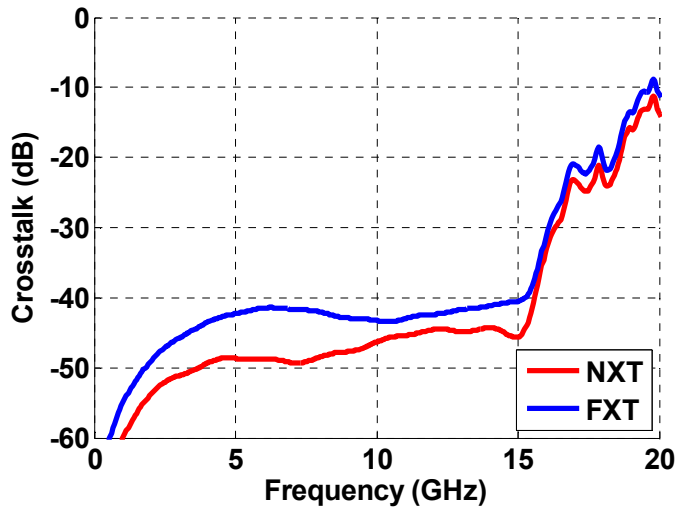
FEXT[%] - Total FEXT : 1.79 1.08 0.42%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 8	Pair 13	0.03	0.01	0.00
Pair 8	Pair 14	-0.16	-0.10	-0.04
Pair 8	Pair 15	0.02	0.01	0.00
Pair 8	Pair 16	-0.08	-0.03	-0.01
Pair 8	Pair 17	-0.09	-0.03	-0.01
Pair 8	Pair 18	-0.01	0.01	-0.00
Pair 8	Pair 19	-0.17	-0.11	-0.05
Pair 8	Pair 21	-0.17	-0.12	-0.05
Pair 8	Pair 22	0.54	0.33	0.13
Pair 8	Pair 23	0.51	0.31	0.12
Pair 8	Pair 24	0.02	0.02	0.01

MEG-ARRAY[®] 8 mm Differential X-talk



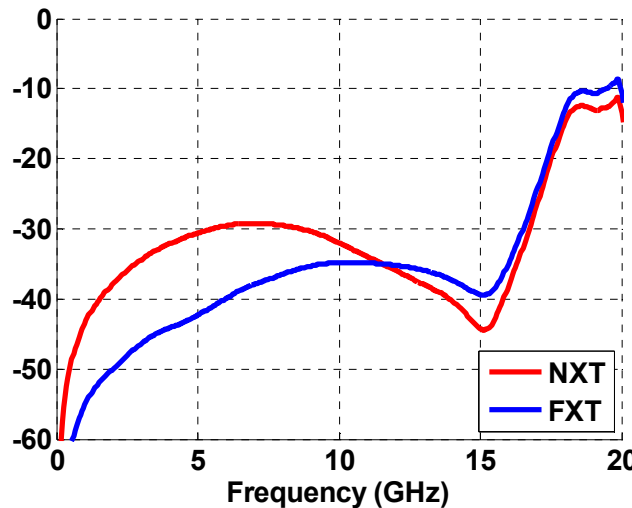
BSC Isolated

Pair 4: POWER SUMMATION OF X-TALK



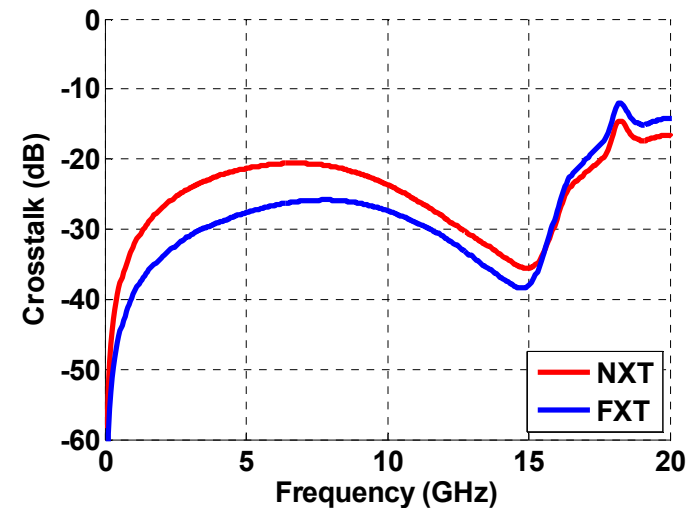
BSC Corner Coupled

Pair 6: POWER SUMMATION OF X-TALK

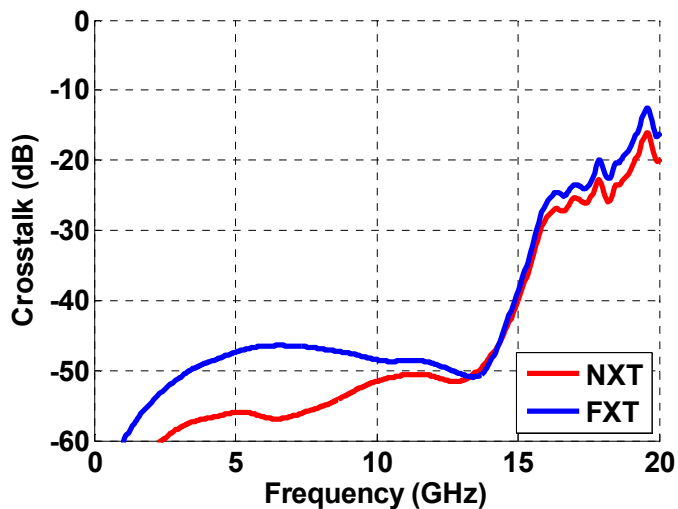


BSC Overlap

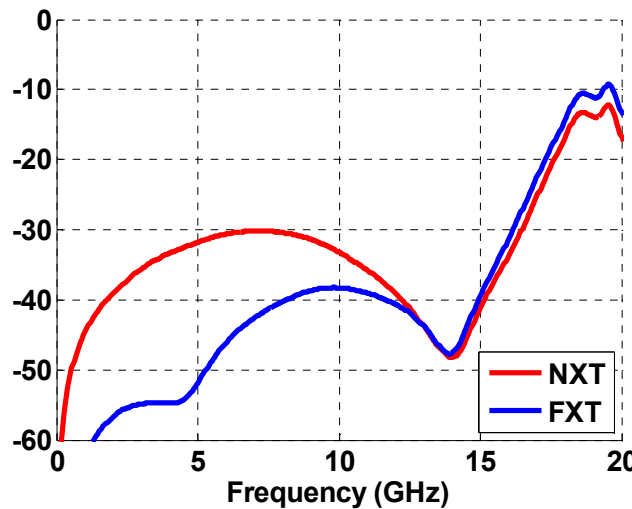
Pair 5: POWER SUMMATION OF X-TALK



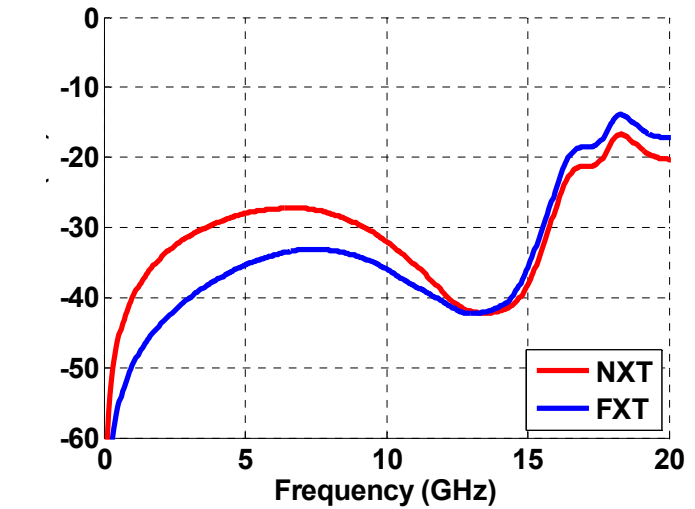
Pair 2: POWER SUMMATION OF X-TALK



Pair 5: POWER SUMMATION OF X-TALK



Pair 8: POWER SUMMATION OF X-TALK



ESC Isolated

ESC Corner Coupled

ESC Overlap

- Minor changes between BSC and ESC (ESC is better)
 - ESC impedance is lower while ESC cross talk is better
- Pair density mostly impacts cross talk
 - Minor changes to Impedance, RL, and IL
 - Outer edge pairs should be avoided or investigated better since cross talk levels are higher
 - Pairs chosen to show typical values, not every combination
- Best practices should be used to impedance match vias and SMT pads (voids under pads on adjacent power/ground layer)
 - Board design can limit connector performance significantly