

MEG-ARRAY[®] 14 mm Comparison Results Broad Side Coupled versus Edge Side Coupled from a Larger 6x6 Model

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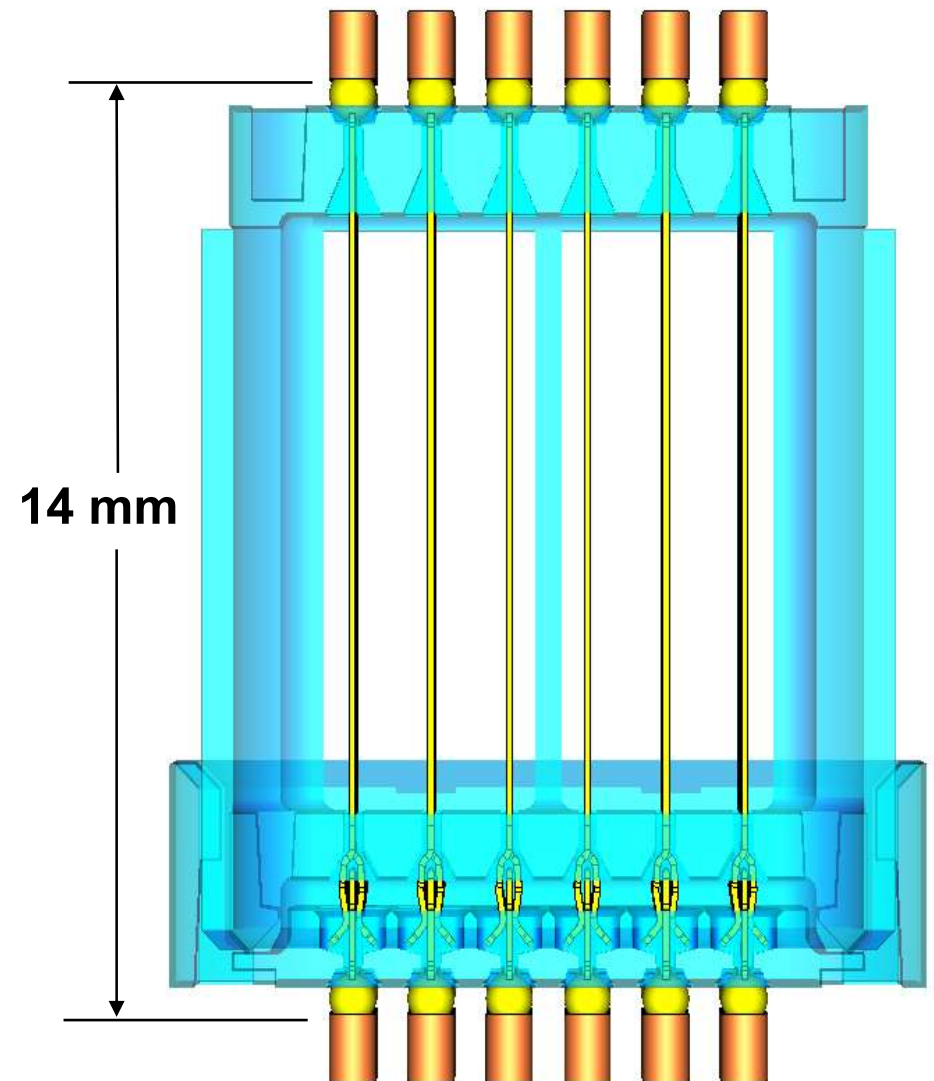
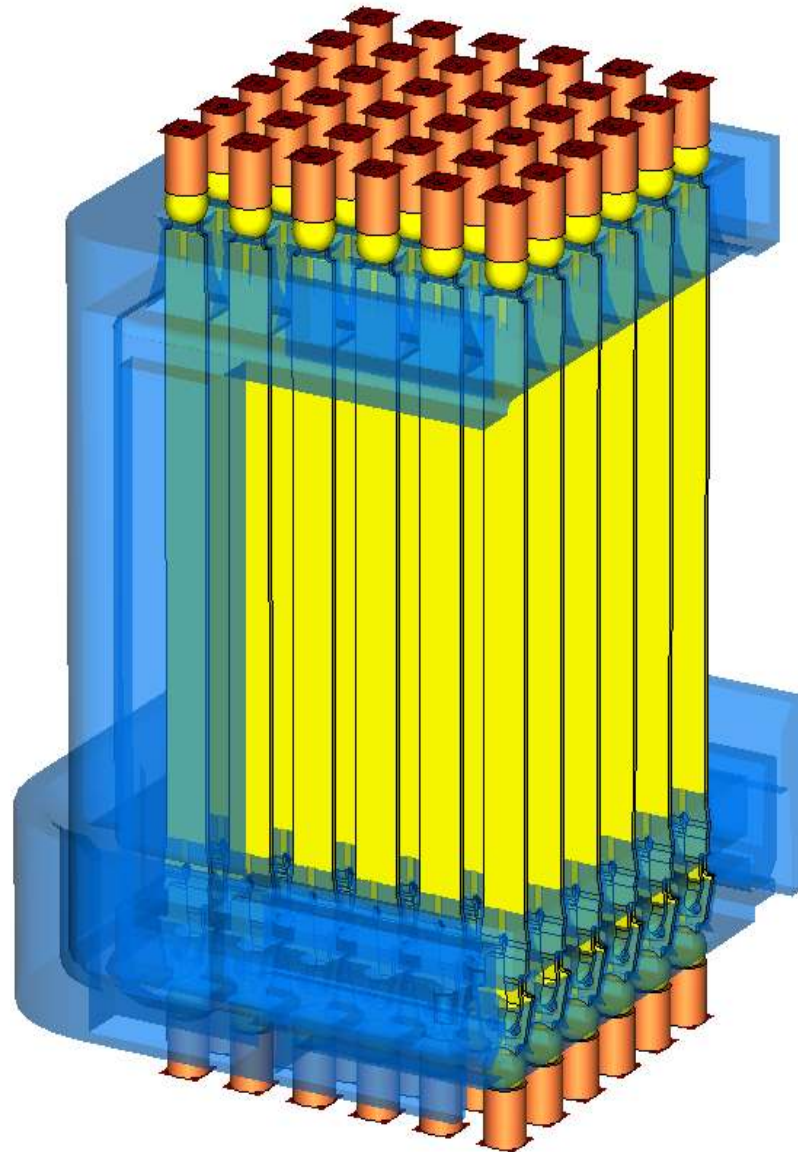
Senior Signal Integrity Engineer

January 19, 2009

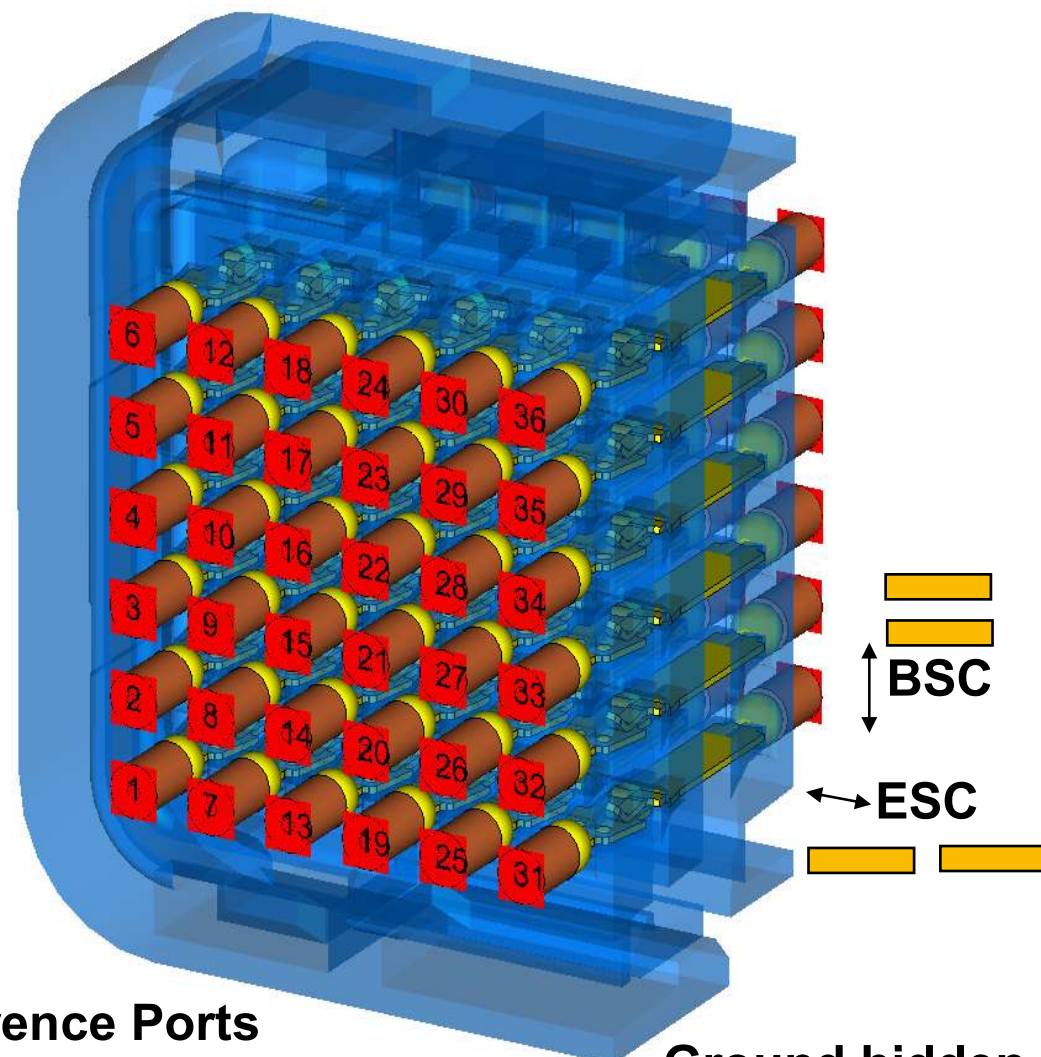
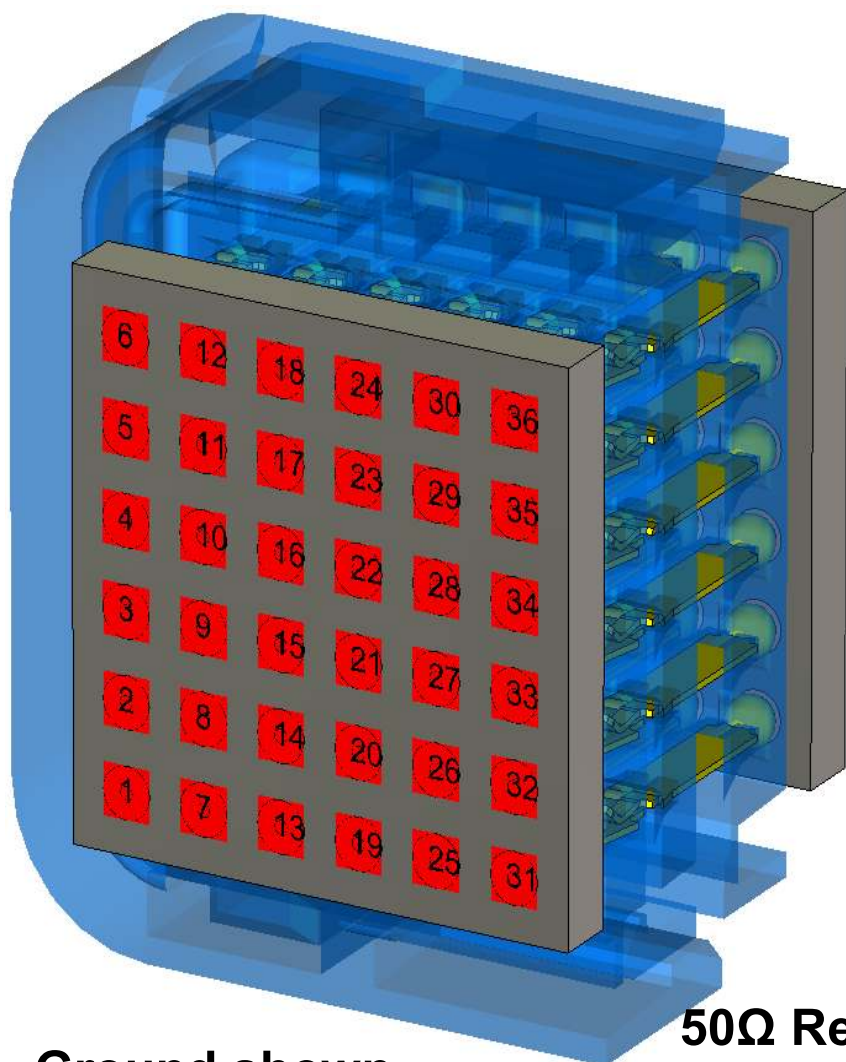
MEG-ARRAY® 14 mm Geometry



Views of 14 mm Part



3D View Showing Ports



Ground shown
(6mm part)

50Ω Reference Ports

Ground hidden
(6mm part)

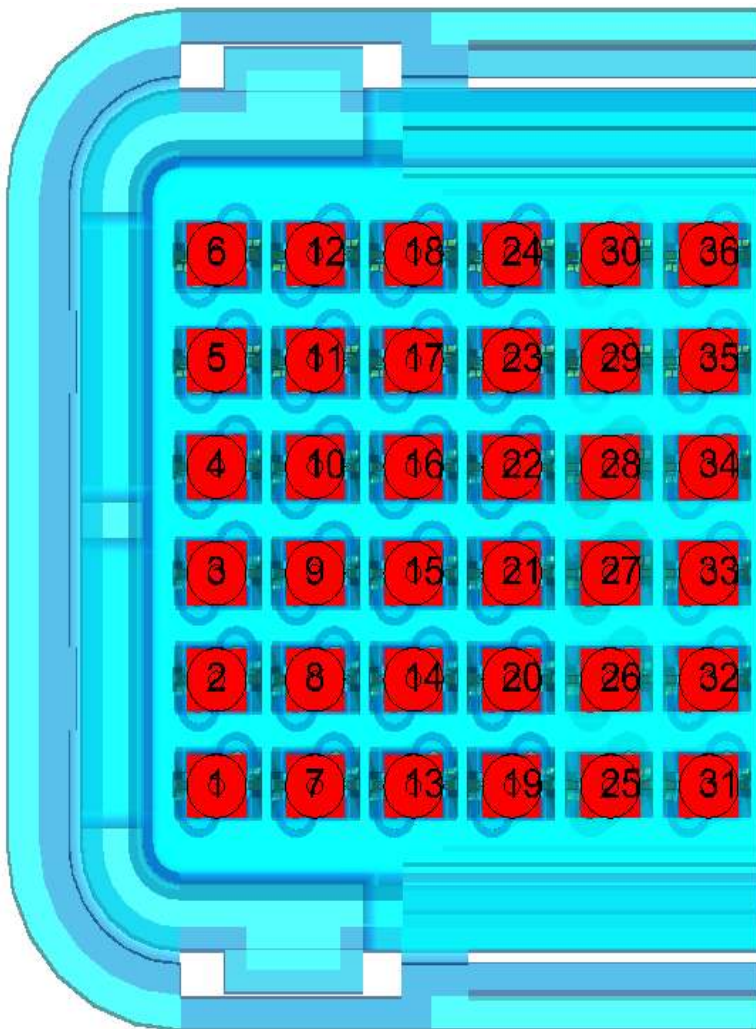
Port 1 connects to port 37, etc.,
Model is BGA to BGA, no vias or pads

MEG-ARRAY® 14 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	8
5	3	9	15	21	27	33	7
2	2	8	14	20	26	32	6
4	1	7	13	19	25	31	5
1							4
							3
							2
							1

ESC Overlap

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

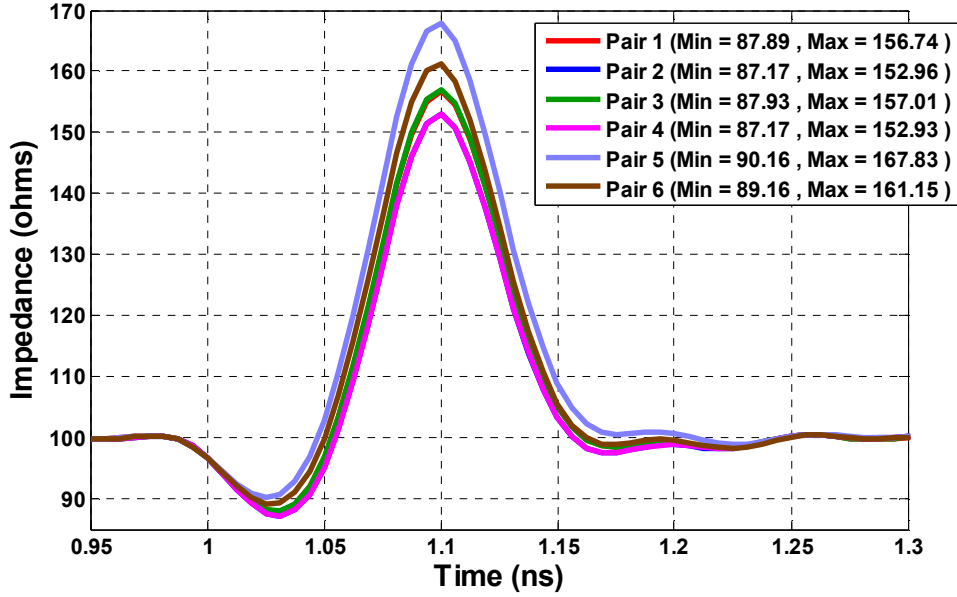
Red ovals show pair for cross talk values

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

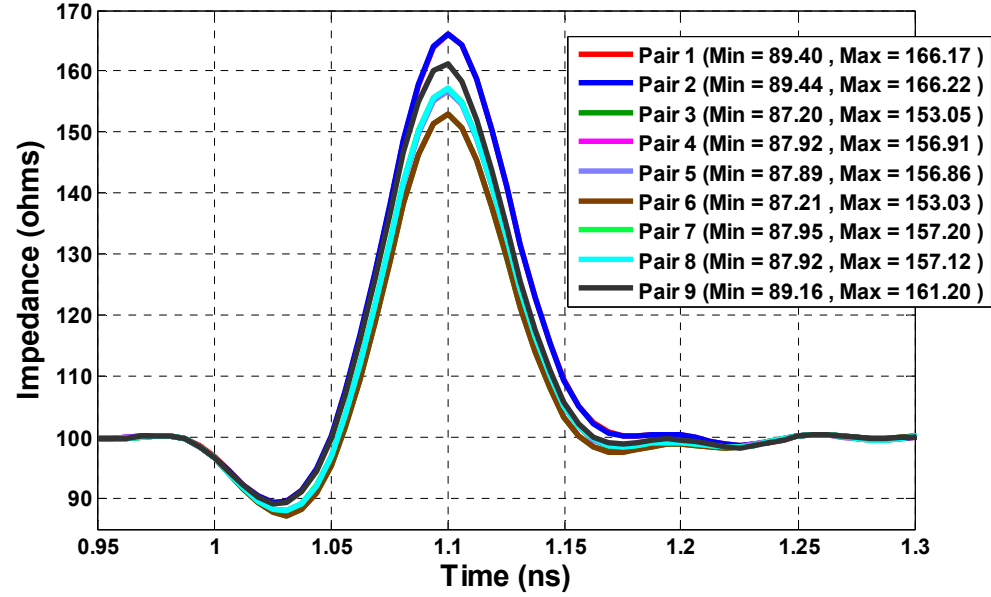
MEG-ARRAY[®] 14 mm Differential Impedance



MA 14mm BSC Isolated - DIFF IMPEDANCE - Edge 50ps (10-90%)



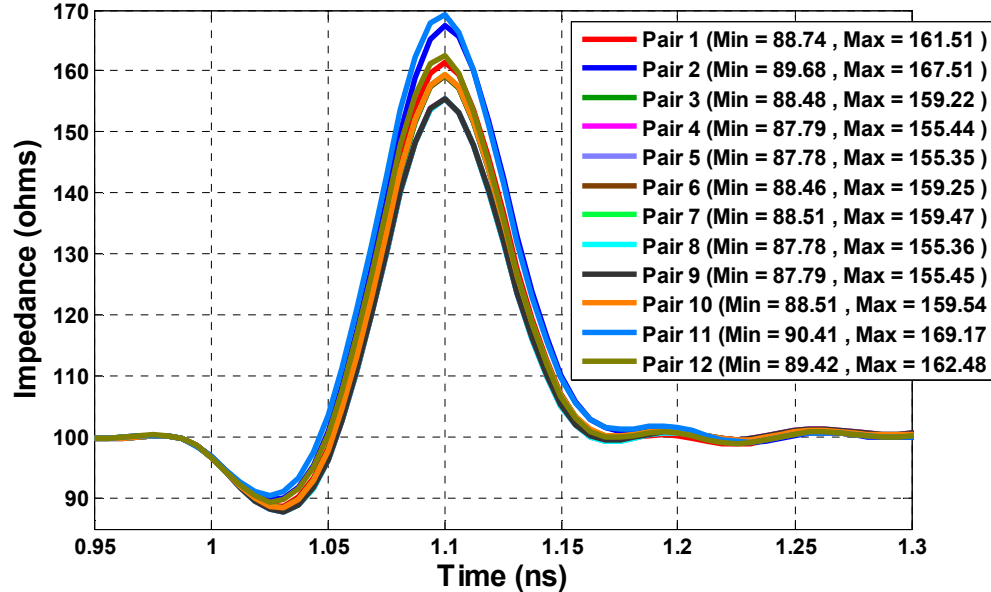
MA 14mm BSC Corners - DIFF IMPEDANCE - Edge 50ps (10-90%)



↑
BSC Isolated

↑
BSC Corner Coupled

MA 14mm BSC Overlap - DIFF IMPEDANCE - Edge 50ps (10-90%)

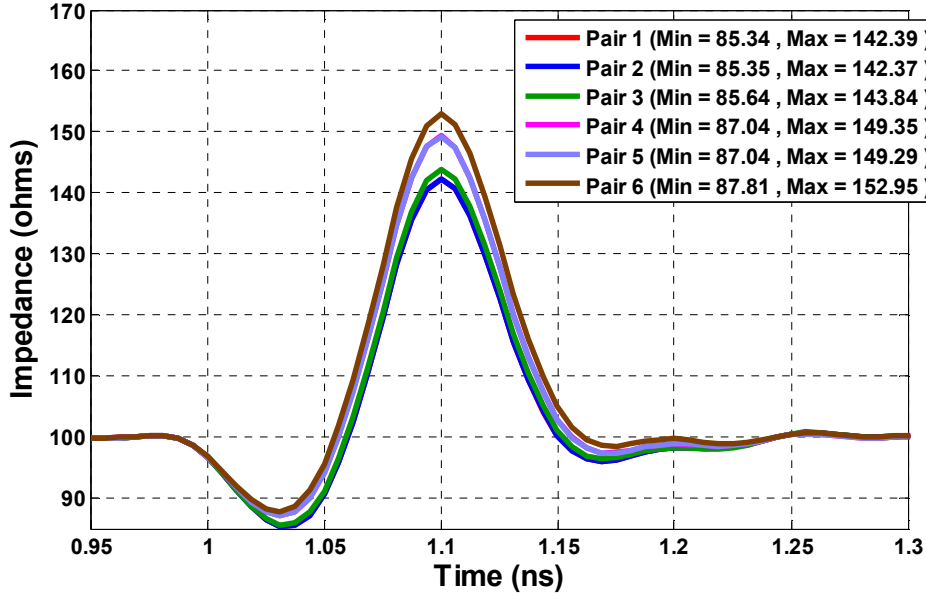


→
BSC Overlap

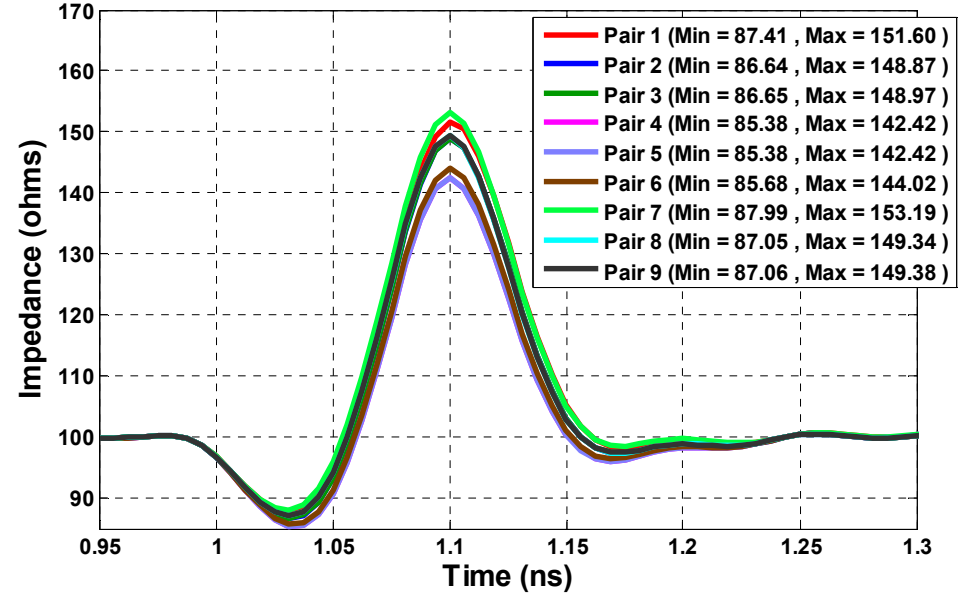
MEG-ARRAY[®] 14 mm Differential Impedance



MA 14mm ESC Isolated - DIFF IMPEDANCE - Edge 50ps (10-90%)



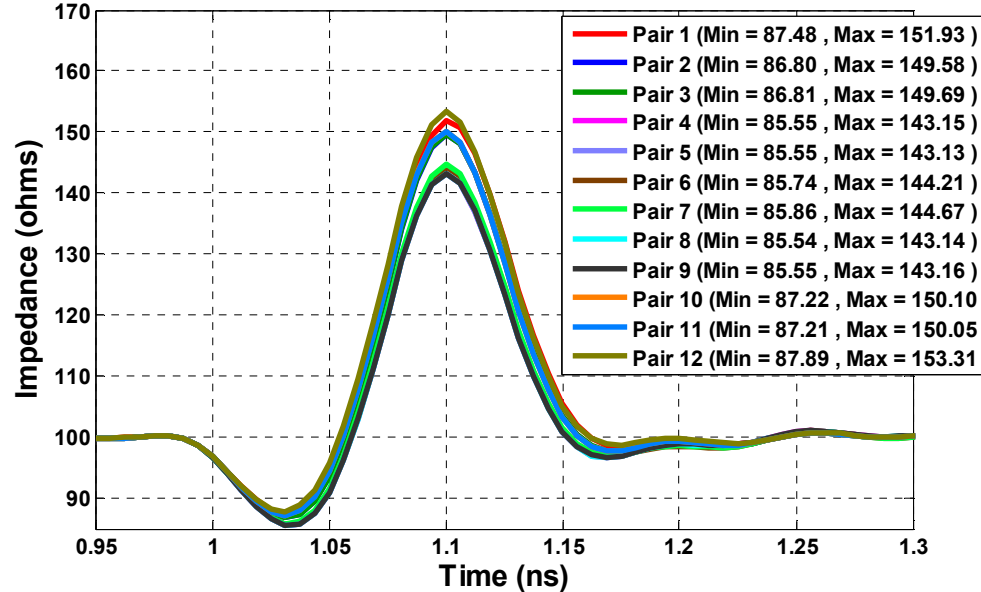
MA 14mm ESC Corners - DIFF IMPEDANCE - Edge 50ps (10-90%)



↑
ESC Isolated

↑
ESC Corner Coupled

MA 14mm ESC Overlap - DIFF IMPEDANCE - Edge 50ps (10-90%)

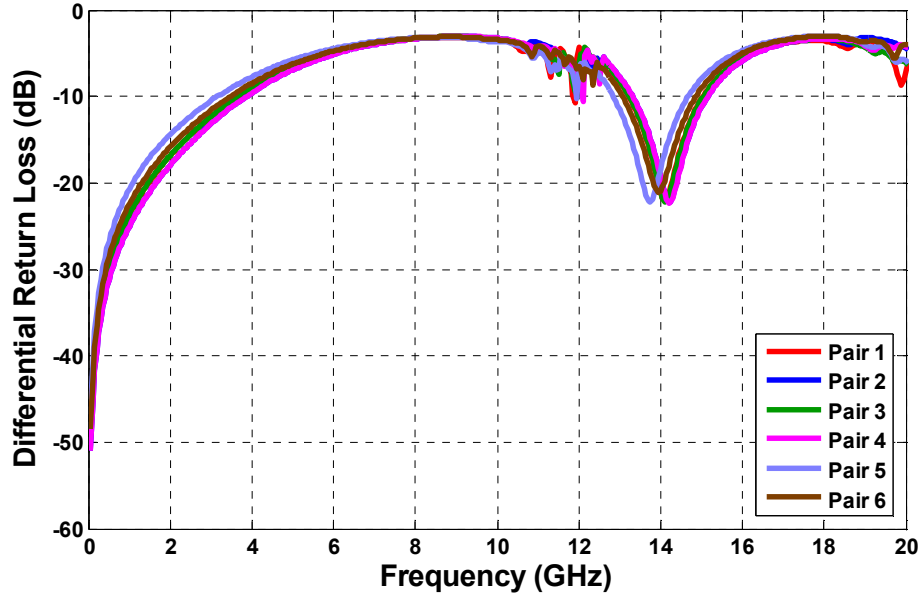


ESC Overlap →

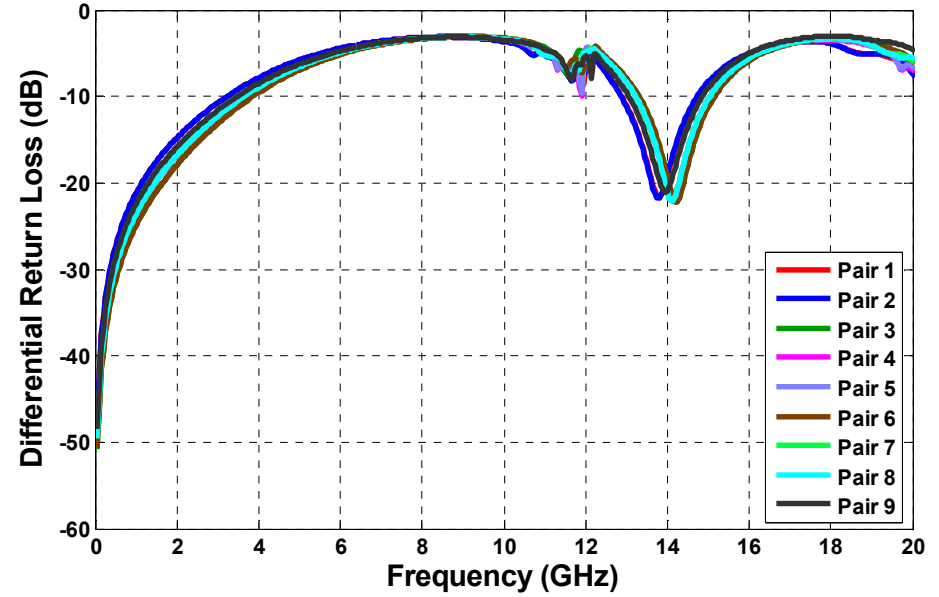
MEG-ARRAY[®] 14 mm Diff. Return Loss



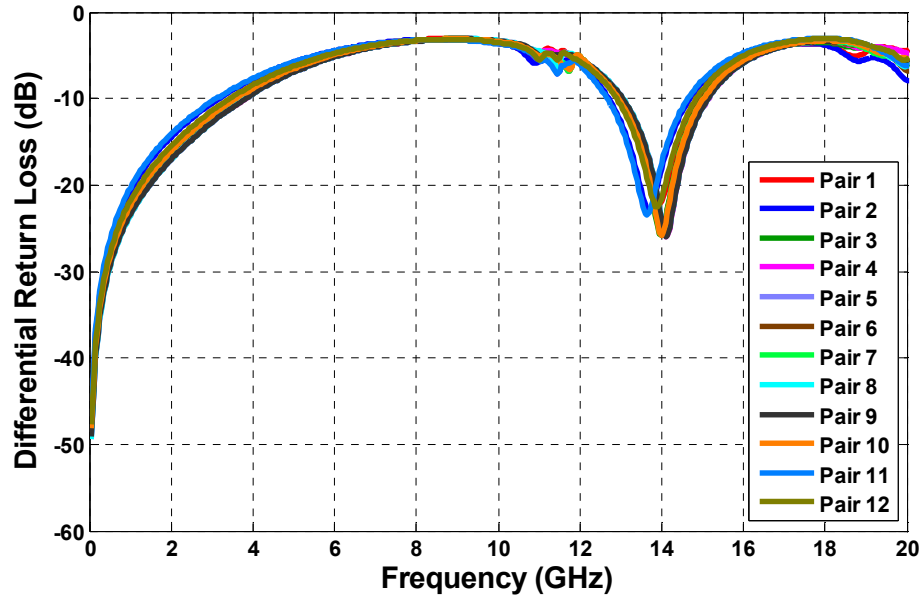
MA 14mm BSC Isolated - DIFFERENTIAL RETURN LOSS



MA 14mm BSC Corners - DIFFERENTIAL RETURN LOSS



MA 14mm BSC Overlap - DIFFERENTIAL RETURN LOSS



↑
BSC Isolated

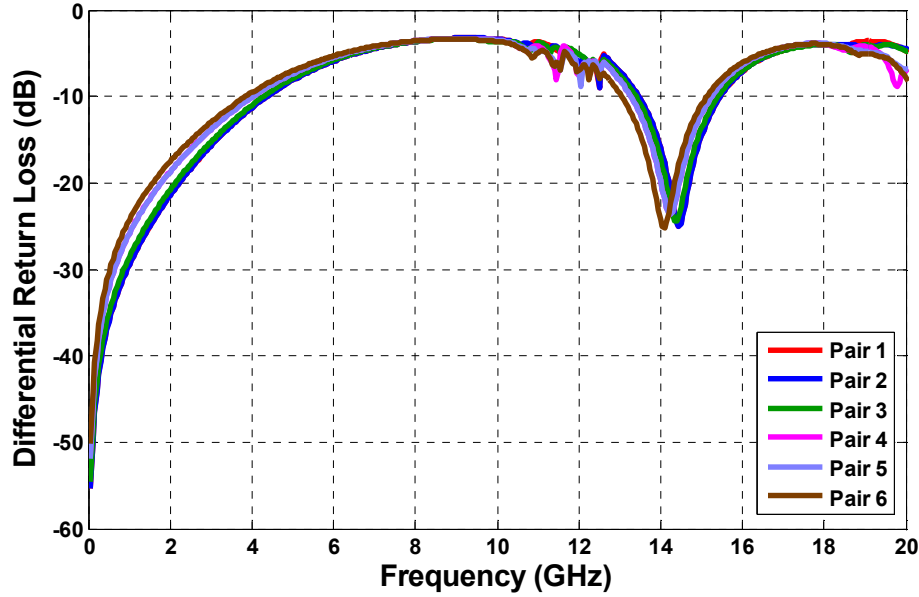
↑
BSC Corner Coupled

BSC Overlap →

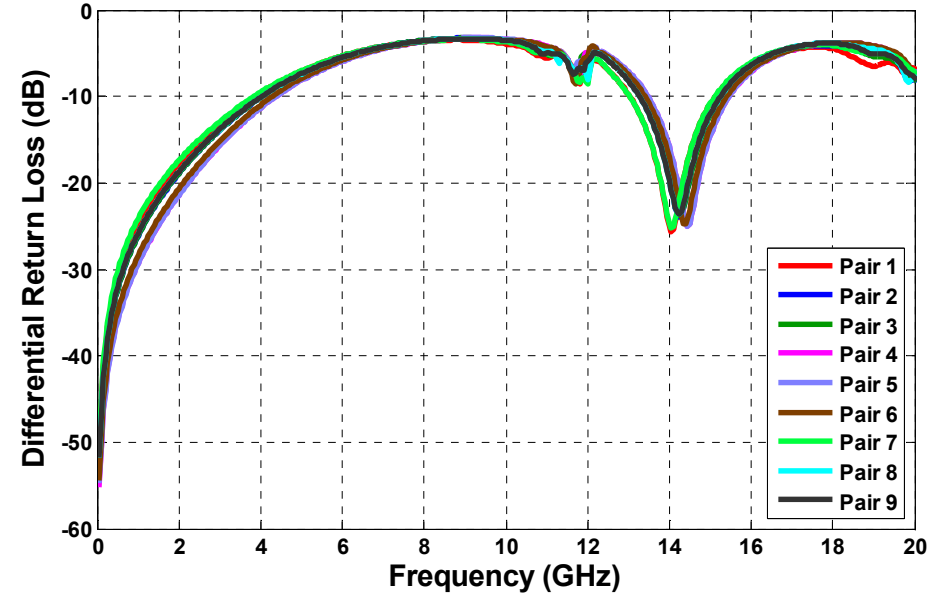
MEG-ARRAY[®] 14 mm Diff. Return Loss



MA 14mm ESC Isolated - DIFFERENTIAL RETURN LOSS



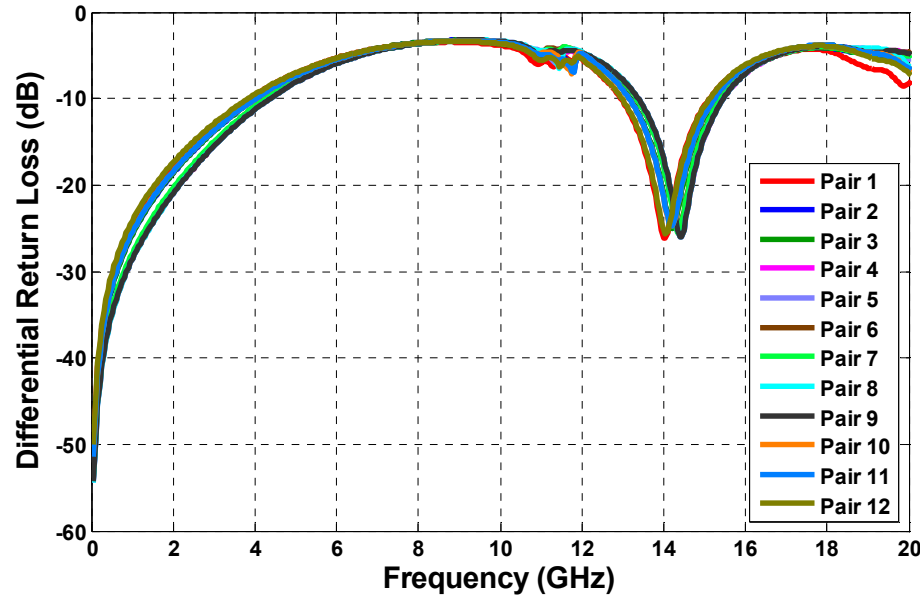
MA 14mm ESC Corners - DIFFERENTIAL RETURN LOSS



ESC Isolated

ESC Corner Coupled

MA 14mm ESC Overlap - DIFFERENTIAL RETURN LOSS

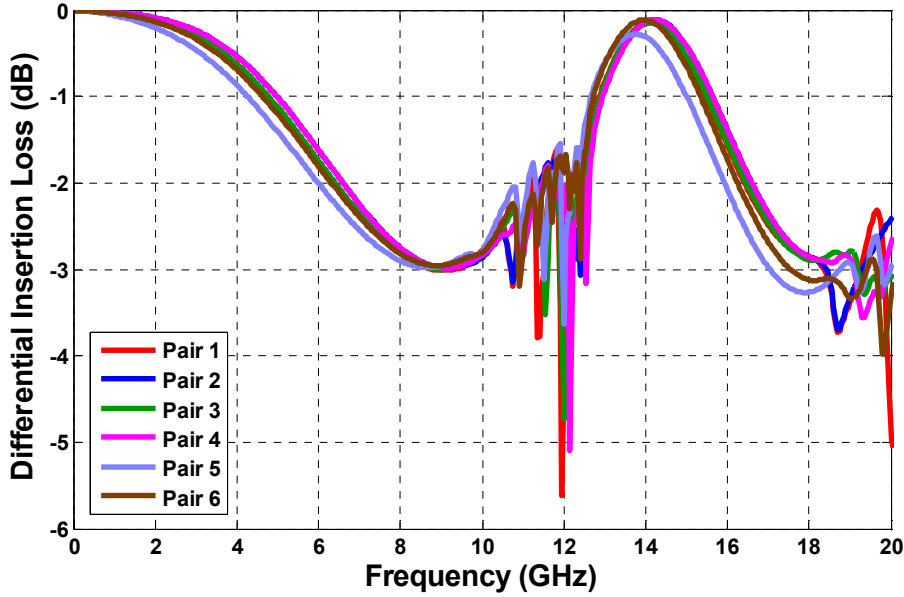


ESC Overlap

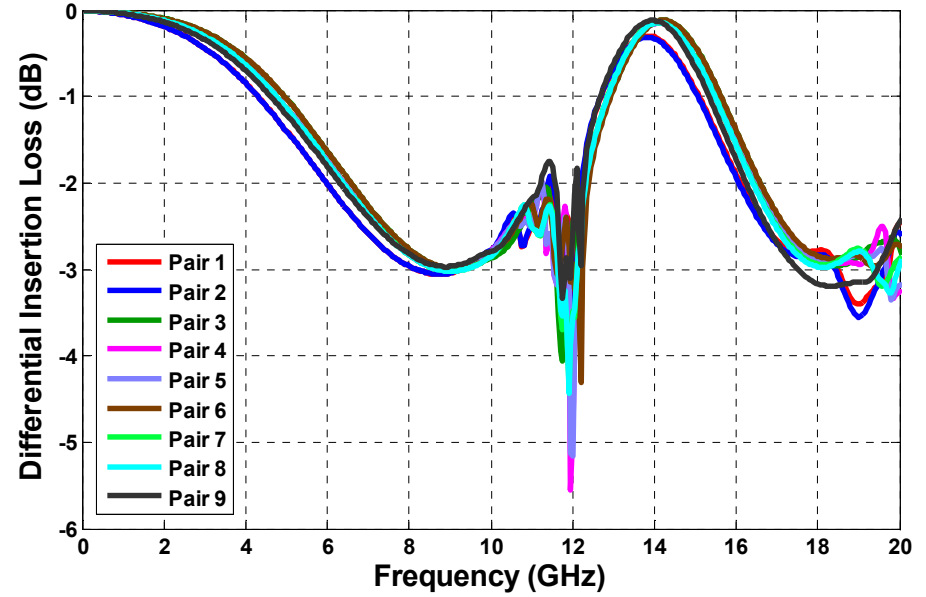
MEG-ARRAY[®] 14 mm Diff. Insertion Loss



MA 14mm BSC Isolated - DIFFERENTIAL INSERTION LOSS



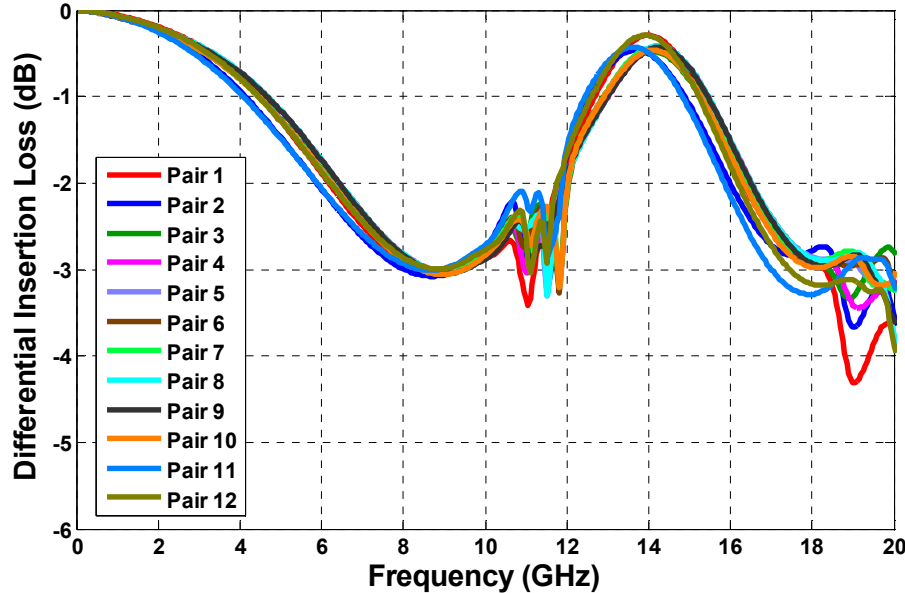
MA 14mm BSC Corners - DIFFERENTIAL INSERTION LOSS



↑
BSC Isolated

↑
BSC Corner Coupled

MA 14mm BSC Overlap - DIFFERENTIAL INSERTION LOSS

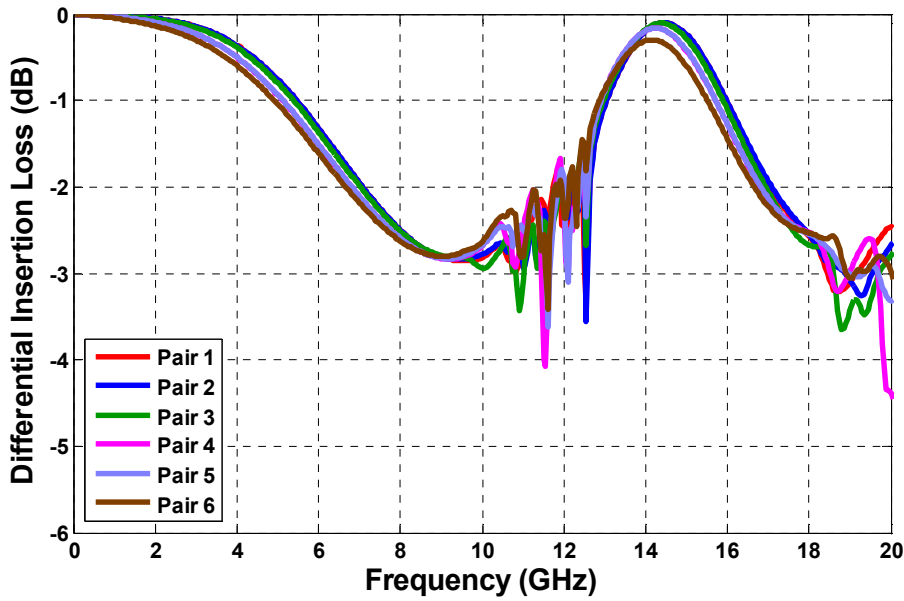


BSC Overlap →

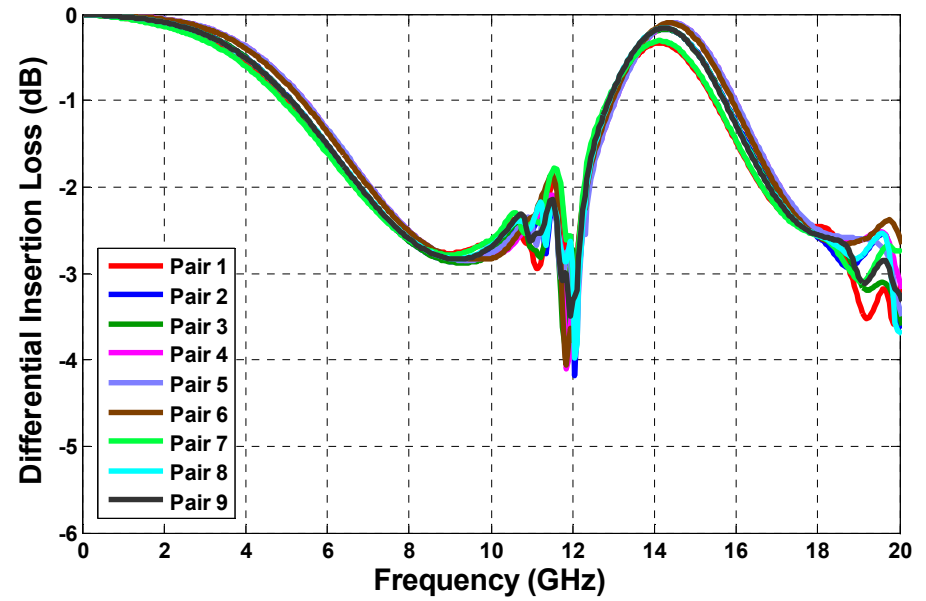
MEG-ARRAY[®] 14 mm Diff. Insertion Loss



MA 14mm ESC Isolated - DIFFERENTIAL INSERTION LOSS



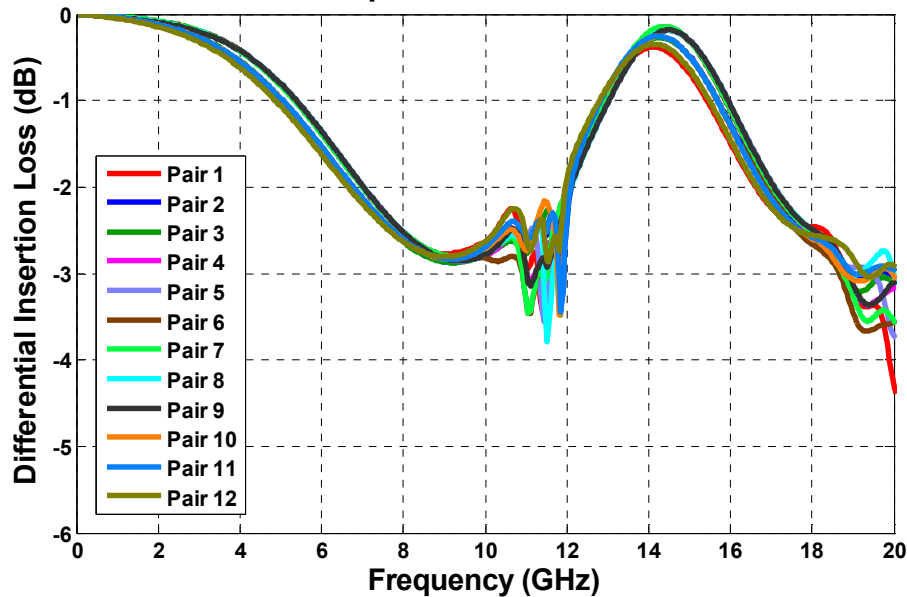
MA 14mm ESC Corners - DIFFERENTIAL INSERTION LOSS



↑
ESC Isolated

↑
ESC Corner Coupled

MA 14mm ESC Overlap - DIFFERENTIAL INSERTION LOSS



→
ESC Overlap

MEG-ARRAY® 14 mm Differential X-talk



BSC Isolated

NEXT[%] - Total NEXT (0.55) 0.16 0.06%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 4	Pair 1	-0.07	-0.02	-0.01
Pair 4	Pair 2	0.13	-0.04	-0.01
Pair 4	Pair 3	-0.11	-0.03	-0.01
Pair 4	Pair 5	-0.10	-0.03	-0.01
Pair 4	Pair 6	0.14	-0.04	-0.01

FEXT[%] - Total FEXT (0.69) 0.32 0.15%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 4	Pair 7	0.06	0.02	0.01
Pair 4	Pair 8	0.22	0.11	0.05
Pair 4	Pair 9	0.10	-0.04	-0.02
Pair 4	Pair 11	0.09	0.03	0.01
Pair 4	Pair 12	0.23	0.12	0.05

BSC Corner Coupled

NEXT[%] - Total NEXT (4.25) 3.15 1.49%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 6	Pair 1	0.08	0.02	0.01
Pair 6	Pair 2	0.07	0.02	0.01
Pair 6	Pair 3	0.17	0.04	0.01
Pair 6	Pair 4	-1.00	-0.79	-0.37
Pair 6	Pair 5	-0.88	-0.72	-0.34
Pair 6	Pair 7	-0.88	-0.72	-0.34
Pair 6	Pair 8	-1.00	-0.79	-0.37
Pair 6	Pair 9	0.18	0.04	0.02

FEXT[%] - Total FEXT (1.73) 1.06 0.37%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 6	Pair 10	-0.07	-0.02	-0.01
Pair 6	Pair 11	-0.06	-0.02	-0.01
Pair 6	Pair 12	0.21	0.09	0.04
Pair 6	Pair 13	0.28	0.20	0.06
Pair 6	Pair 14	0.30	0.21	0.07
Pair 6	Pair 16	0.30	0.21	0.07
Pair 6	Pair 17	0.28	0.20	0.06
Pair 6	Pair 18	0.23	0.10	0.04

Circled % values are for 50 ps edge rates

BSC Overlap

NEXT[%] - Total NEXT (9.65) 8.04 4.36%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 5	Pair 1	0.49	0.44	0.32
Pair 5	Pair 2	-0.08	-0.03	-0.02
Pair 5	Pair 3	-3.17	-2.65	-1.41
Pair 5	Pair 4	-0.89	-0.72	-0.34
Pair 5	Pair 6	-0.10	-0.05	-0.03
Pair 5	Pair 7	-3.20	-2.78	-1.47
Pair 5	Pair 8	-0.99	-0.79	-0.37
Pair 5	Pair 9	0.48	0.44	0.32
Pair 5	Pair 10	0.04	-0.03	-0.02
Pair 5	Pair 11	-0.15	-0.10	-0.07
Pair 5	Pair 12	-0.06	-0.03	-0.02

FEXT[%] - Total FEXT (5.43) 4.21 2.12%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 5	Pair 13	-0.63	-0.55	-0.30
Pair 5	Pair 14	0.06	0.03	0.01
Pair 5	Pair 15	1.61	1.27	0.64
Pair 5	Pair 16	0.30	0.20	0.06
Pair 5	Pair 18	0.09	0.05	0.02
Pair 5	Pair 19	1.62	1.23	0.62
Pair 5	Pair 20	0.28	0.18	0.05
Pair 5	Pair 21	-0.62	-0.54	-0.31
Pair 5	Pair 22	0.05	0.03	0.02
Pair 5	Pair 23	0.13	0.10	0.07
Pair 5	Pair 24	0.06	0.03	0.02

MEG-ARRAY[®] 14 mm Differential X-talk



ESC Isolated

ESC Corner Coupled

NEXT[%] - Total NEXT : 0.39 0.09 0.03%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 2	Pair 1	-0.06	-0.01	-0.01
Pair 2	Pair 3	0.08	-0.02	-0.01
Pair 2	Pair 4	-0.05	-0.01	-0.01
Pair 2	Pair 5	-0.12	-0.04	-0.01
Pair 2	Pair 6	0.08	-0.01	-0.01

NEXT[%] - Total NEXT : 3.39 2.74 1.27%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 5	Pair 1	0.06	0.02	0.01
Pair 5	Pair 2	-0.83	-0.69	-0.32
Pair 5	Pair 3	-0.73	-0.64	-0.29
Pair 5	Pair 4	0.07	0.02	0.01
Pair 5	Pair 6	0.09	0.03	0.02
Pair 5	Pair 7	0.06	0.02	0.01
Pair 5	Pair 8	-0.72	-0.63	-0.29
Pair 5	Pair 9	-0.83	-0.69	-0.32

FEXT[%] - Total FEXT : 0.40 0.18 0.08%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 2	Pair 7	0.06	0.04	0.02
Pair 2	Pair 9	-0.07	0.04	0.02
Pair 2	Pair 10	0.05	0.01	0.01
Pair 2	Pair 11	-0.15	-0.08	-0.03
Pair 2	Pair 12	-0.06	0.02	0.01

FEXT[%] - Total FEXT : 1.01 0.65 0.21%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 5	Pair 10	-0.05	-0.02	-0.01
Pair 5	Pair 11	0.18	0.13	0.04
Pair 5	Pair 12	0.20	0.15	0.04
Pair 5	Pair 13	-0.06	0.02	-0.01
Pair 5	Pair 15	-0.08	-0.03	-0.01
Pair 5	Pair 16	-0.05	-0.02	-0.01
Pair 5	Pair 17	0.20	0.15	0.04
Pair 5	Pair 18	0.18	0.13	0.04

Circled % values are for 50 ps edge rates

ESC Overlap

NEXT[%] - Total NEXT : 4.85 3.76 1.92%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 8	Pair 1	-0.07	-0.02	-0.01
Pair 8	Pair 2	-0.15	-0.07	-0.03
Pair 8	Pair 3	0.04	-0.02	-0.01
Pair 8	Pair 4	-0.83	-0.69	-0.32
Pair 8	Pair 5	-0.75	-0.64	-0.29
Pair 8	Pair 6	-0.05	-0.02	-0.01
Pair 8	Pair 7	0.16	0.14	0.10
Pair 8	Pair 9	0.16	0.14	0.10
Pair 8	Pair 10	-1.28	-1.07	-0.55
Pair 8	Pair 11	-1.30	-0.94	-0.49
Pair 8	Pair 12	0.06	0.01	0.01

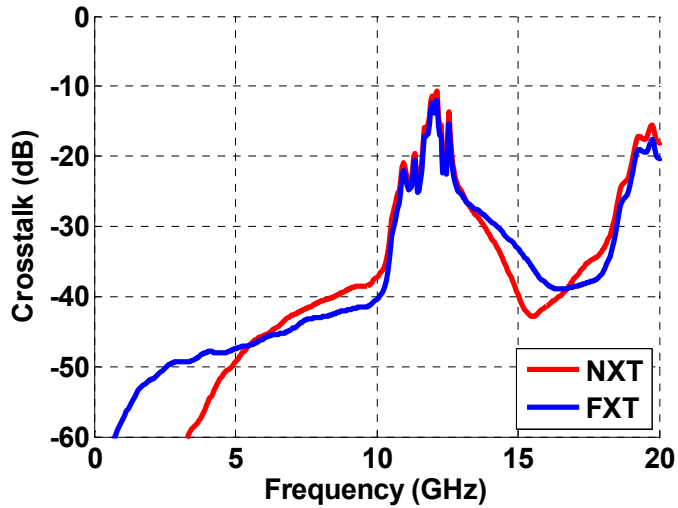
FEXT[%] - Total FEXT : 2.09 1.54 0.65%				
From	To	Risetime = 50 ps (10-90%)	Risetime = 100 ps (10-90%)	Risetime = 250 ps (10-90%)
Pair 8	Pair 13	0.06	0.03	0.01
Pair 8	Pair 14	-0.14	-0.06	-0.02
Pair 8	Pair 15	-0.04	0.03	0.01
Pair 8	Pair 16	0.18	0.13	0.04
Pair 8	Pair 17	0.21	0.14	0.04
Pair 8	Pair 18	0.05	0.01	0.01
Pair 8	Pair 19	-0.20	-0.18	-0.09
Pair 8	Pair 21	-0.20	-0.18	-0.10
Pair 8	Pair 22	0.48	0.36	0.16
Pair 8	Pair 23	0.48	0.41	0.18
Pair 8	Pair 24	-0.05	-0.01	-0.00

MEG-ARRAY® 14 mm Differential X-talk



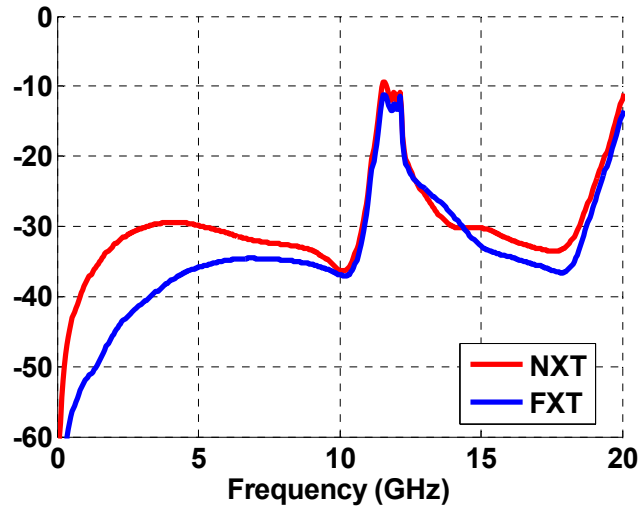
BSC Isolated

Pair 4: POWER SUMMATION OF X-TALK



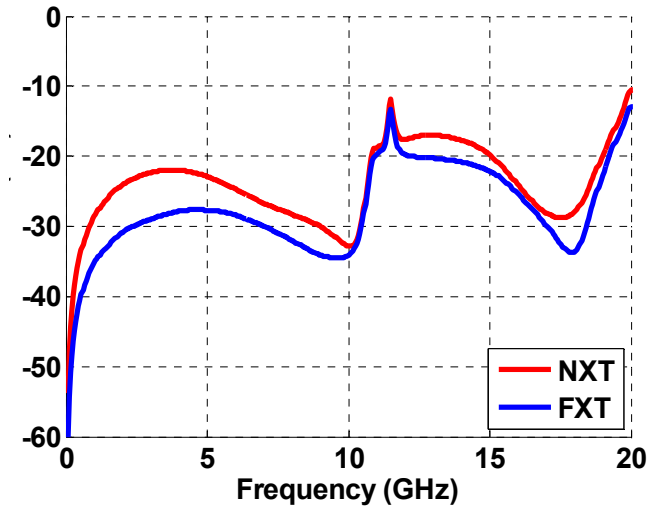
BSC Corner Coupled

Pair 6: POWER SUMMATION OF X-TALK

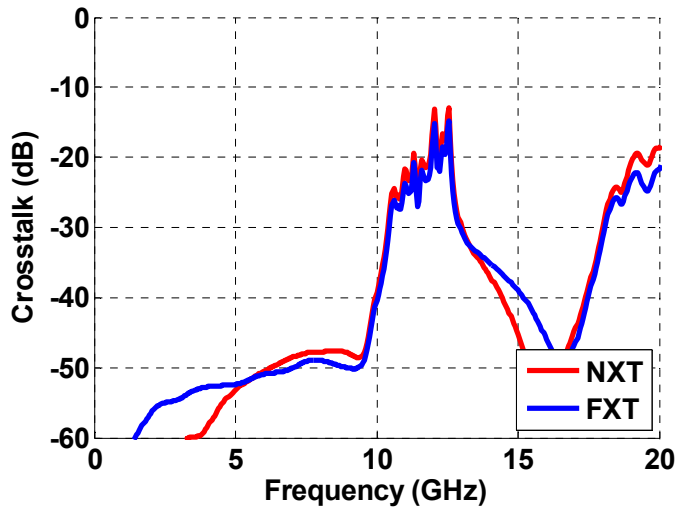


BSC Overlap

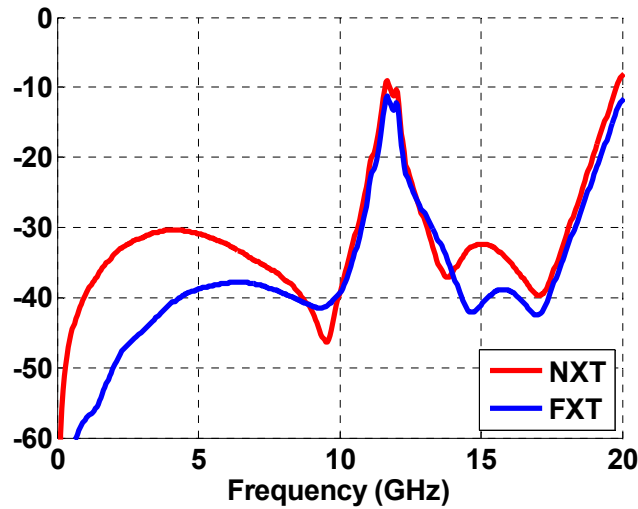
Pair 5: POWER SUMMATION OF X-TALK



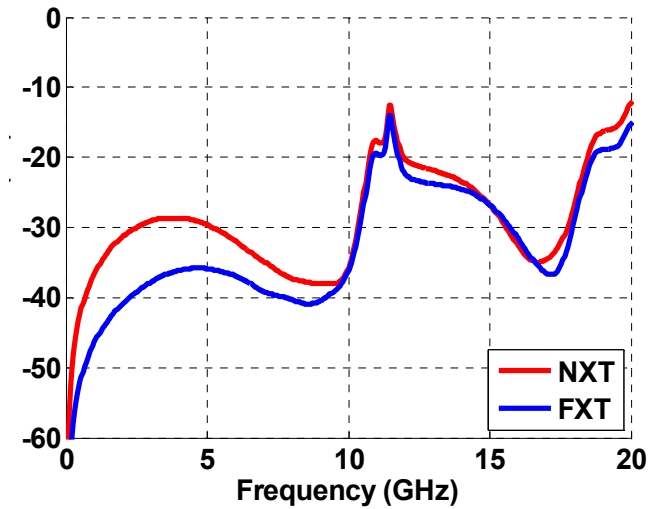
Pair 2: POWER SUMMATION OF X-TALK



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