

EFAPEL - Empresa Fabril Produtos Electricos SA

LETTER REPORT

SCOPE OF WORK

ETL Verification initial qualification testing of RJ-45 keystone jack electrical transmission performance to the requirements of ANSI/TIA-568.2-D for Category 6A connecting hardware.

REPORT NUMBER

104226985CRT-001a

ISSUE DATE

30-May-2020

REVISED DATE

None

TESTS START DATE

15-May-2020

TESTS END DATE

29-May-2020

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DOCUMENT CONTROL NUMBER

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LETTER REPORT

30-May-2020

Intertek Report No. 104226985CRT-001a

Intertek Project No. G104226985

Mr. Emanuel Martins
EFAPEL - Empresa Fabril Produtos Electricos SA
Serpins
3200-355 SERPINS
PORTUGAL

Subject: Initial qualification testing of Category 6A connecting hardware per ANSI/TIA-568.2-D

Dear Mr. Martins:

This letter report represents the results of our evaluation of the above referenced product(s) to the requirements contained in the following document(s):

ANSI/TIA-568.2-D-2018, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, dated September 2018

SECTION 1

SUMMARY

Intertek wishes to inform you that the electrical transmission tests have been performed on the connecting hardware referenced above. This testing was performed under project G104226985 and quotation Qu-01032599 issued 23-January-2020. Compliant results were obtained for the relevant tests contained in ANSI/TIA-568.2-D section 6.10 for connecting hardware transmission performance.

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SECTION 2

NON-CONFORMANCES

None

SECTION 3

TESTING

The tables below represent a summary of the tests and results. The detailed test data is enclosed to this letter report.

Test description	ANSI/TIA-568.2-D section	Result
Connecting hardware dc resistance	6.10.1	Compliant
Connecting hardware dc resistance unbalance	6.10.3	Compliant
Connecting hardware return loss	6.10.7	Compliant
Connecting hardware insertion loss	6.10.8	Compliant
Connecting hardware NEXT loss	6.10.9	Compliant
Connecting hardware FEXT loss	6.10.11	Compliant
Connecting hardware TCL	6.10.15	Compliant
Connecting hardware TCTL	6.10.17	Compliant
Connecting hardware shield transfer impedance	6.10.21	Not applicable
Connecting hardware PSANEXT loss	6.10.23	Compliant
Connecting hardware PSAFEXT loss	6.10.26	Compliant

Test equipment used	Model number	Control number	Calibration due date
Keysight Network Analyzer	E8357A	E382	07-January-2021
Keysight LCR Meter	4263A	N968	25-March-2021
Keysight Network Analyzer	E5071C	R172	20-April-2021
Keysight Network Analyzer	E5080A	J387	15-February-2021
Temperature/humidity meter	OM-EL-USB-2-LCD	H243	23-April-2021

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SECTION 4

SAMPLE DESCRIPTION

The client submitted test specimens of Category 6A, RJ-45, keystone jack identified as part number 82021. The component level alien crosstalk was tested with a 24-port 1RU patch panel part number Not Available.

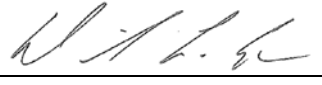
The samples were received on 12-May-2020 and were production samples in undamaged condition.

SECTION 5

PROJECT STATUS & ACTION

Issuance of this letter report completes the initial qualification testing of this connecting hardware electrical transmission performance per ANSI/TIA-568.2-D covered by Intertek Project No. G104226985 and quotation Qu-01032599. The test results are compliant with the requirements of the standard(s) and sections referred to on pages 2 and 3. The testing was performed at Intertek located in Cortland, NY.

If there are any questions regarding the results contained in this report, or any of the other services offered by Intertek, please do not hesitate to contact your dedicated Intertek Project Manager.

Completed by:	David Ayers	Reviewed by:	Antoine Pelletier
Title:	Technician	Title:	Project Engineer
Signature:		Signature:	
Date:	30-May-2020	Date:	30-May-2020

Please note: this Letter Report does not represent authorization for the use of any Intertek certification marks.

NEXT

Combination	Forward						Reverse					
	36-45	12-36	36-78	12-45	45-78	12-78	36-45	12-36	36-78	12-45	45-78	12-78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	2.20	3.87	2.34	3.64	1.72	3.35	2.06	3.57	3.80	3.78	5.80	2.84
Freq. (MHz)	177	249	251	250	250	19	500	500	250	250	10	15

FEXT

Combination	45-12	45-36	45-78	12-45	12-36	12-78	36-45	36-12	36-78	78-45	78-12	78-36
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	1.61	14.74	13.82	1.54	5.10	16.13	10.25	3.74	3.76	9.66	15.51	3.76
Freq. (MHz)	10	3	1	6	5	3	489	434	10	2	3	4

Return Loss

Pair	Forward				Reverse			
	45	12	36	78	45	12	36	78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	0.82	3.70	3.92	1.72	1.63	5.27	5.94	3.66
Freq. (MHz)	385	500	483	500	297	500	356	500

Insertion Loss

Pair	45	12	36	78
Result	PASS	PASS	PASS	PASS
Margin (dB)	0.08	0.08	0.02	0.09
Freq. (MHz)	23	24	403	25

TCL

Pair	Forward				Reverse			
	45	12	36	78	45	12	36	78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	3.26	9.55	3.89	9.78	6.00	14.87	6.48	9.78
Freq. (MHz)	387	500	392	26	351	500	366	26

TCTL

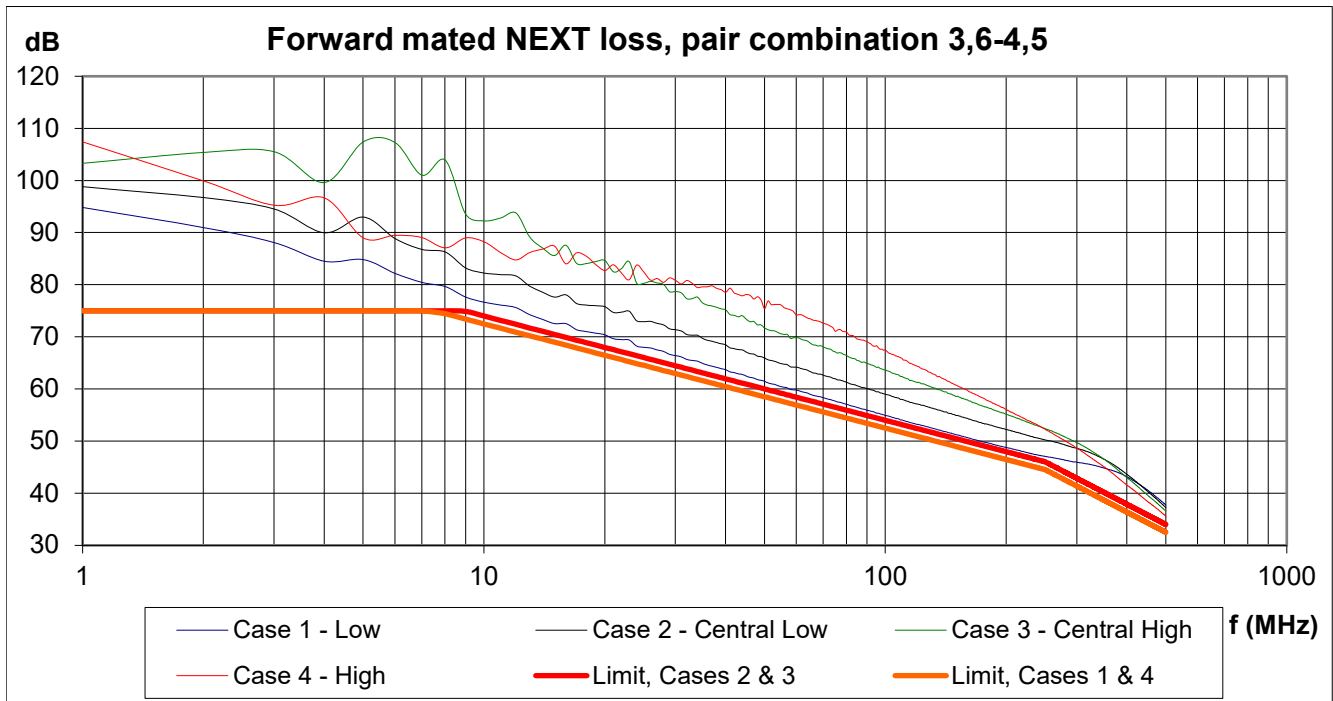
Pair	Forward				Reverse			
	45	12	36	78	45	12	36	78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	4.11	8.74	4.52	14.08	2.81	7.34	2.22	14.78
Freq. (MHz)	396	30	366	498	412	500	406	500

DC Resistance (Limit = 200 mΩ)

Conductor	5	4	1	2	3	6	7	8
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (mΩ)	129.4	121.4	155.9	137.7	160.5	159.5	150.6	144.2

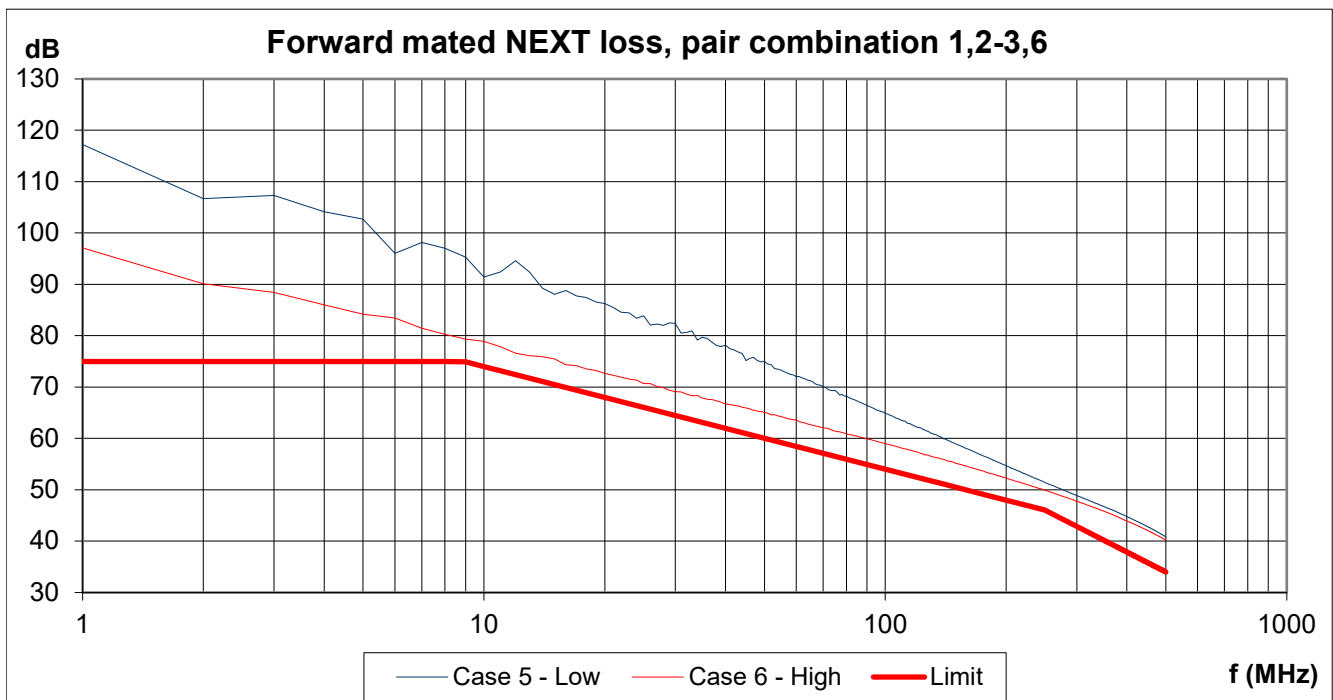
DC Resistance Unbalance (Limit = 50 mΩ)

Pair	45	12	36	78
Result	PASS	PASS	PASS	PASS
Margin (mΩ)	42.0	31.8	49.0	43.6



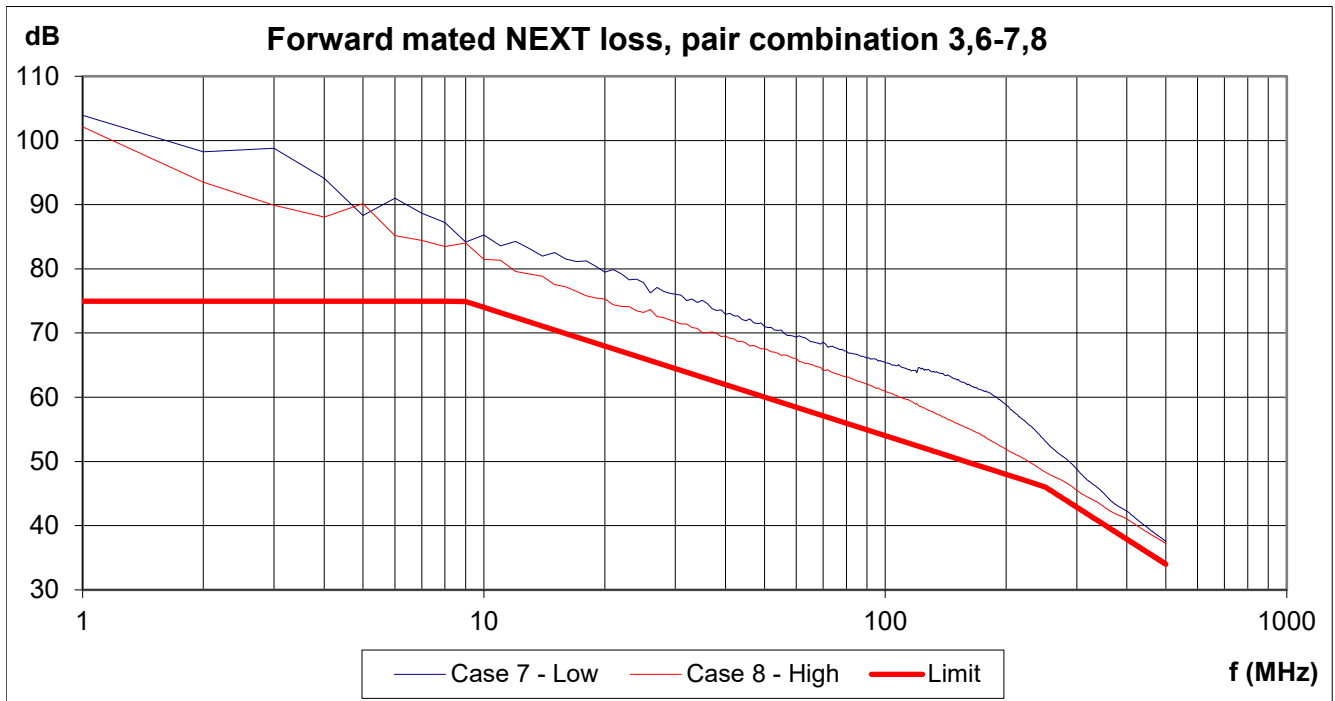
PASS

Summary	Case 1	Case 2	Case 3	Case 4
Margin (dB)	2.20	3.25	2.58	3.10
Freq. (MHz)	177	500	500	500



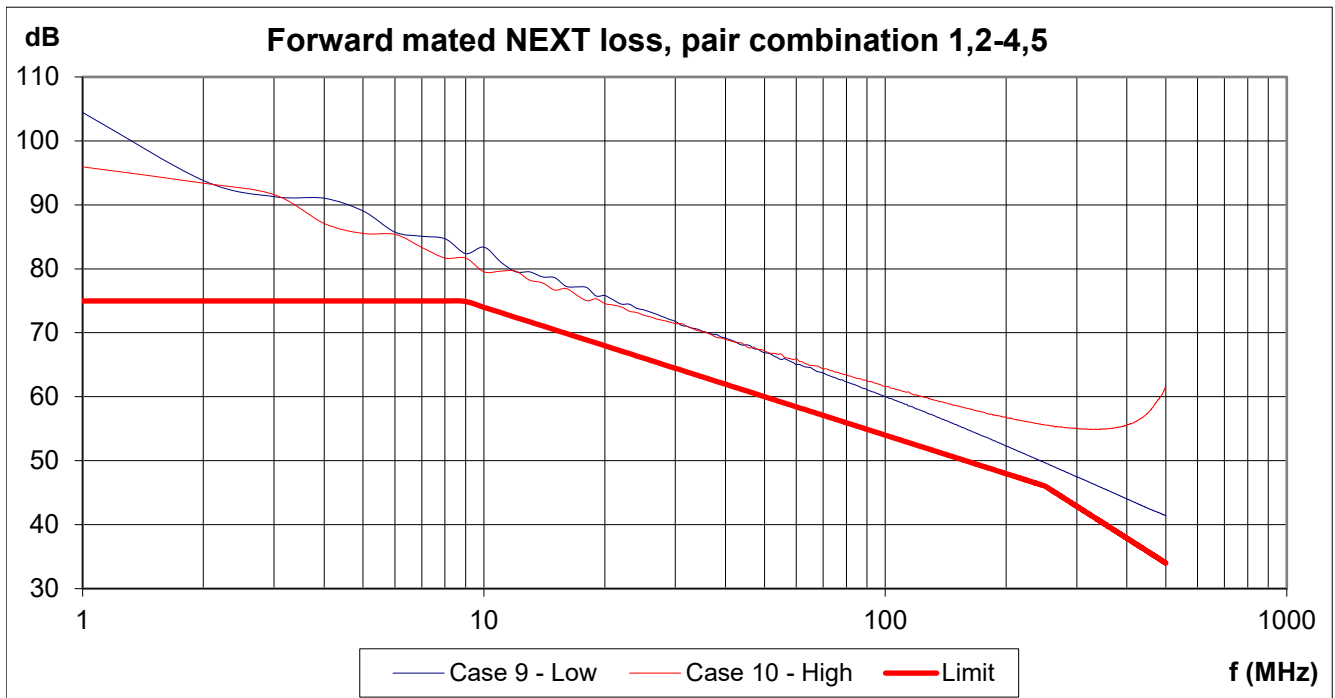
PASS

Summary	Case 5	Case 6
Margin (dB)	5.39	3.87
Freq. (MHz)	250	249



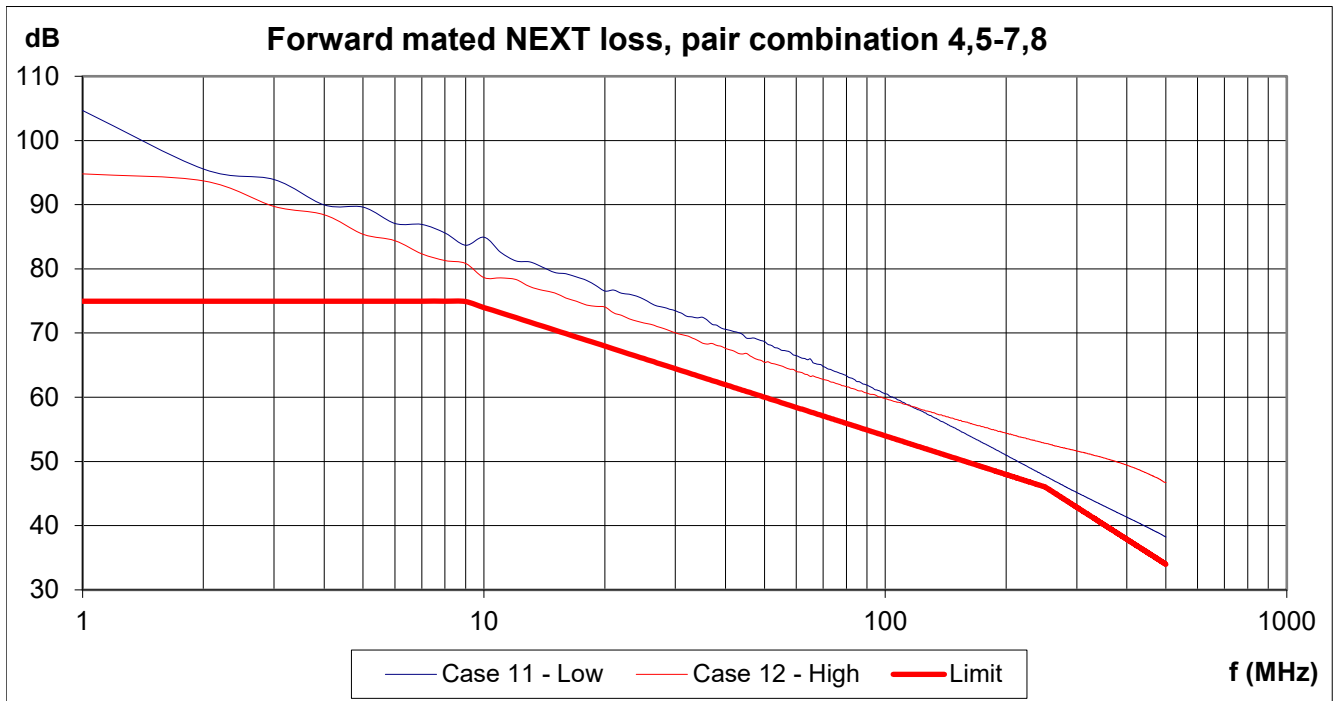
PASS

Summary	Case 7	Case 8
Margin (dB)	3.55	2.34
Freq. (MHz)	500	251



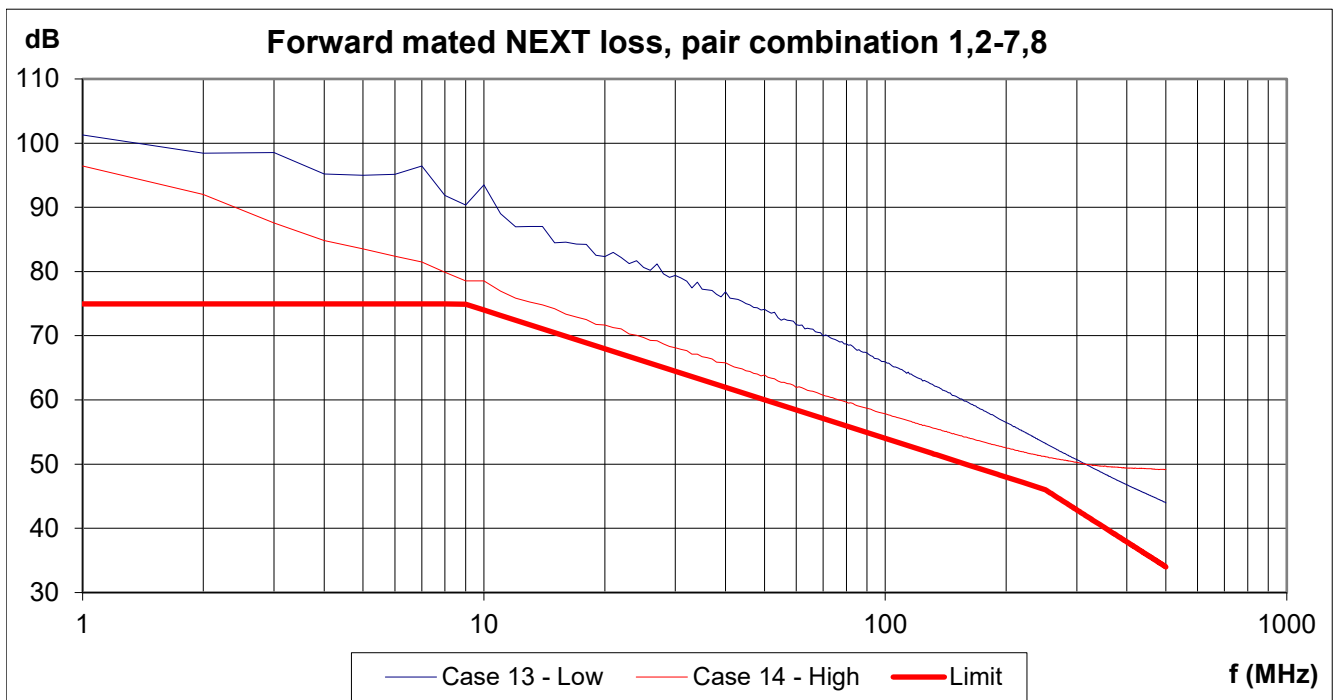
PASS

Summary	Case 9	Case 10
Margin (dB)	3.64	5.54
Freq. (MHz)	250	10



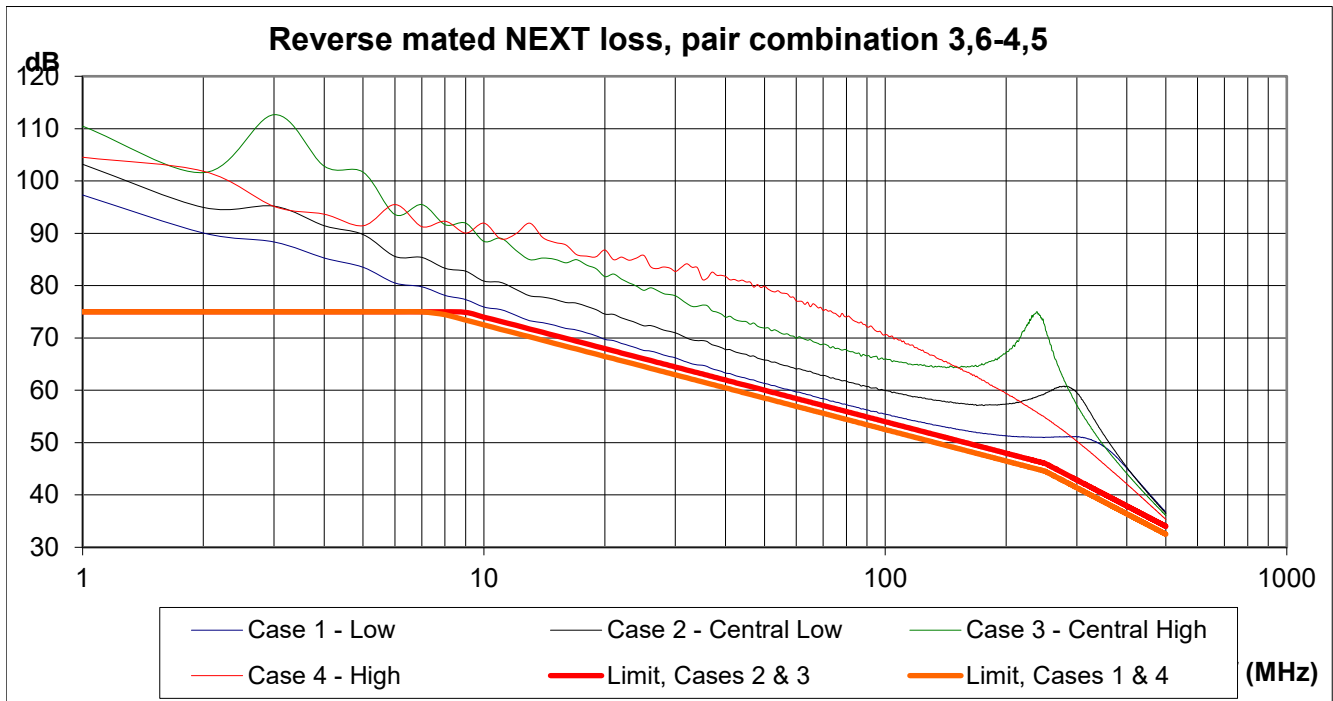
PASS

Summary	Case 11	Case 12
Margin (dB)	1.72	4.64
Freq. (MHz)	250	10



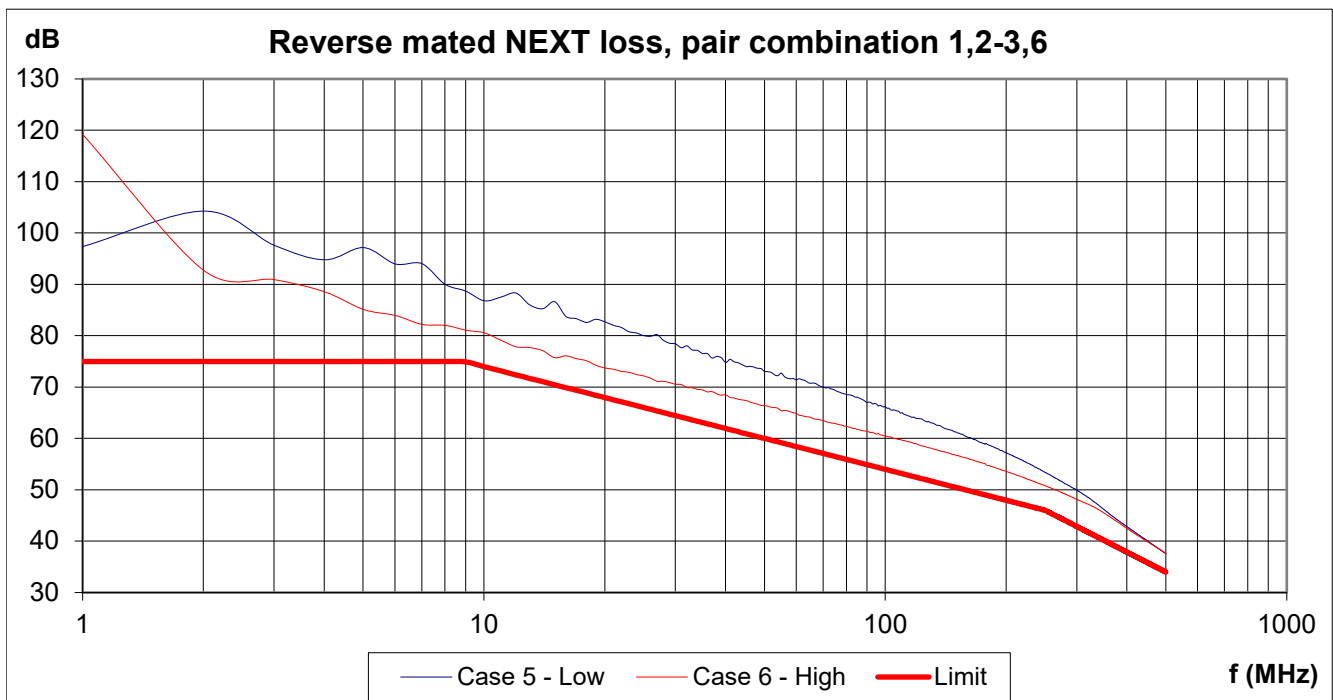
PASS

Summary	Case 13	Case 14
Margin (dB)	7.22	3.35
Freq. (MHz)	251	19



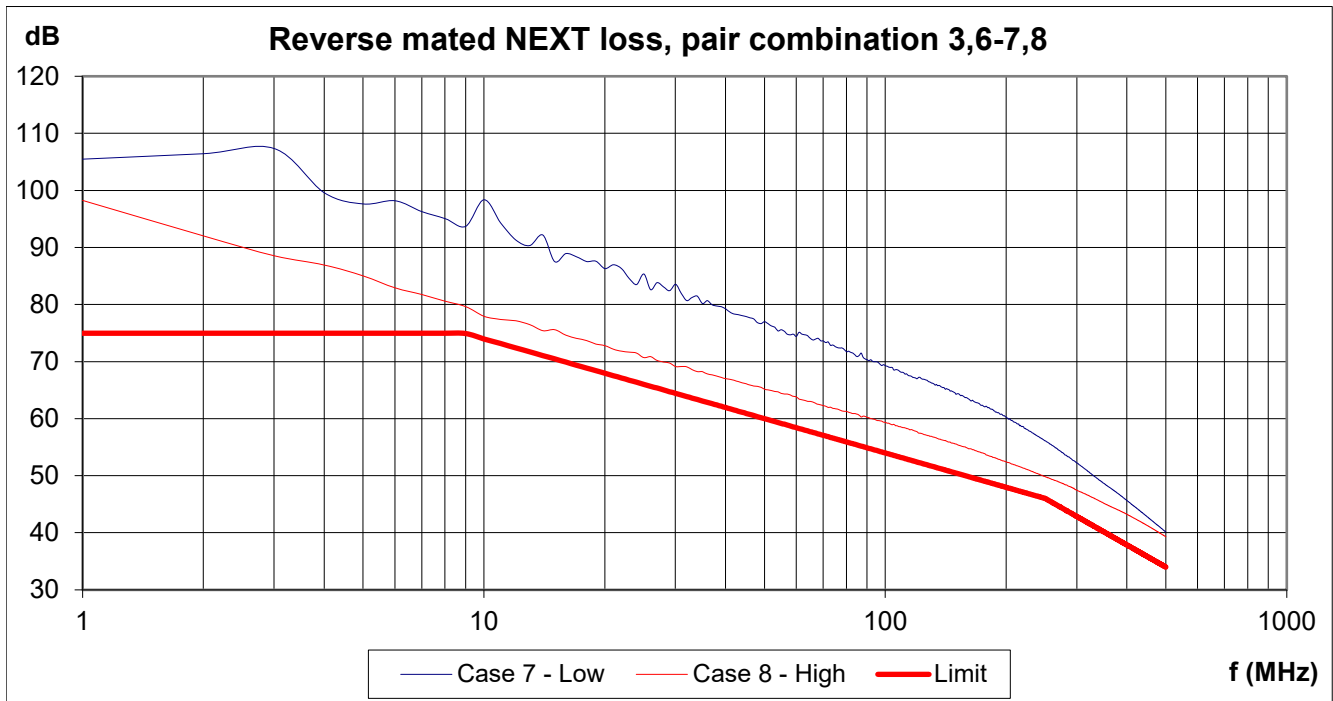
PASS

Summary	Case 1	Case 2	Case 3	Case 4
Margin (dB)	2.71	2.50	2.06	2.81
Freq. (MHz)	73	500	500	500



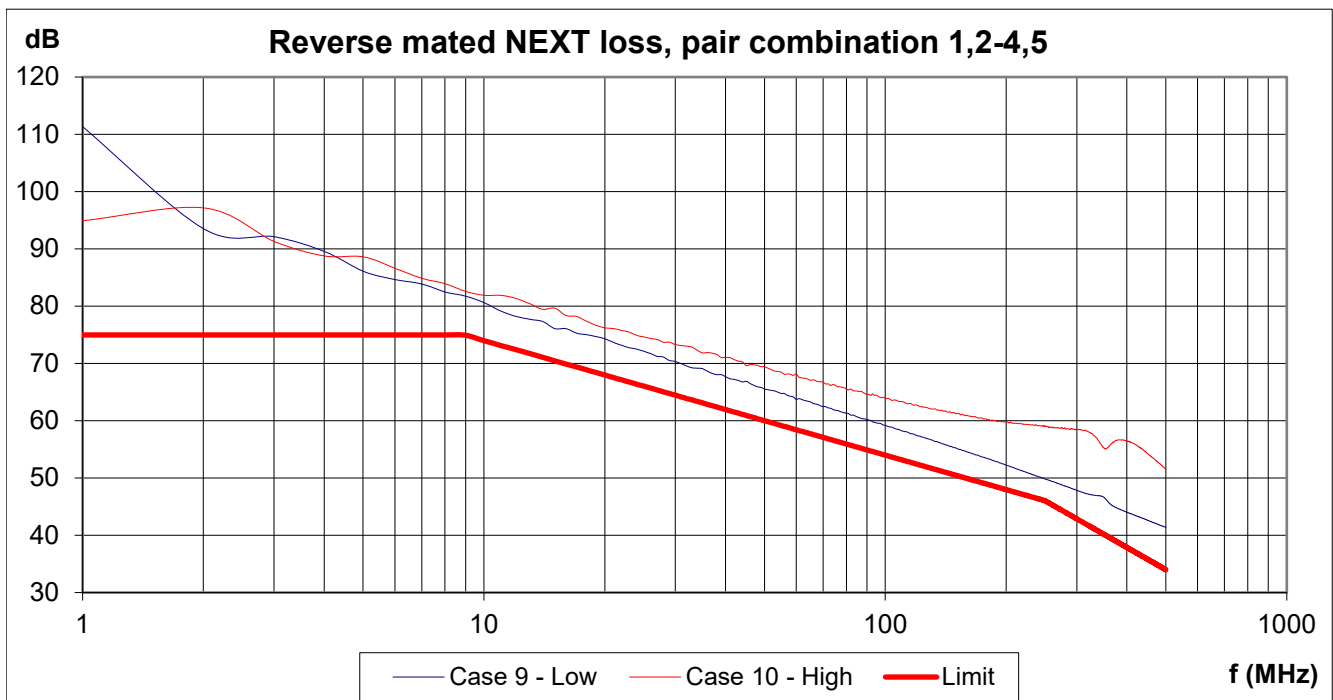
PASS

Summary	Case 5	Case 6
Margin (dB)	3.57	3.64
Freq. (MHz)	500	500



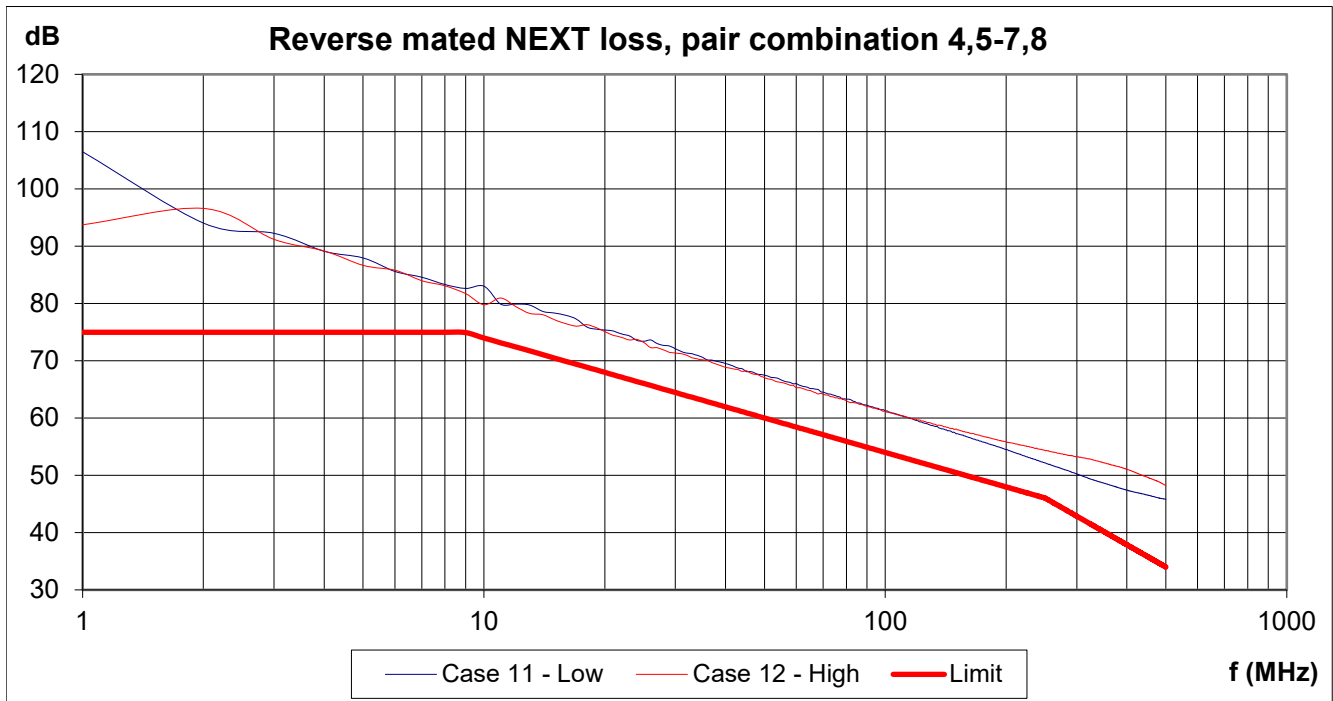
PASS

Summary	Case 7	Case 8
Margin (dB)	6.14	3.80
Freq. (MHz)	500	250



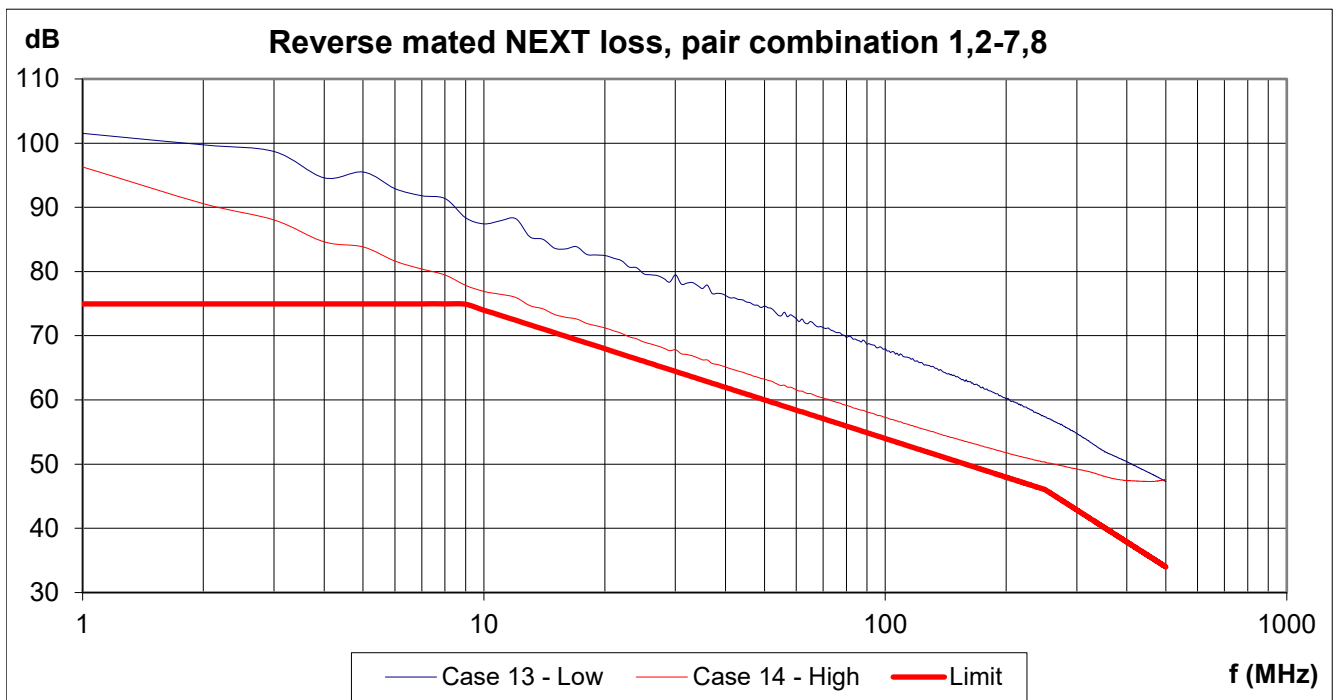
PASS

Summary	Case 9	Case 10
Margin (dB)	3.78	7.66
Freq. (MHz)	250	9



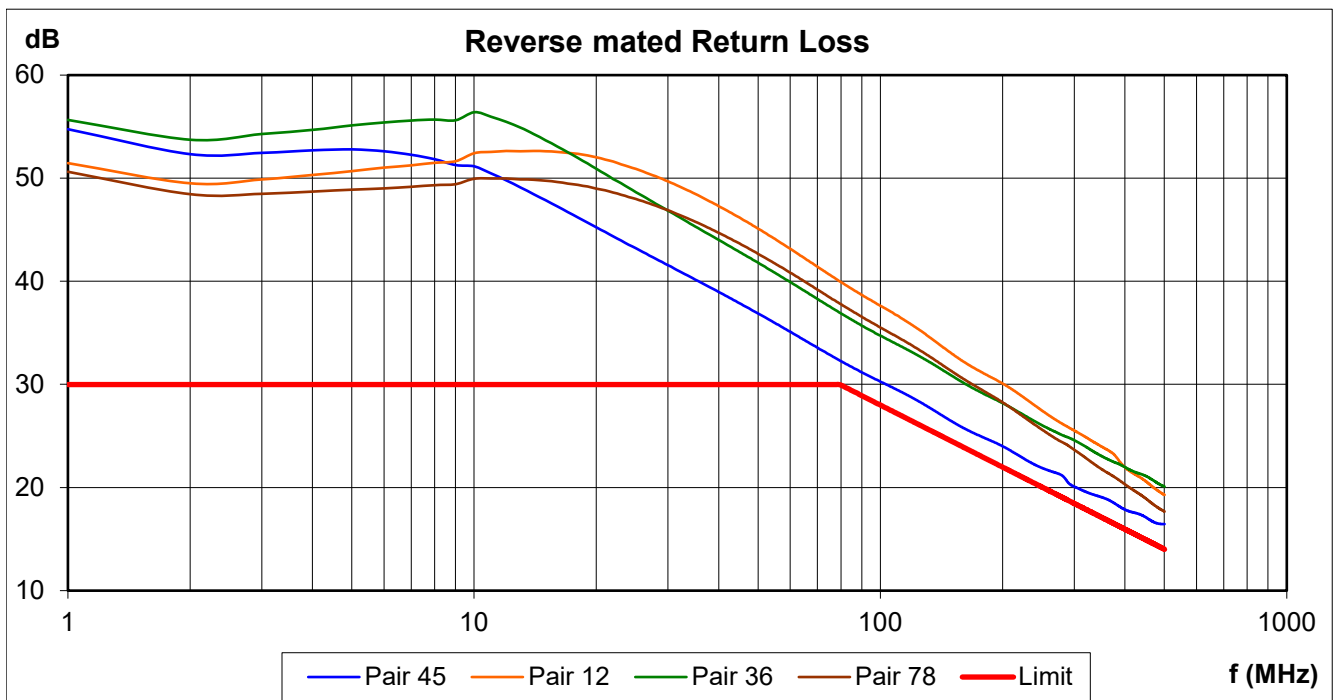
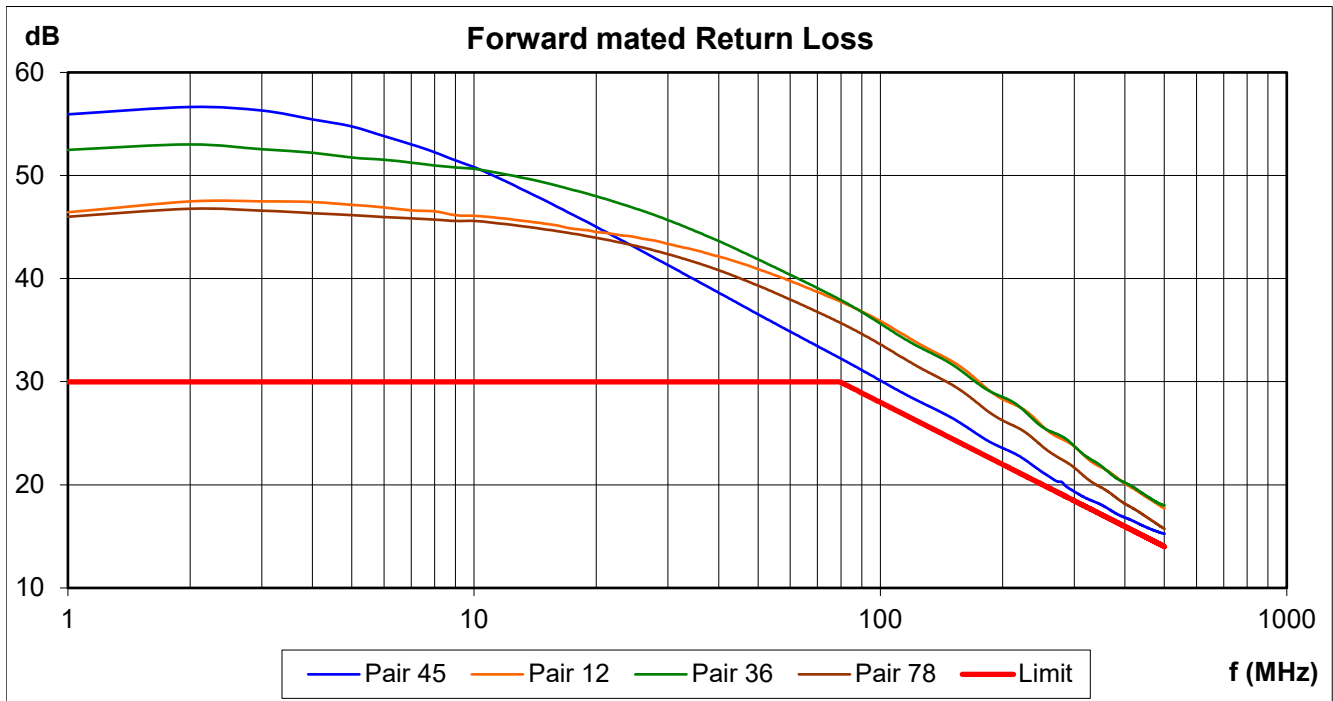
PASS

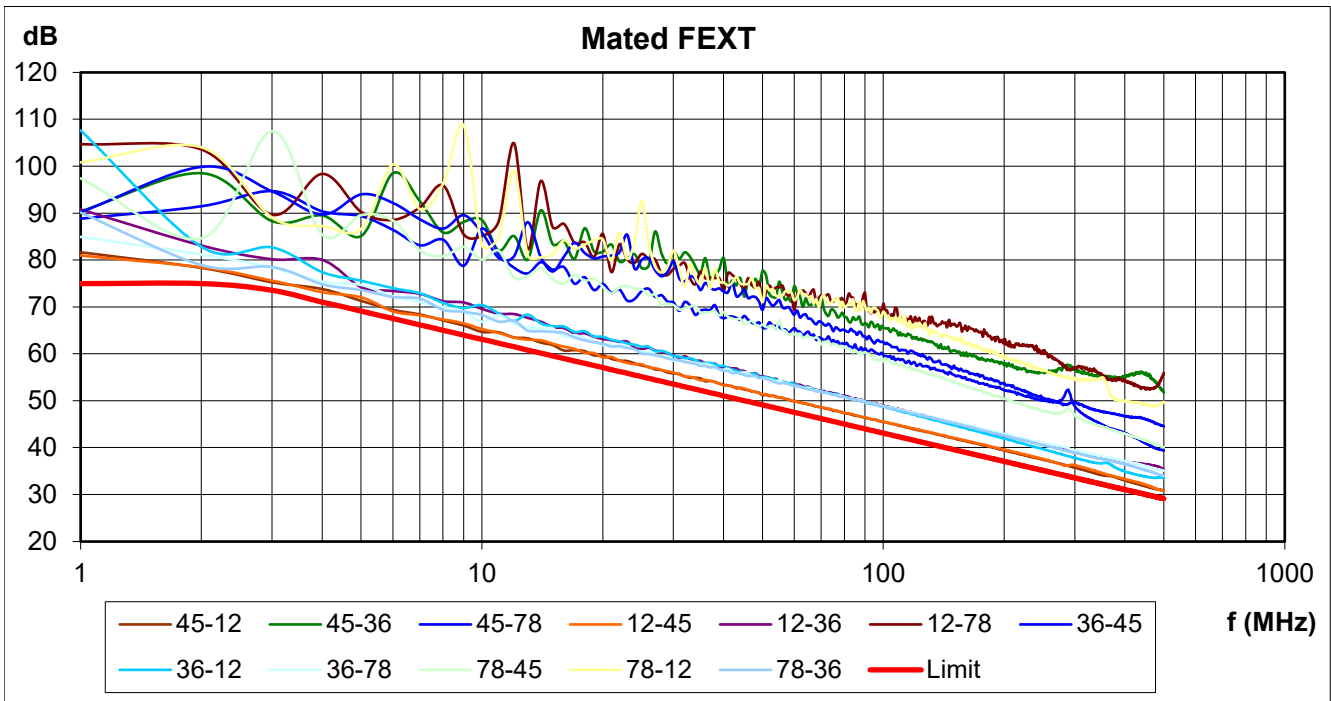
Summary	Case 11	Case 12
Margin (dB)	6.13	5.80
Freq. (MHz)	248	10



PASS

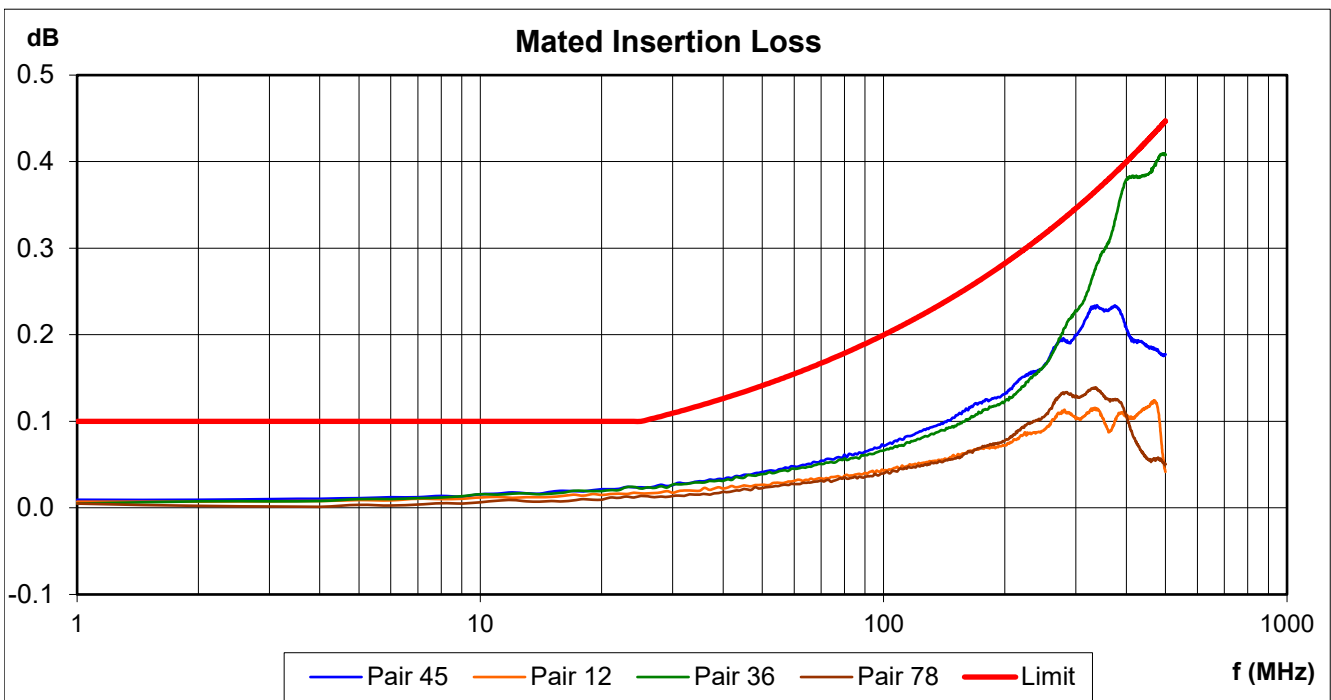
Summary	Case 13	Case 14
Margin (dB)	11.32	2.84
Freq. (MHz)	249	15





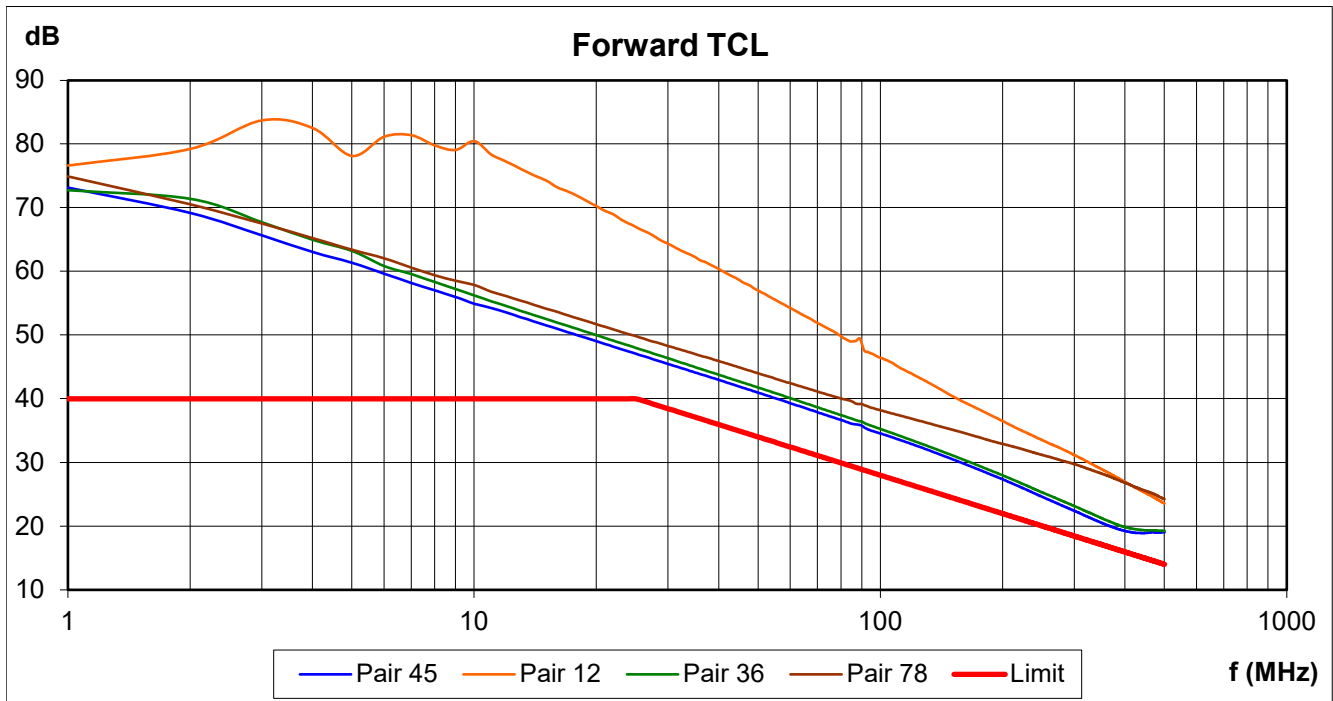
PASS

Summary	45-12	45-36	45-78	12-45	12-36	12-78	36-45	36-12	36-78	78-45	78-12	78-36
Margin (dB)	1.61	14.74	13.82	1.54	5.10	16.13	10.25	3.74	3.76	9.66	15.51	3.76
Freq. (MHz)	10	3	1	6	5	3	489	434	10	2	3	4



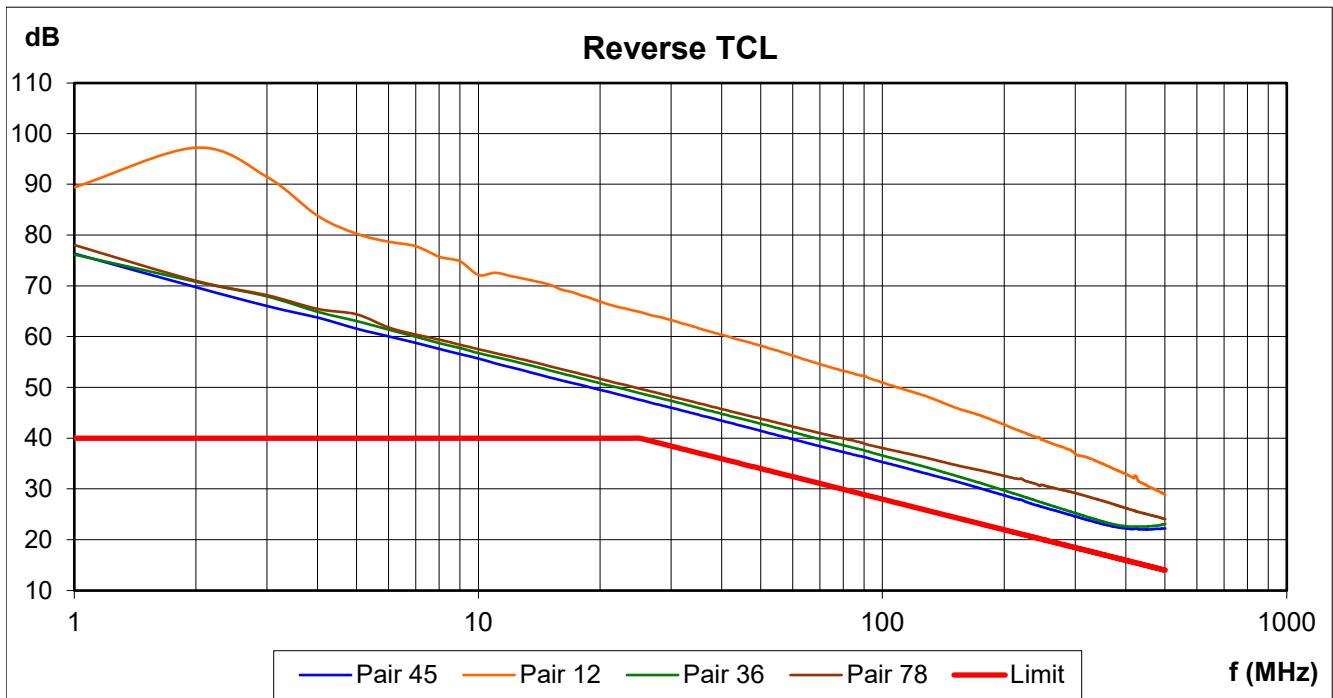
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	0.08	0.08	0.02	0.09
Freq. (MHz)	23	24	403	25



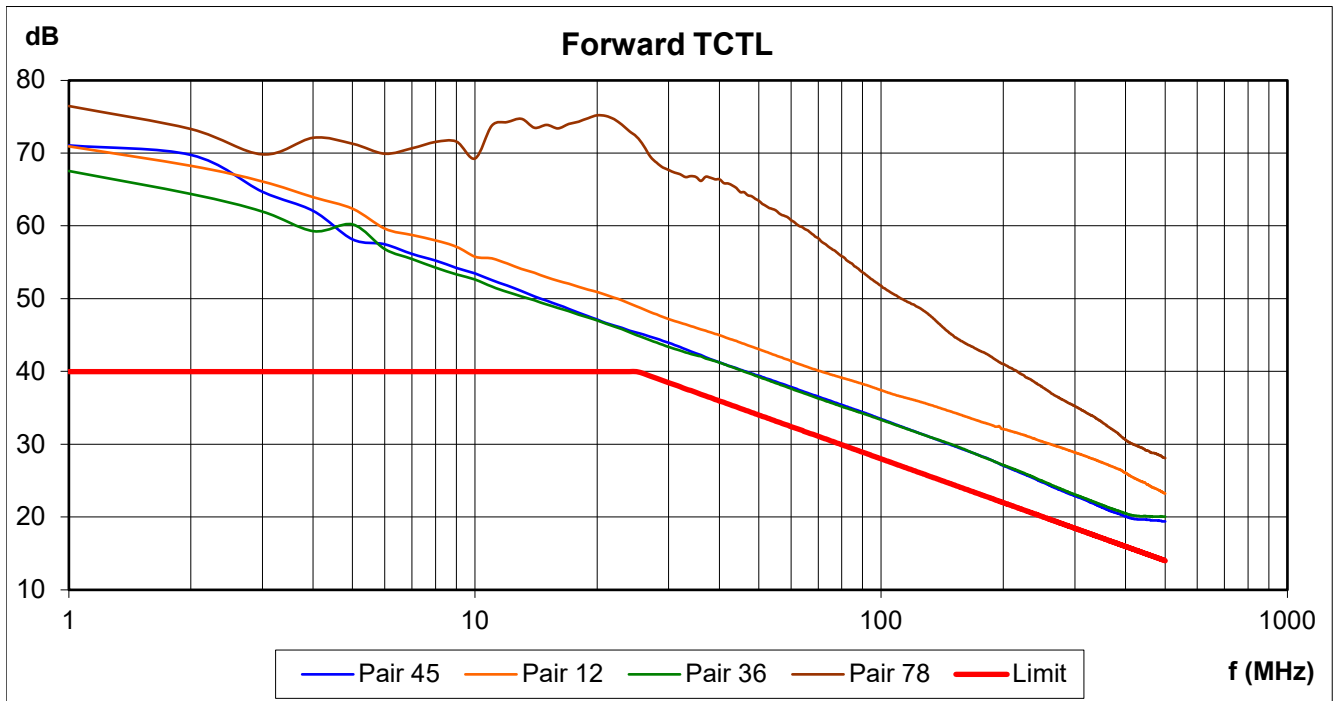
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	3.26	9.55	3.89	9.78
Freq (MHz)	387	500	392	26



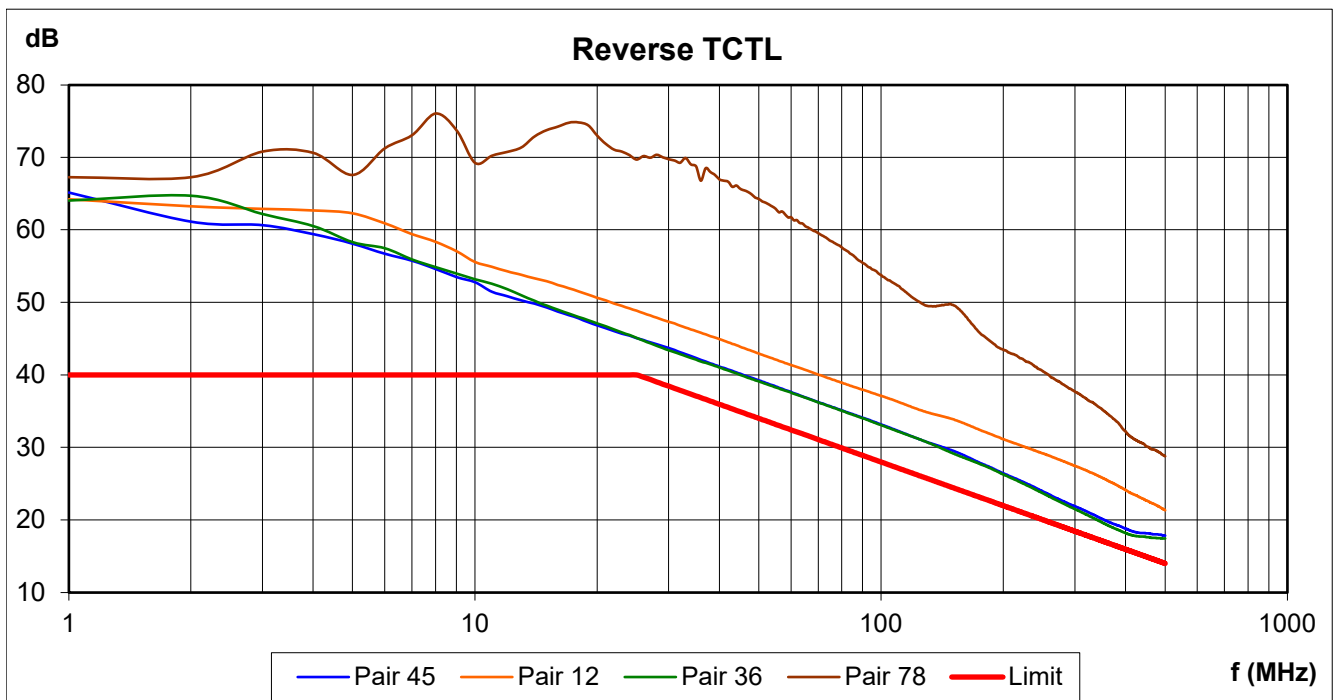
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	6.00	14.87	6.48	9.78
Freq (MHz)	351	500	366	26



PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	4.11	8.74	4.52	14.08
Freq (MHz)	396	30	366	498



PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	2.81	7.34	2.22	14.78
Freq (MHz)	412	500	406	500

NEXT

Combination	Forward						Reverse					
	36-45	12-36	36-78	12-45	45-78	12-78	36-45	12-36	36-78	12-45	45-78	12-78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	1.69	2.86	2.66	3.74	1.32	8.19	1.53	3.51	4.24	4.76	4.92	7.24
Freq. (MHz)	500	251	251	250	250	60	500	500	251	248	249	9

FEXT

Combination	45-12	45-36	45-78	12-45	12-36	12-78	36-45	36-12	36-78	78-45	78-12	78-36
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	0.48	15.87	14.49	1.53	9.28	19.70	9.93	7.21	4.10	11.26	18.44	3.45
Freq. (MHz)	3	5	250	4	284	1	496	438	4	500	4	4

Return Loss

Pair	Forward				Reverse			
	45	12	36	78	45	12	36	78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	0.91	3.32	4.41	1.90	2.23	4.90	7.09	3.85
Freq. (MHz)	389	500	481	500	320	500	490	500

Insertion Loss

Pair	45	12	36	78
Result	PASS	PASS	PASS	PASS
Margin (dB)	0.08	0.10	0.04	0.08
Freq. (MHz)	23	25	403	25

TCL

Pair	Forward				Reverse			
	45	12	36	78	45	12	36	78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	4.50	10.71	4.00	10.51	5.91	15.32	6.61	10.36
Freq. (MHz)	410	500	393	26	350	500	371	27

TCTL

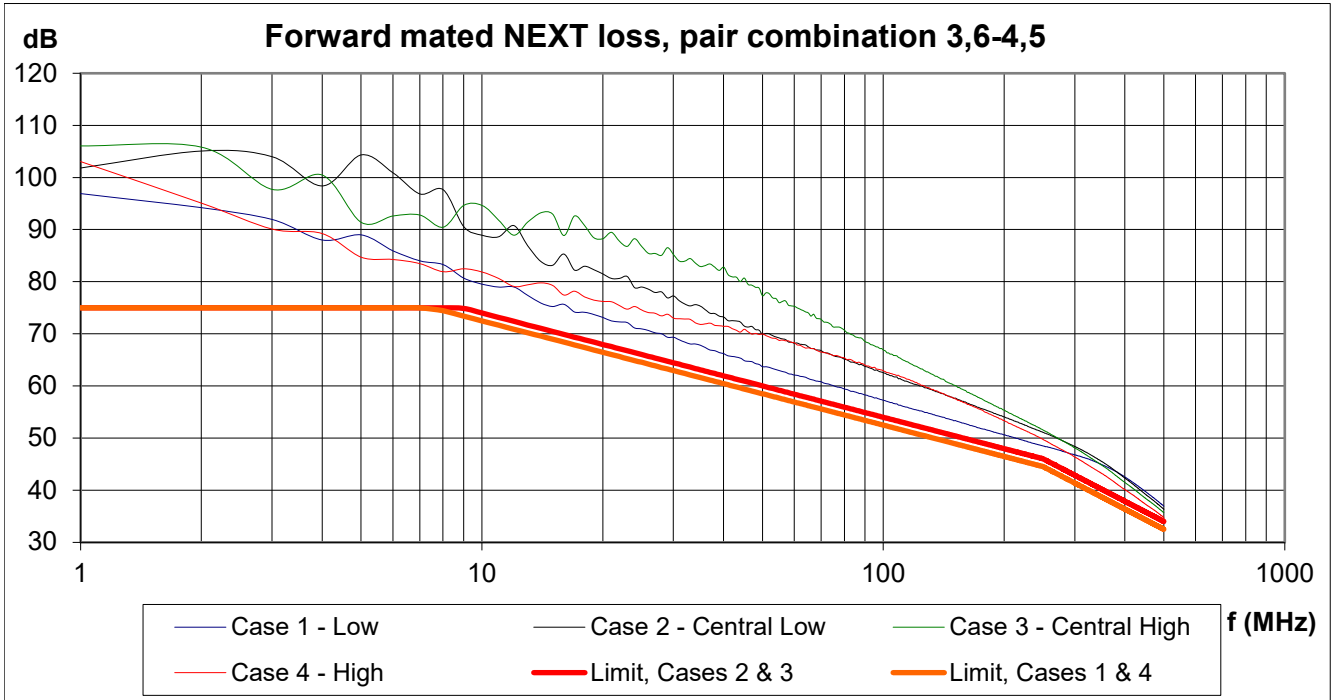
Pair	Forward				Reverse			
	45	12	36	78	45	12	36	78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	3.77	9.17	4.44	14.21	2.37	7.80	2.00	15.12
Freq. (MHz)	412	29	368	500	407	500	407	500

DC Resistance (Limit = 200 mΩ)

Conductor	5	4	1	2	3	6	7	8
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (mΩ)	157.5	116.7	148.0	121.3	124.8	124.0	153.0	146.6

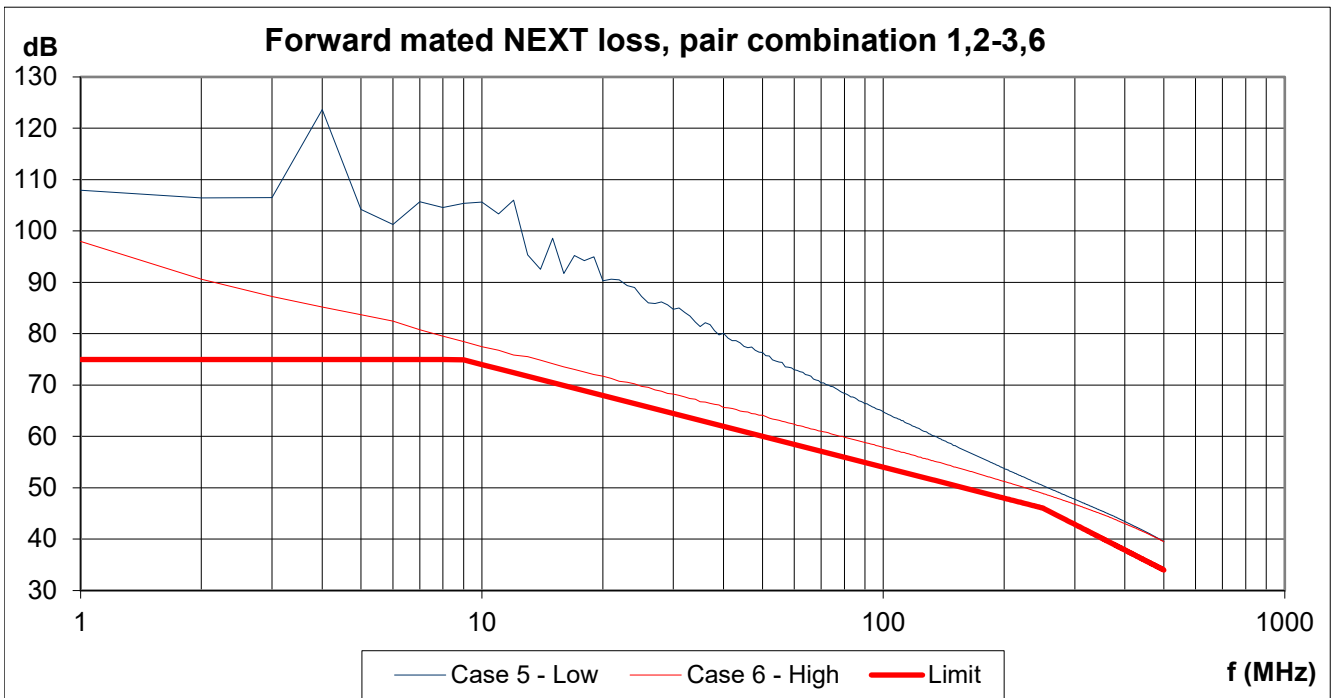
DC Resistance Unbalance (Limit = 50 mΩ)

Pair	45	12	36	78
Result	PASS	PASS	PASS	PASS
Margin (mΩ)	9.2	23.4	49.2	43.6



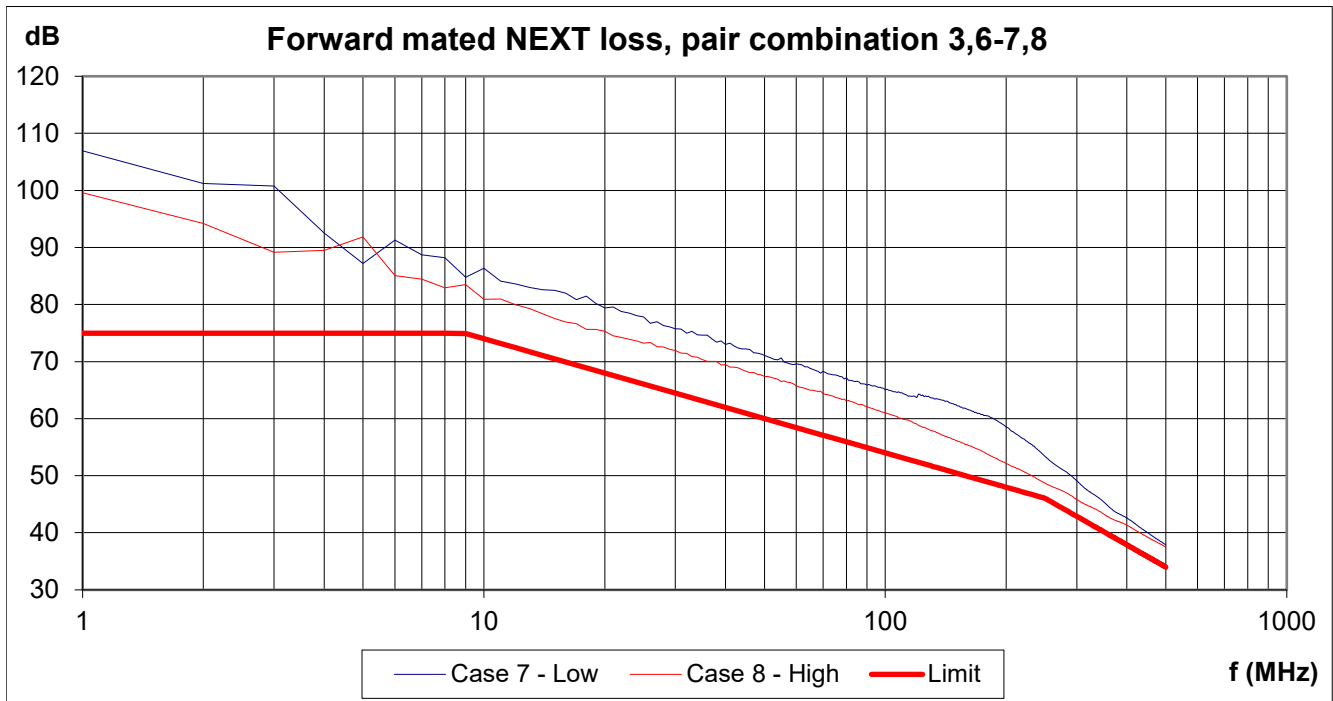
PASS

Summary	Case 1	Case 2	Case 3	Case 4
Margin (dB)	3.96	2.35	1.69	2.27
Freq. (MHz)	240	500	500	500



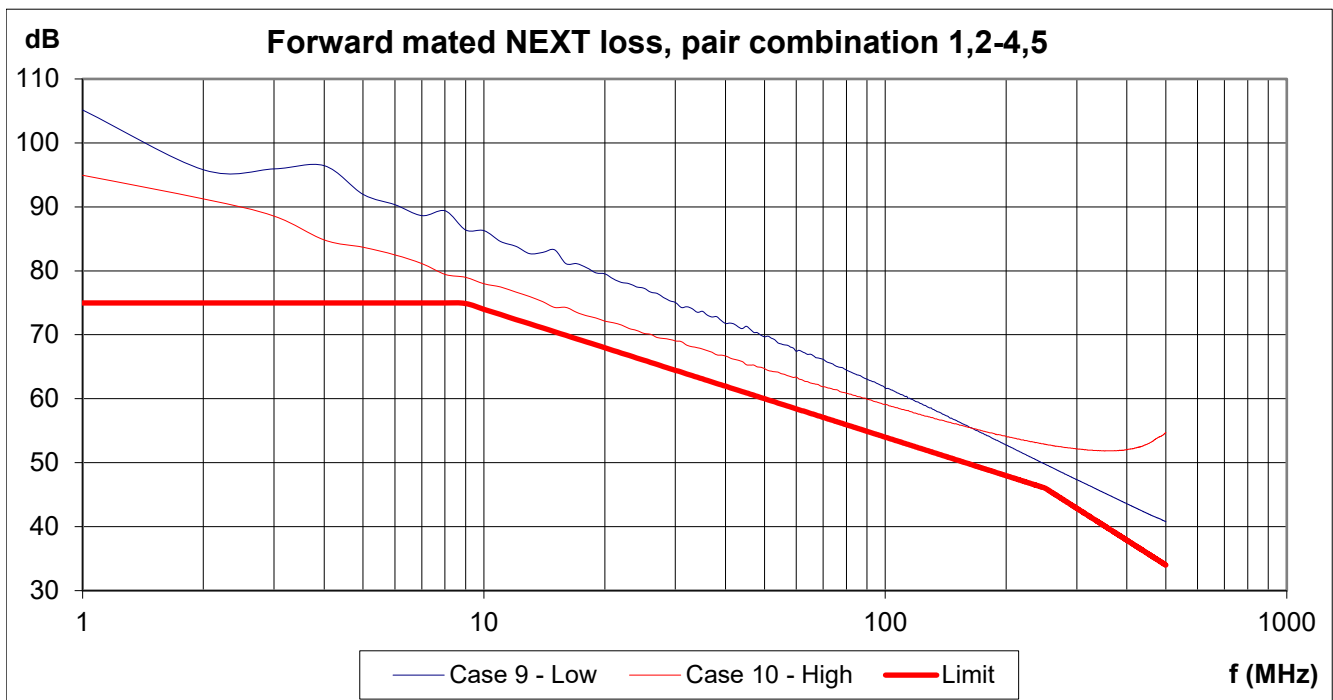
PASS

Summary	Case 5	Case 6
Margin (dB)	4.37	2.86
Freq. (MHz)	251	251



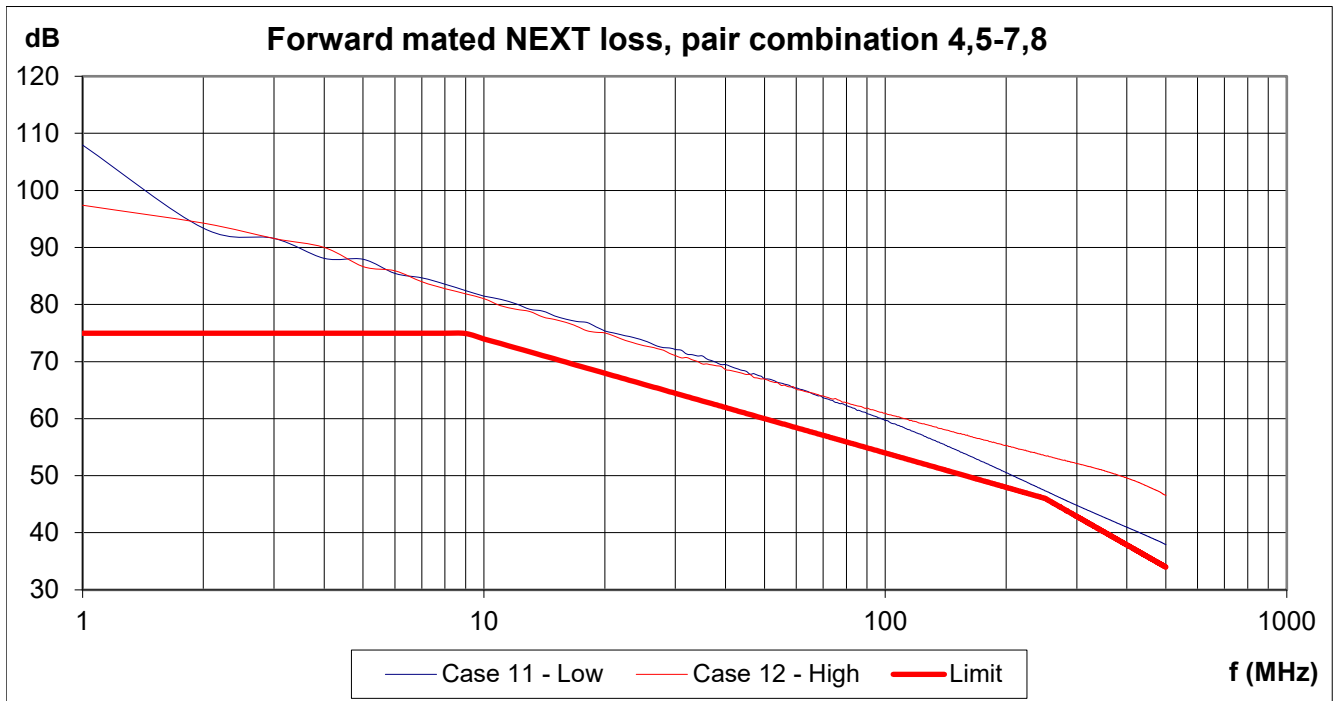
PASS

Summary	Case 7	Case 8
Margin (dB)	3.87	2.66
Freq. (MHz)	500	251



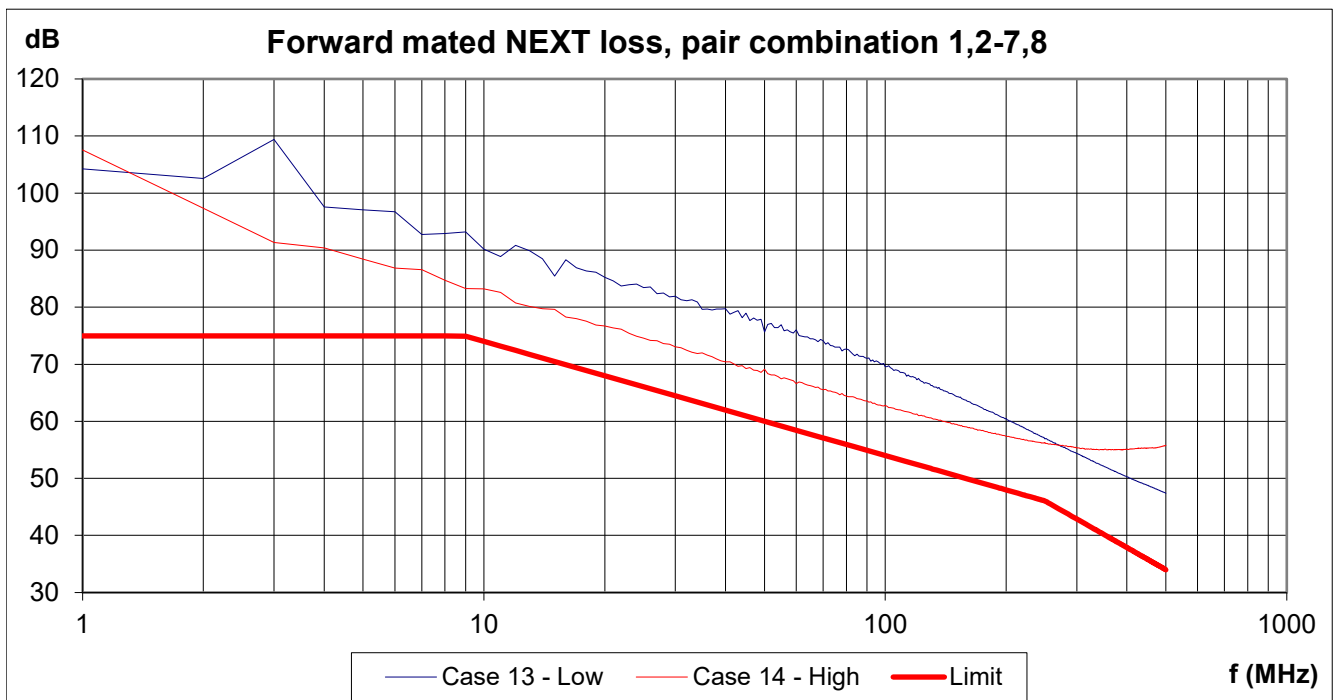
PASS

Summary	Case 9	Case 10
Margin (dB)	3.74	3.81
Freq. (MHz)	250	15



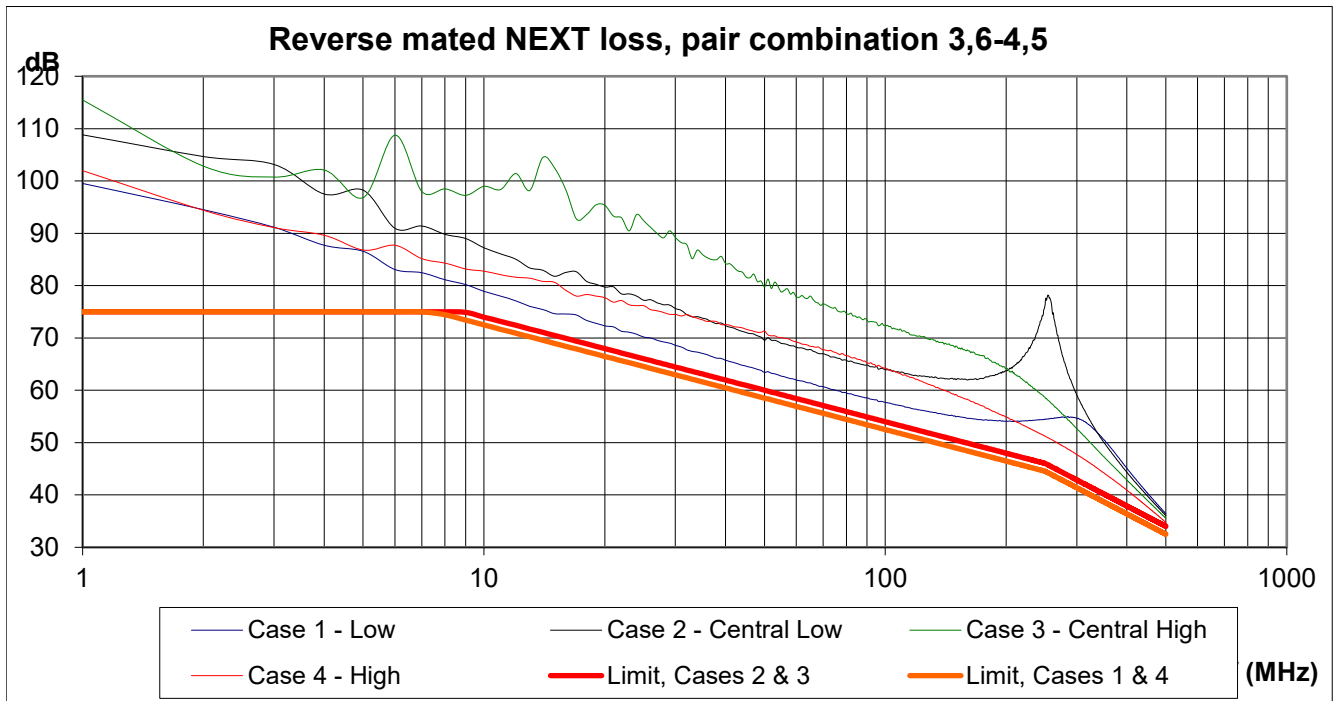
PASS

Summary	Case 11	Case 12
Margin (dB)	1.32	6.47
Freq. (MHz)	250	35



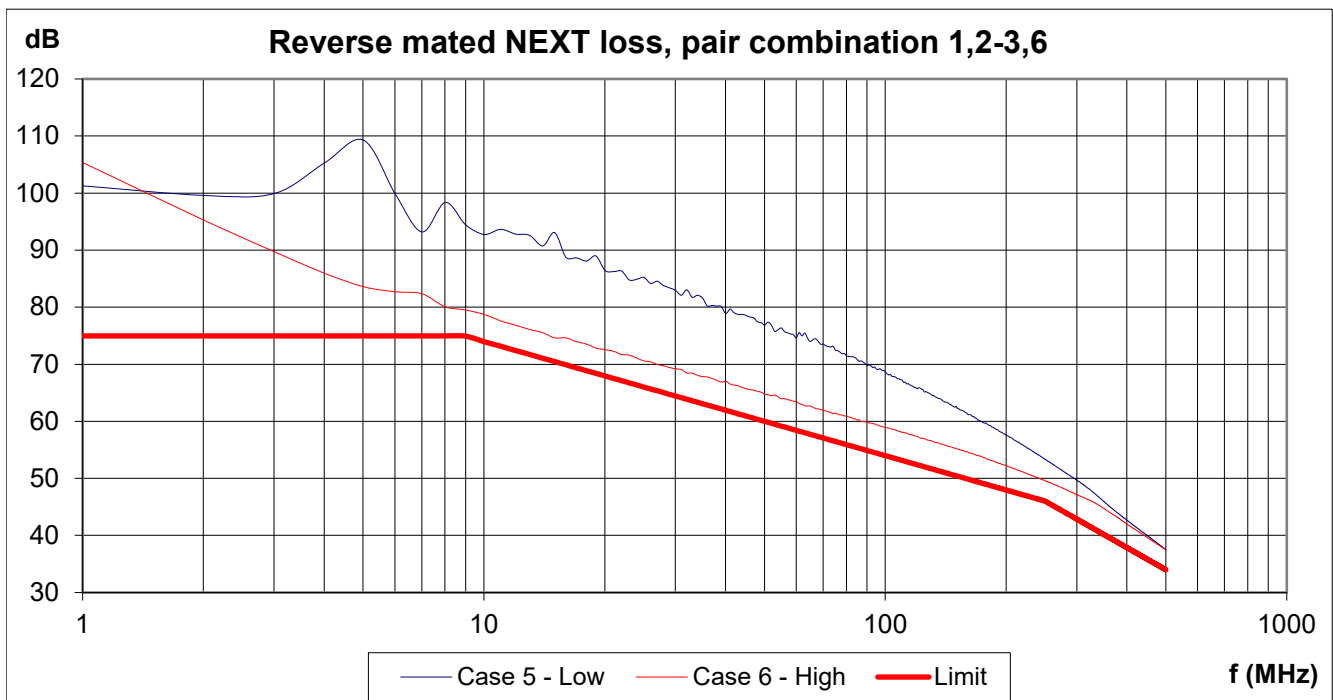
PASS

Summary	Case 13	Case 14
Margin (dB)	10.88	8.19
Freq. (MHz)	250	60



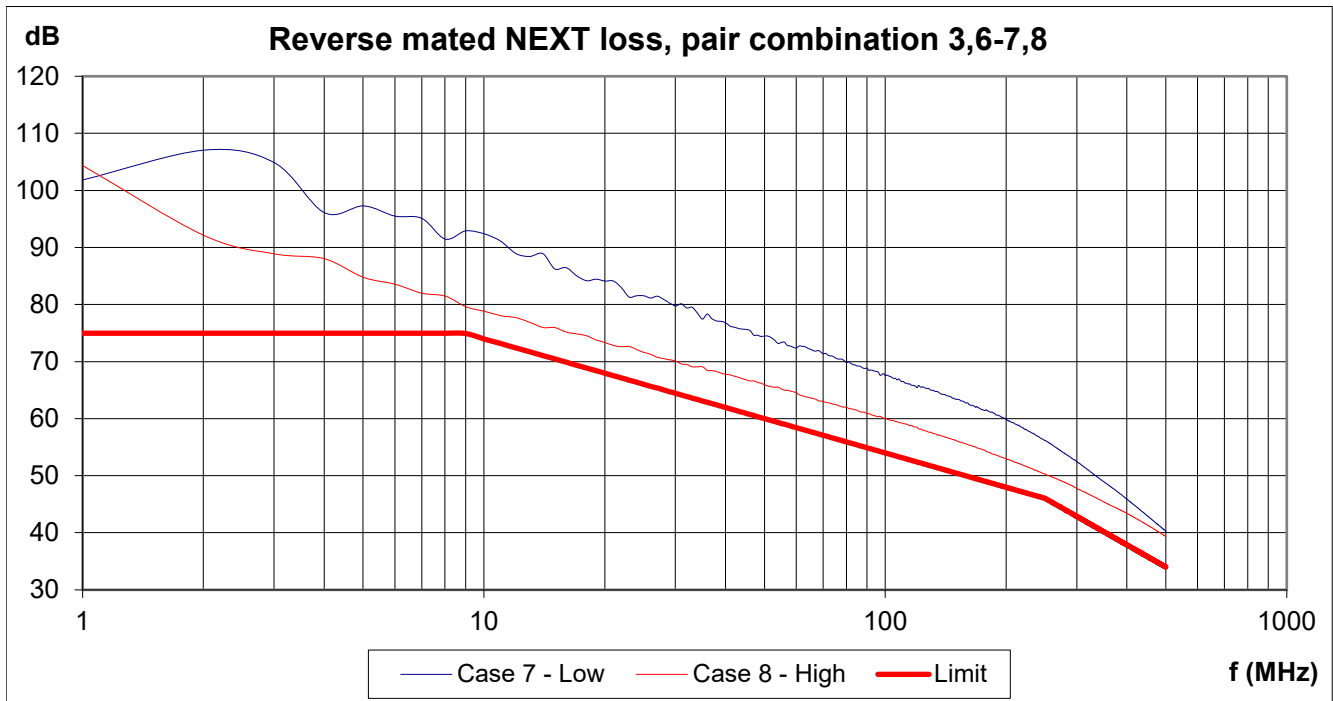
PASS

Summary	Case 1	Case 2	Case 3	Case 4
Margin (dB)	3.92	2.05	1.53	2.24
Freq. (MHz)	500	500	500	500



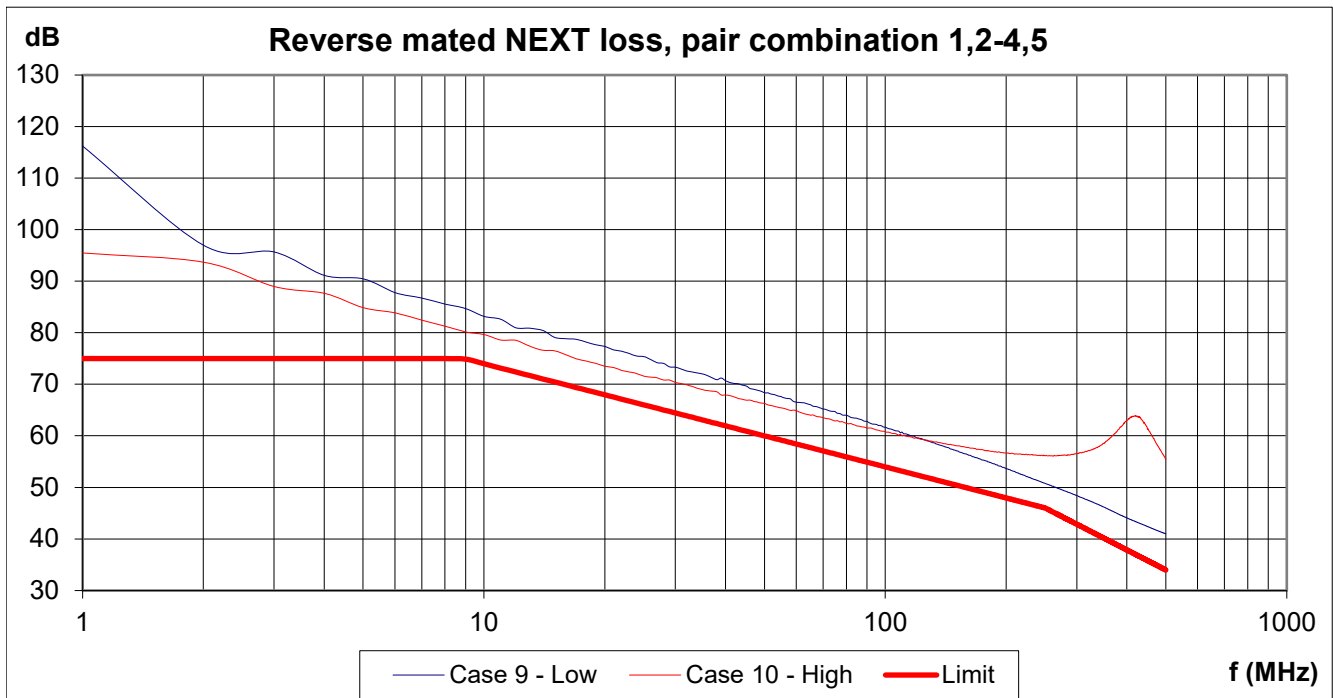
PASS

Summary	Case 5	Case 6
Margin (dB)	3.54	3.51
Freq. (MHz)	500	500



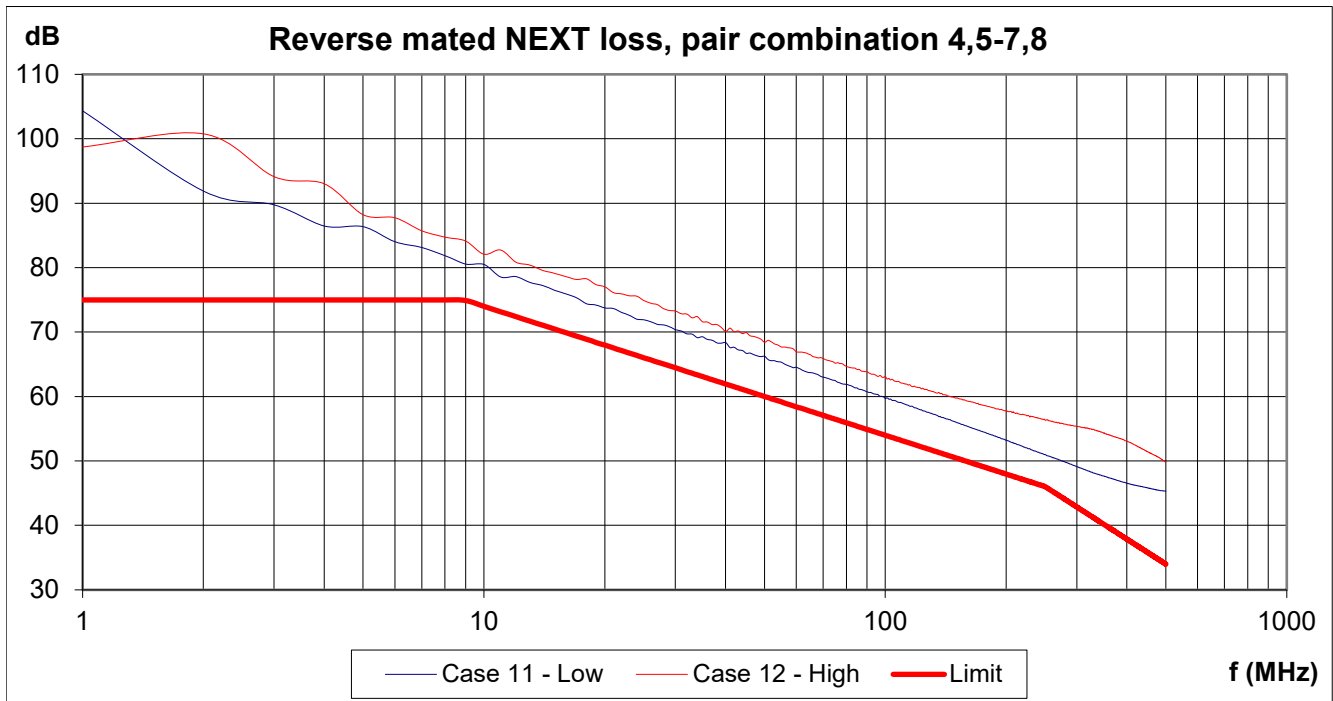
PASS

Summary	Case 7	Case 8
Margin (dB)	6.28	4.24
Freq. (MHz)	500	251



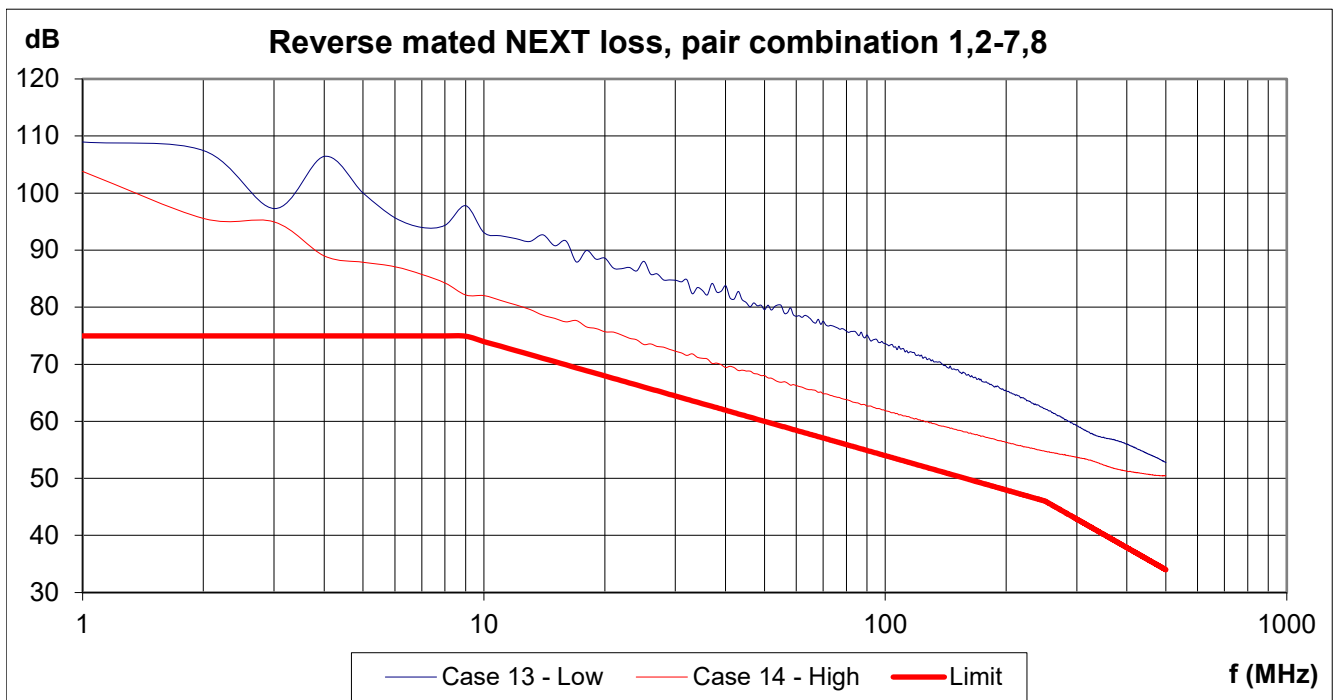
PASS

Summary	Case 9	Case 10
Margin (dB)	4.76	5.27
Freq. (MHz)	248	9



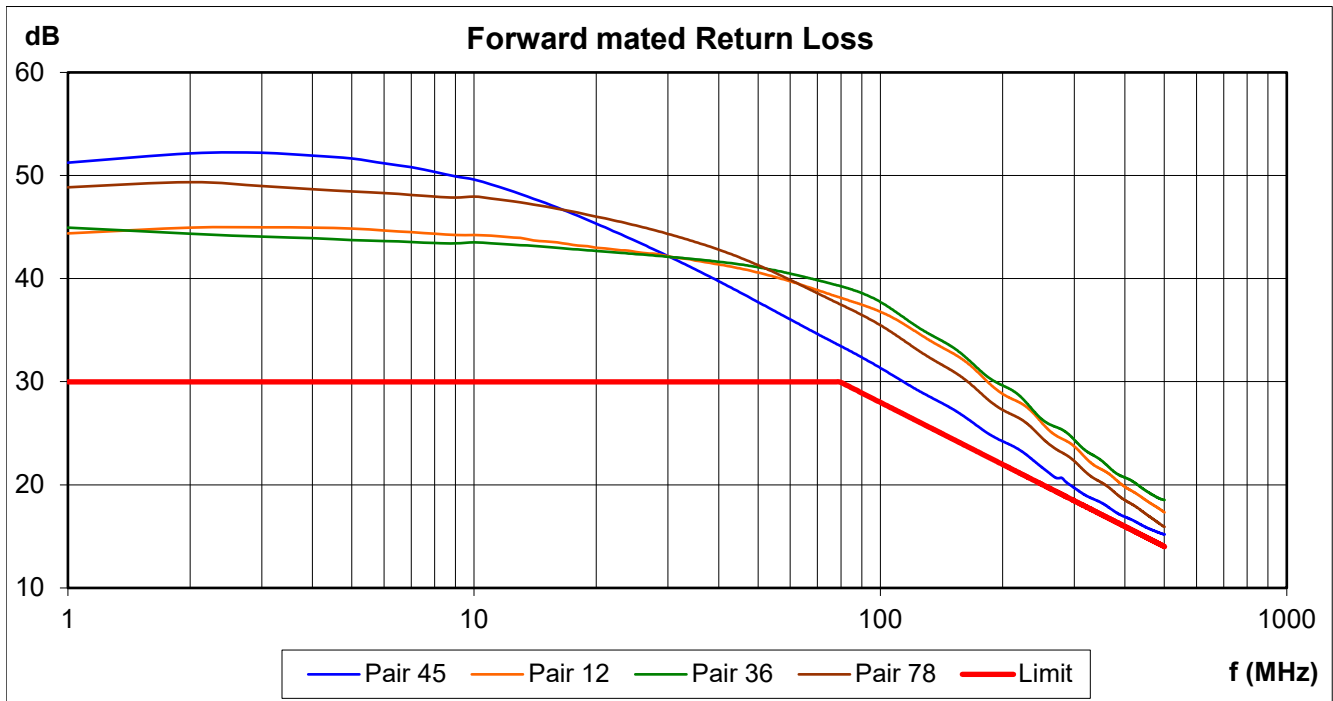
PASS

Summary	Case 11	Case 12
Margin (dB)	4.92	8.09
Freq. (MHz)	249	10



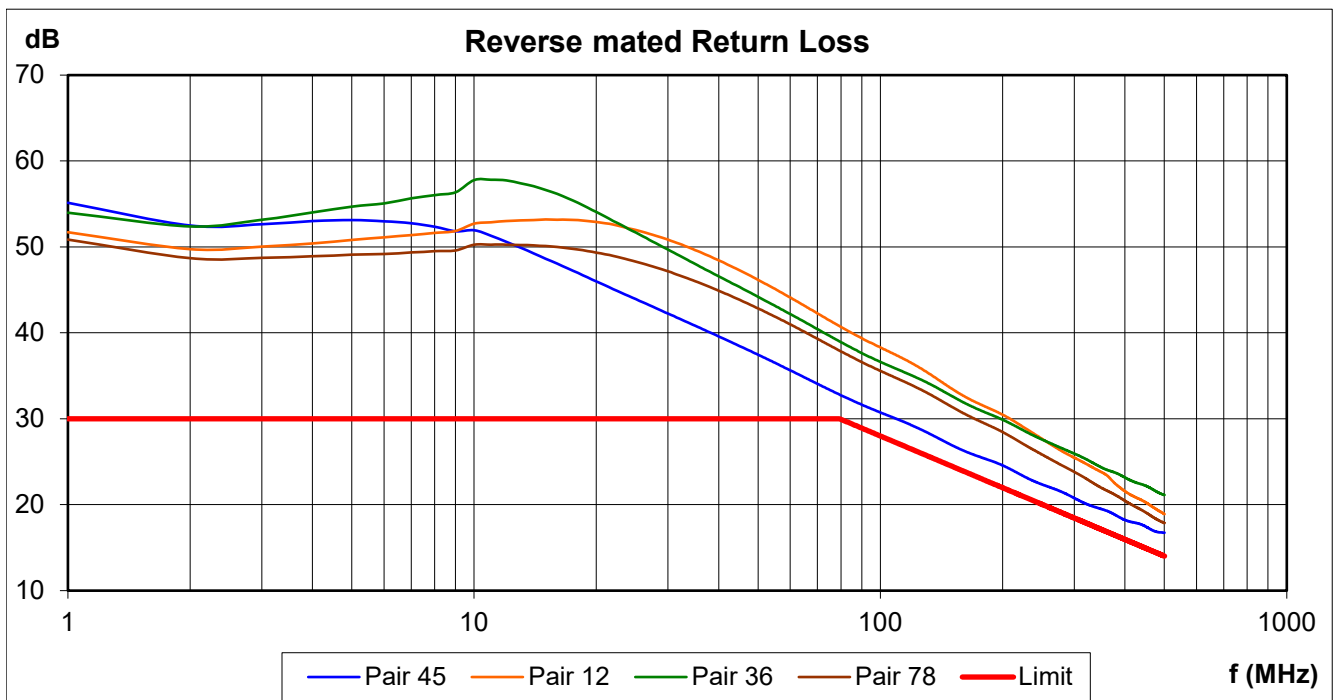
PASS

Summary	Case 13	Case 14
Margin (dB)	16.15	7.24
Freq. (MHz)	251	9



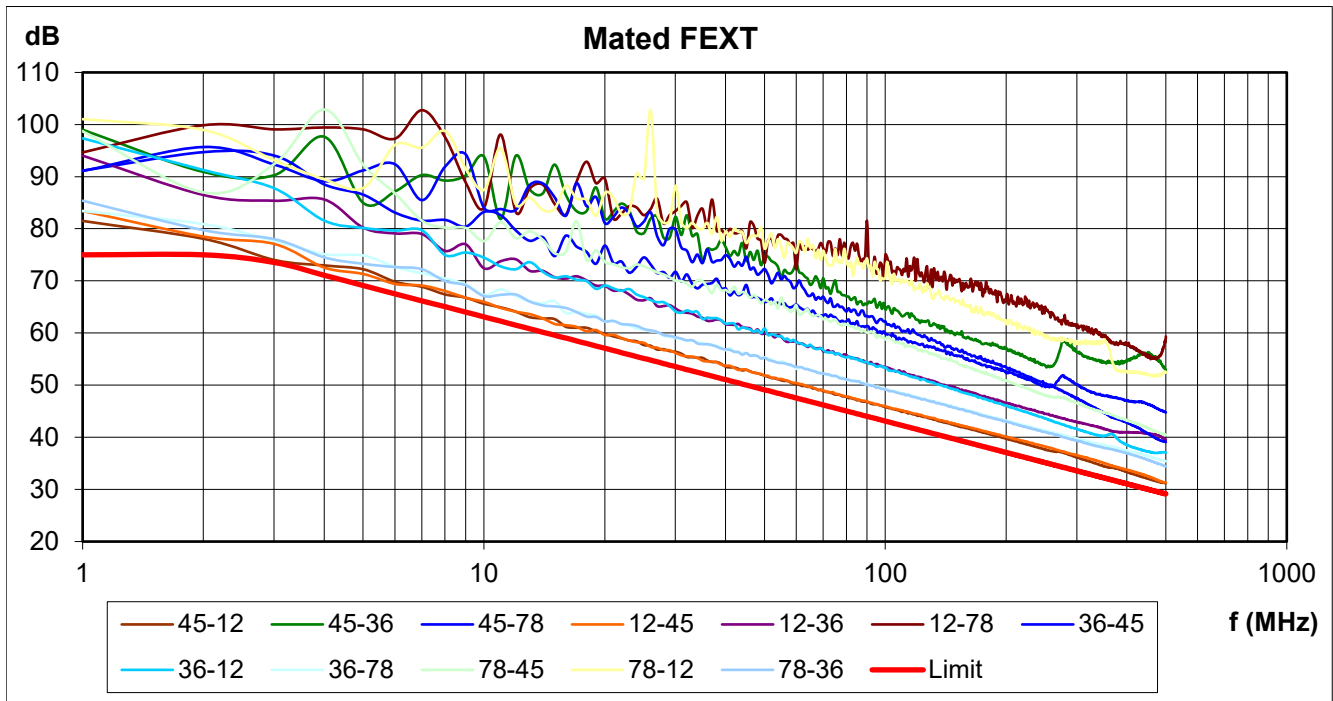
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	0.91	3.32	4.41	1.90
Freq. (MHz)	389	500	481	500



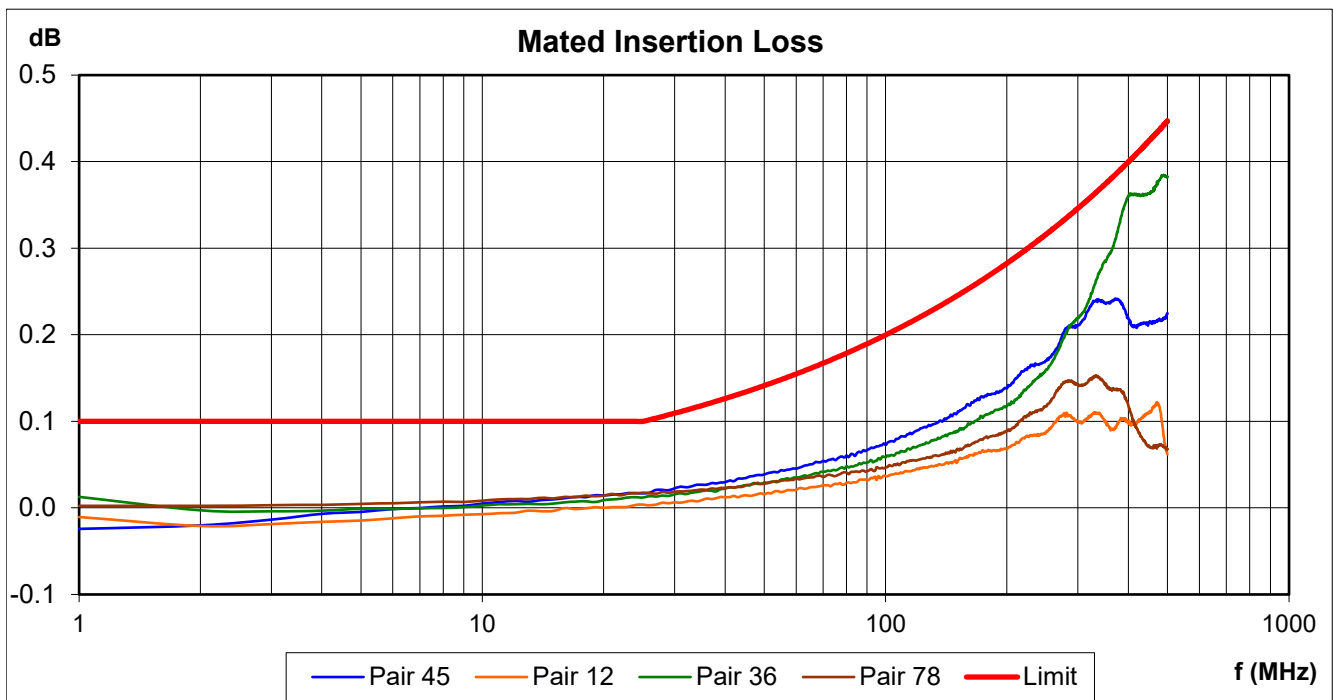
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	2.23	4.90	7.09	3.85
Freq. (MHz)	320	500	490	500



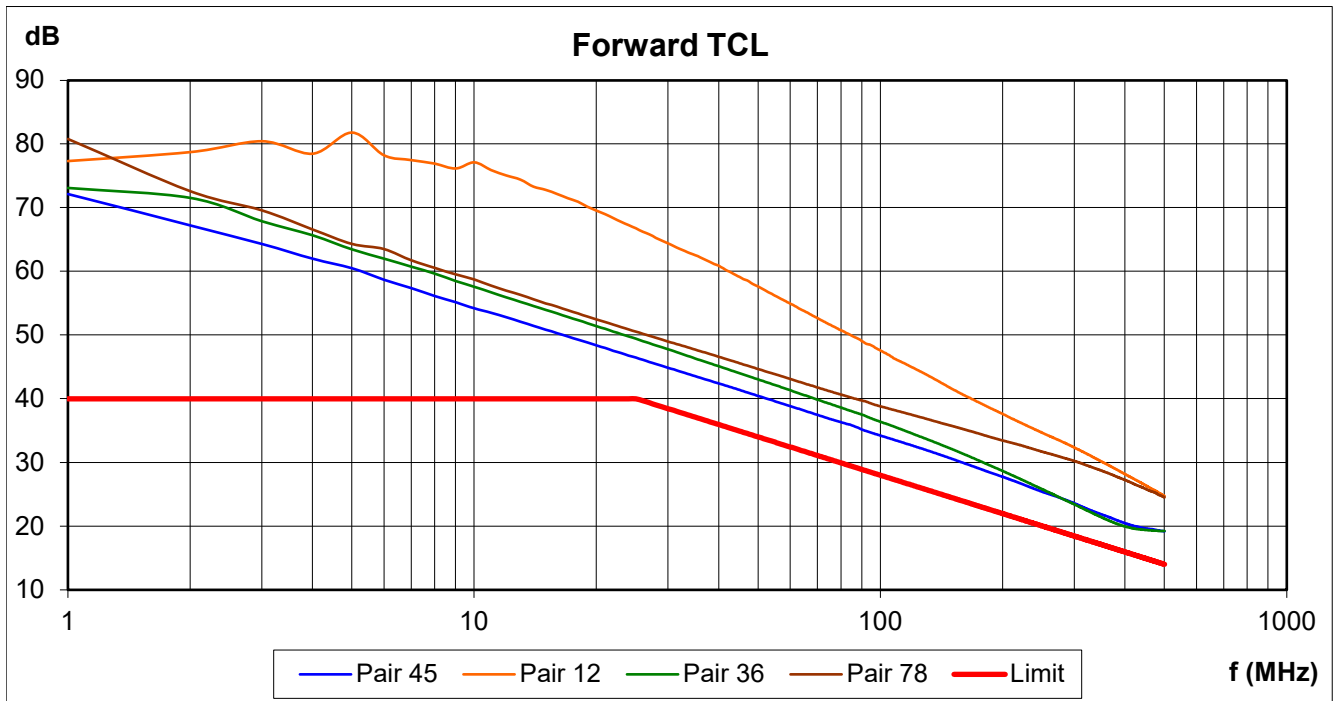
PASS

Summary	45-12	45-36	45-78	12-45	12-36	12-78	36-45	36-12	36-78	78-45	78-12	78-36
Margin (dB)	0.48	15.87	14.49	1.53	9.28	19.70	9.93	7.21	4.10	11.26	18.44	3.45
Freq. (MHz)	3	5	250	4	284	1	496	438	4	500	4	4



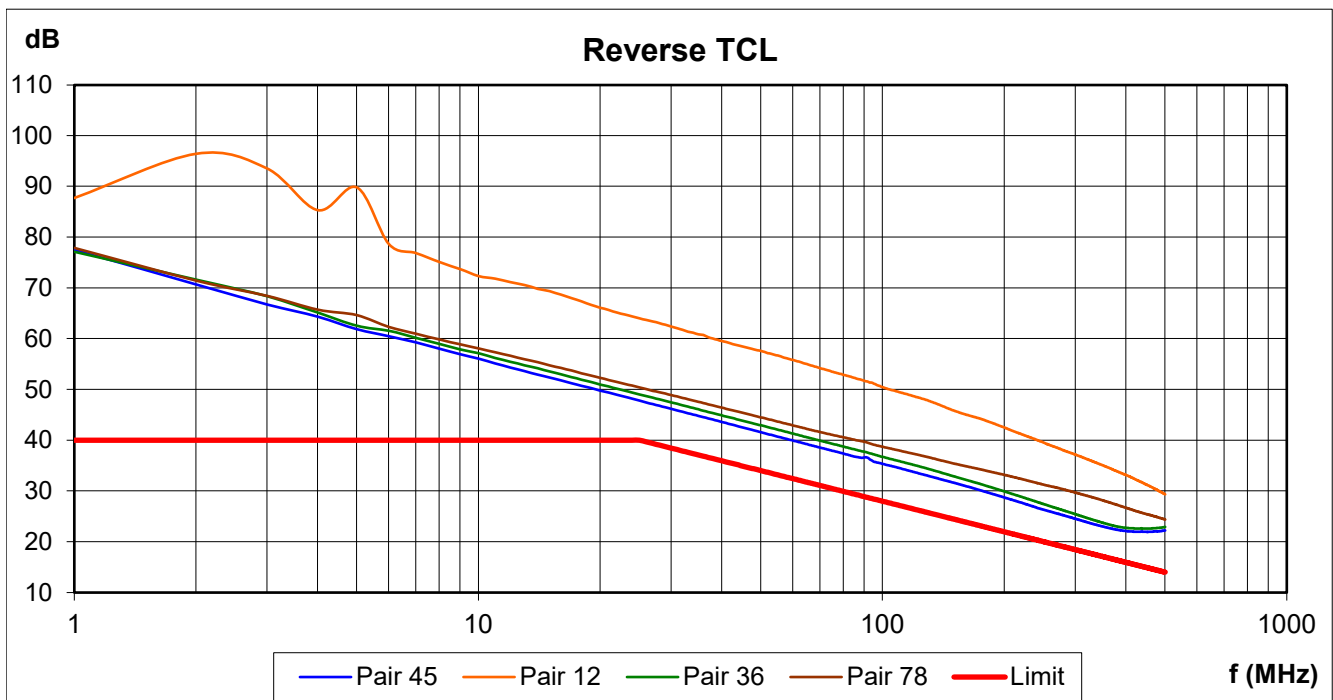
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	0.08	0.10	0.04	0.08
Freq. (MHz)	23	25	403	25



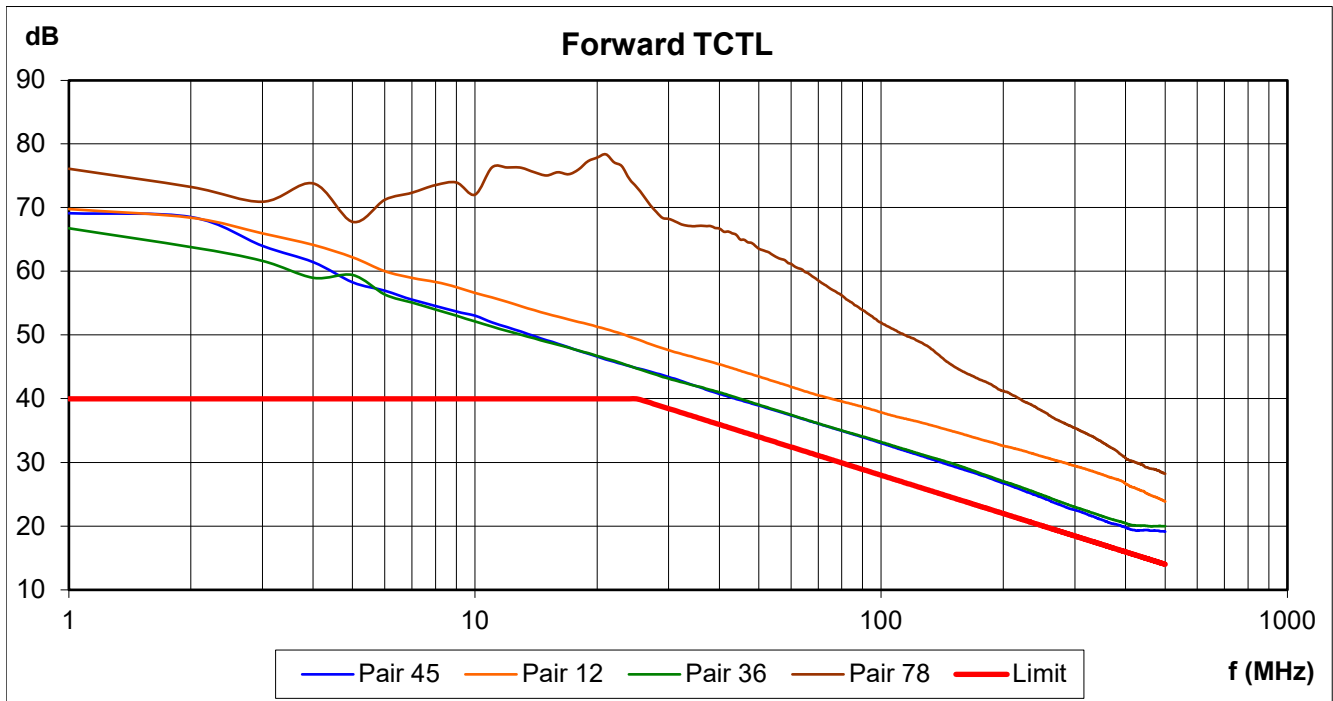
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	4.50	10.71	4.00	10.51
Freq (MHz)	410	500	393	26



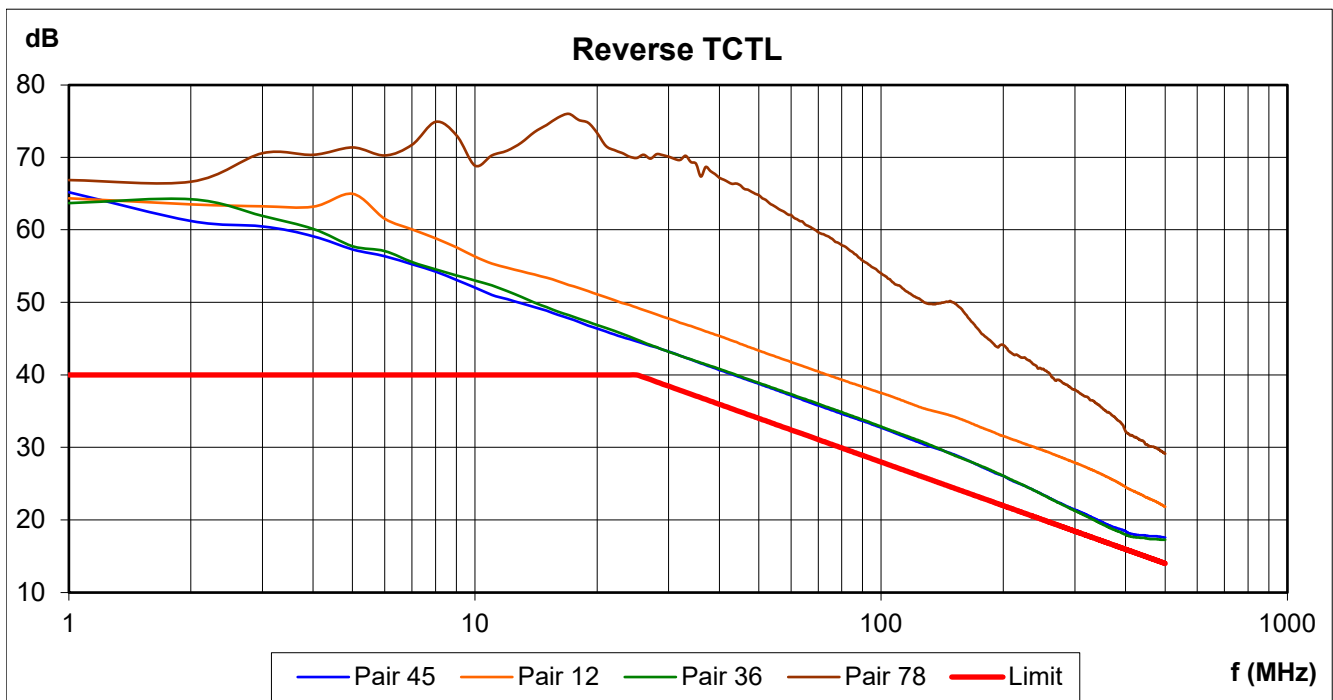
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	5.91	15.32	6.61	10.36
Freq (MHz)	350	500	371	27



PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	3.77	9.17	4.44	14.21
Freq (MHz)	412	29	368	500



PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	2.37	7.80	2.00	15.12
Freq (MHz)	407	500	407	500

NEXT

Combination	Forward						Reverse					
	36-45	12-36	36-78	12-45	45-78	12-78	36-45	12-36	36-78	12-45	45-78	12-78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	2.17	3.52	2.39	2.40	1.03	8.82	1.57	3.46	4.98	3.67	5.15	8.01
Freq. (MHz)	500	249	250	18	250	12	500	500	251	9	250	15

FEXT

Combination	45-12	45-36	45-78	12-45	12-36	12-78	36-45	36-12	36-78	78-45	78-12	78-36
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	0.77	14.10	10.84	1.81	7.49	18.99	9.96	6.43	2.98	8.81	16.21	3.50
Freq. (MHz)	3	3	7	6	3	4	496	451	3	498	2	4

Return Loss

Pair	Forward				Reverse			
	45	12	36	78	45	12	36	78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	0.77	3.01	3.92	2.22	1.83	4.54	6.05	4.13
Freq. (MHz)	319	500	490	500	318	500	497	494

Insertion Loss

Pair	45	12	36	78
Result	PASS	PASS	PASS	PASS
Margin (dB)	0.09	0.10	0.06	0.09
Freq. (MHz)	23	25	401	24

TCL

Pair	Forward				Reverse			
	45	12	36	78	45	12	36	78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	4.50	10.71	4.00	10.51	5.91	15.32	6.61	10.36
Freq. (MHz)	410	500	393	26	350	500	371	27

TCTL

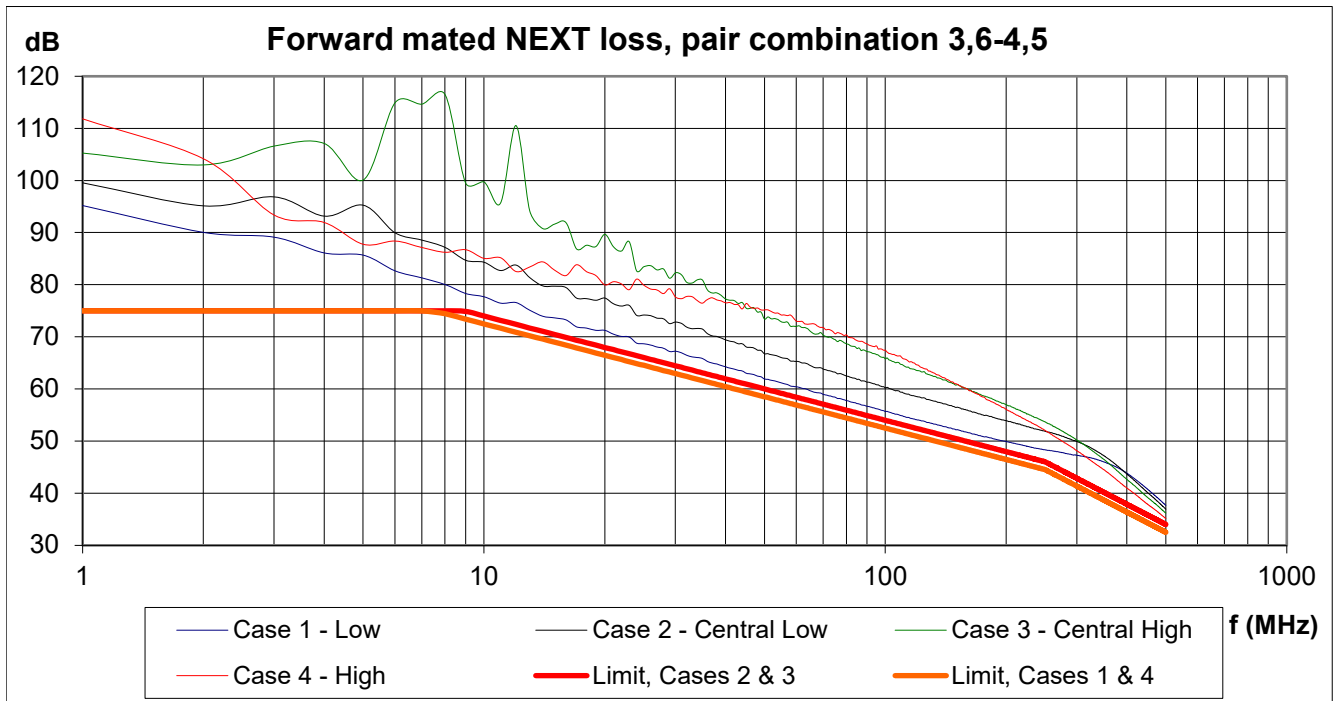
Pair	Forward				Reverse			
	45	12	36	78	45	12	36	78
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (dB)	3.77	9.17	4.44	14.21	2.37	7.80	2.00	15.12
Freq. (MHz)	412	29	368	500	407	500	407	500

DC Resistance (Limit = 200 mΩ)

Conductor	5	4	1	2	3	6	7	8
Result	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Margin (mΩ)	134.9	124.6	152.0	140.6	128.2	130.8	156.6	142.9

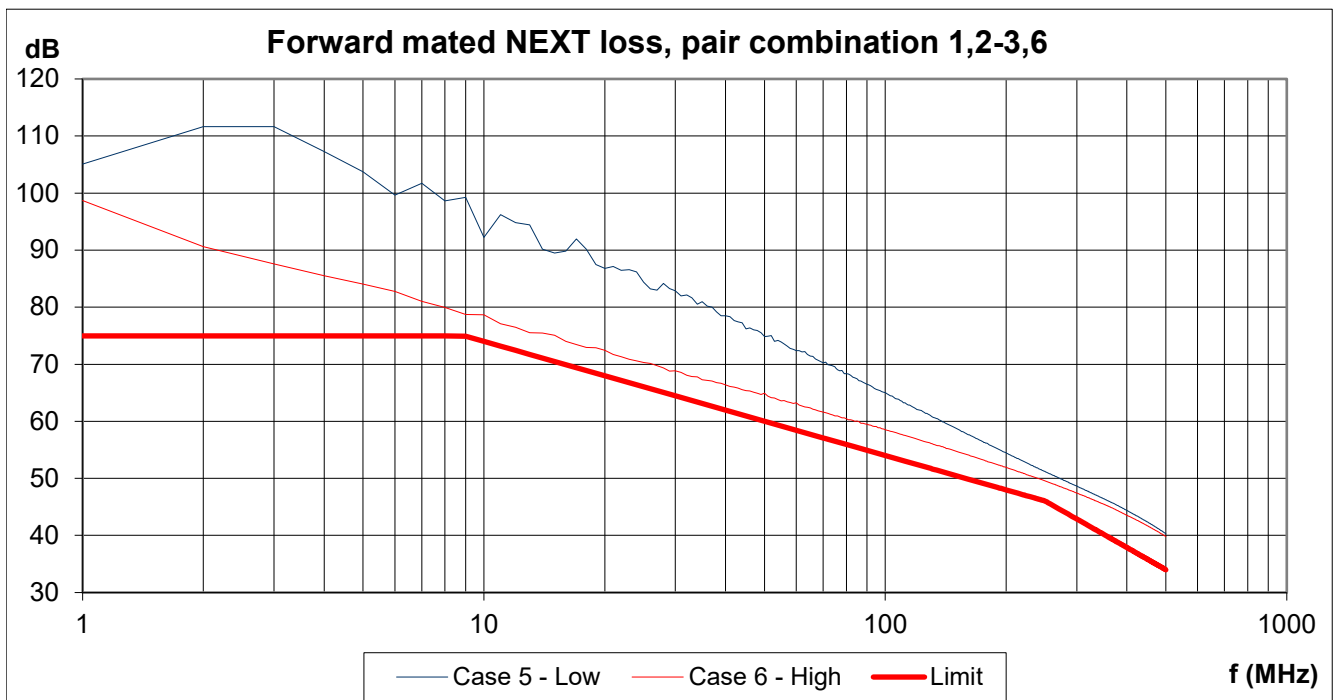
DC Resistance Unbalance (Limit = 50 mΩ)

Pair	45	12	36	78
Result	PASS	PASS	PASS	PASS
Margin (mΩ)	39.7	38.6	47.4	36.3



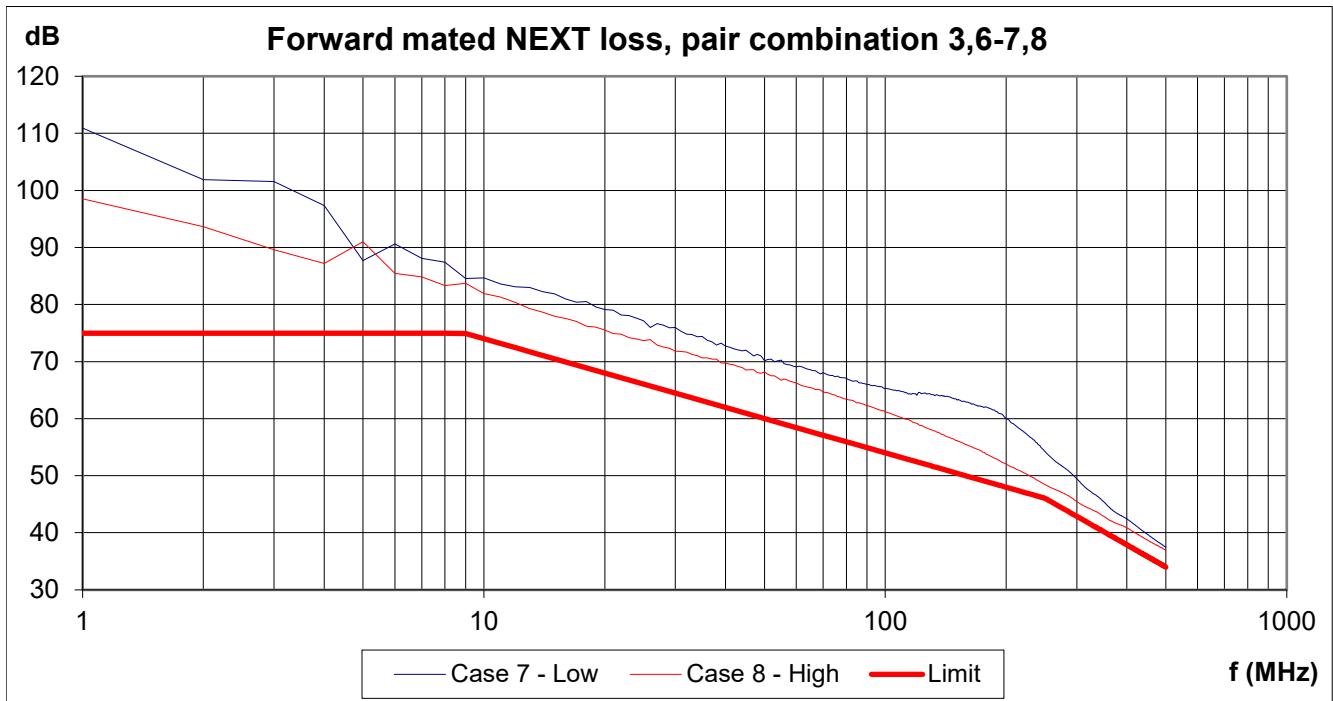
PASS

Summary	Case 1	Case 2	Case 3	Case 4
Margin (dB)	3.13	2.94	2.17	2.64
Freq. (MHz)	113	500	500	500



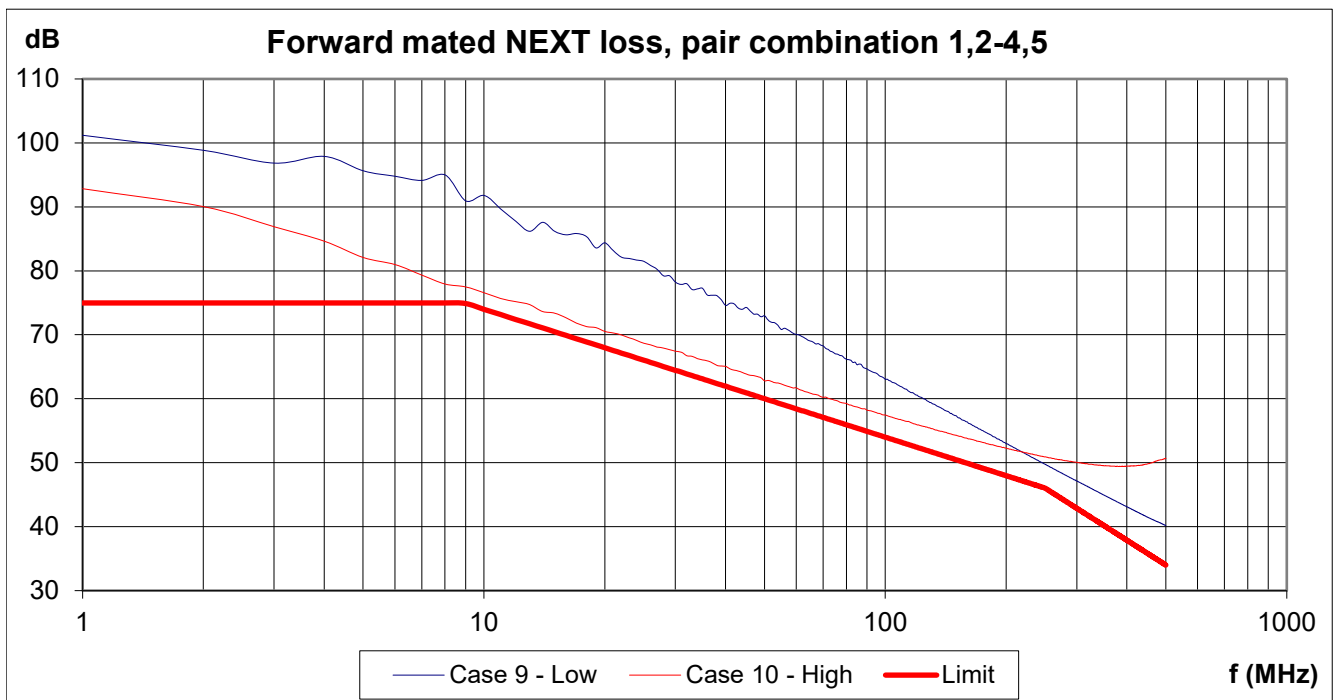
PASS

Summary	Case 5	Case 6
Margin (dB)	5.16	3.52
Freq. (MHz)	249	249



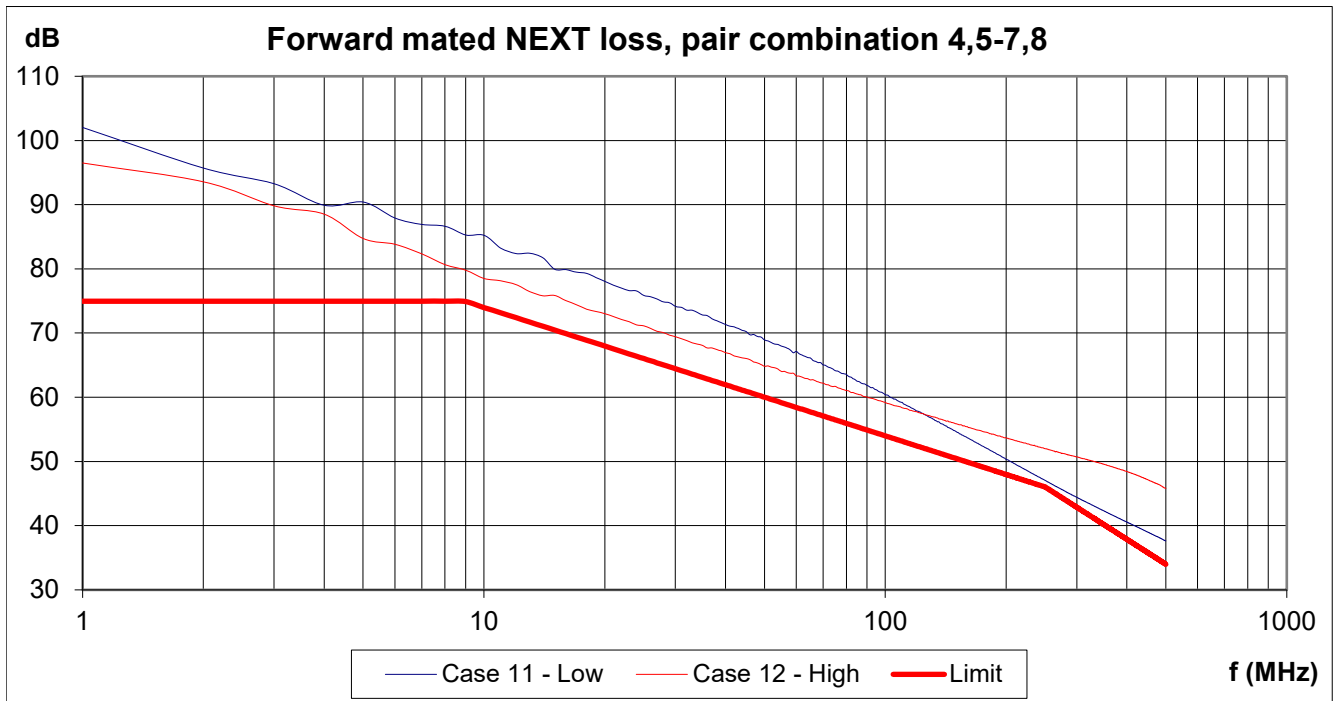
PASS

Summary	Case 7	Case 8
Margin (dB)	3.45	2.39
Freq. (MHz)	500	250



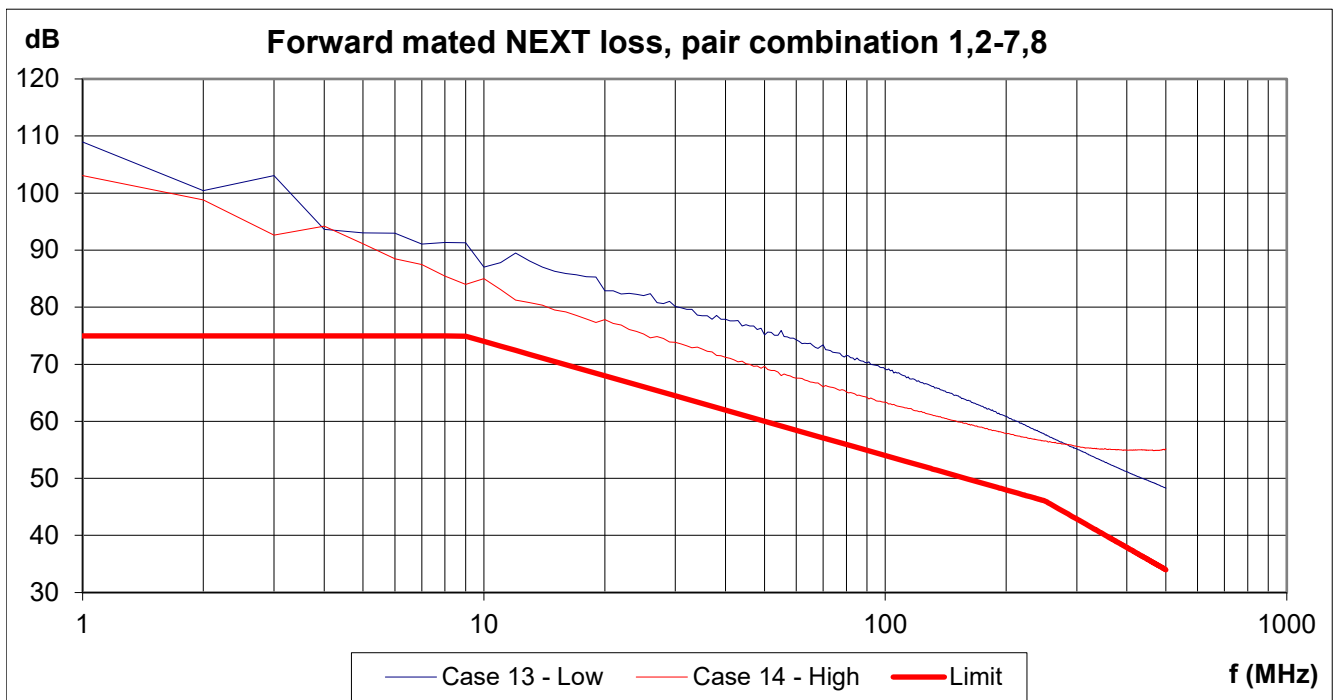
PASS

Summary	Case 9	Case 10
Margin (dB)	3.72	2.40
Freq. (MHz)	250	18



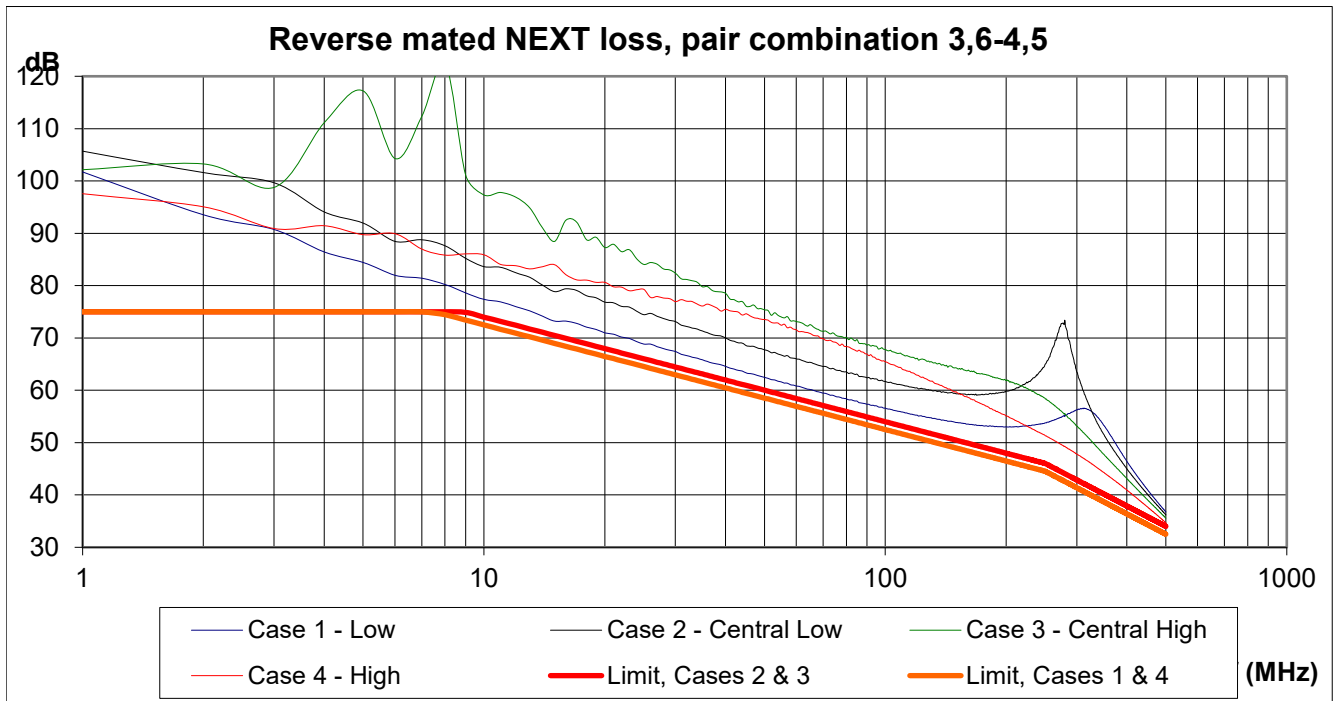
PASS

Summary	Case 11	Case 12
Margin (dB)	1.03	4.54
Freq. (MHz)	250	10



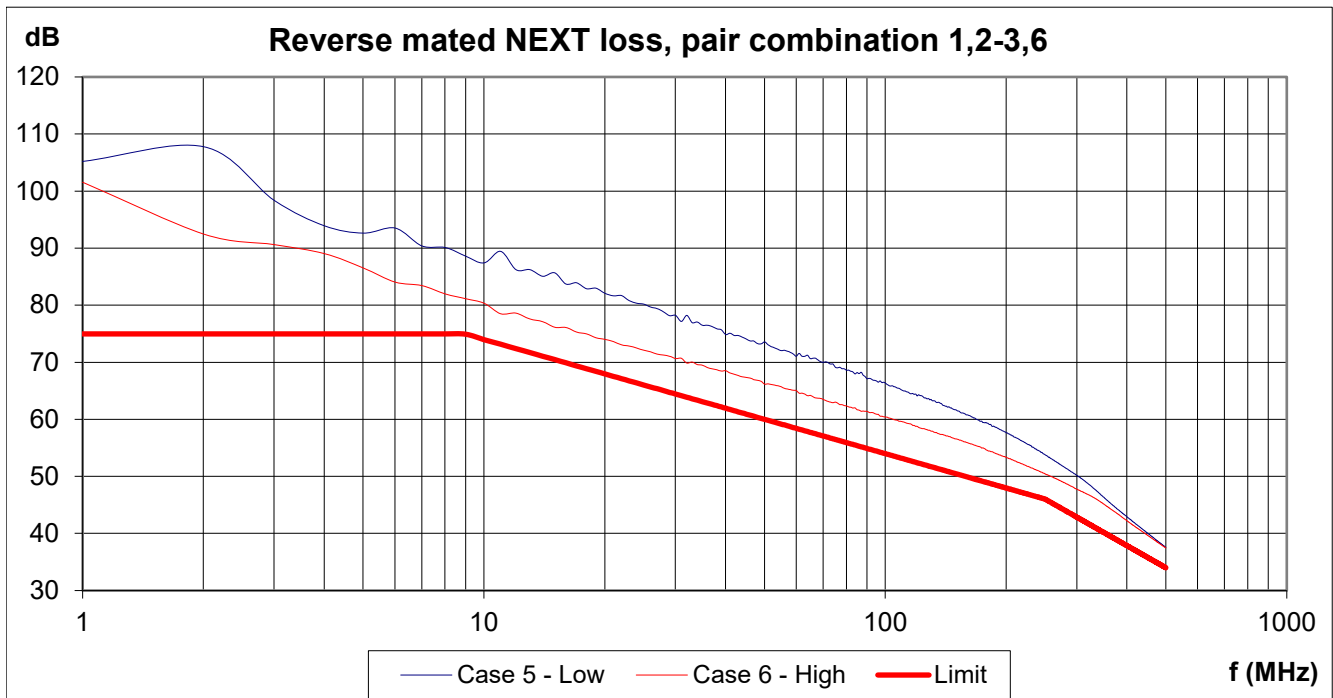
PASS

Summary	Case 13	Case 14
Margin (dB)	11.63	8.82
Freq. (MHz)	251	12



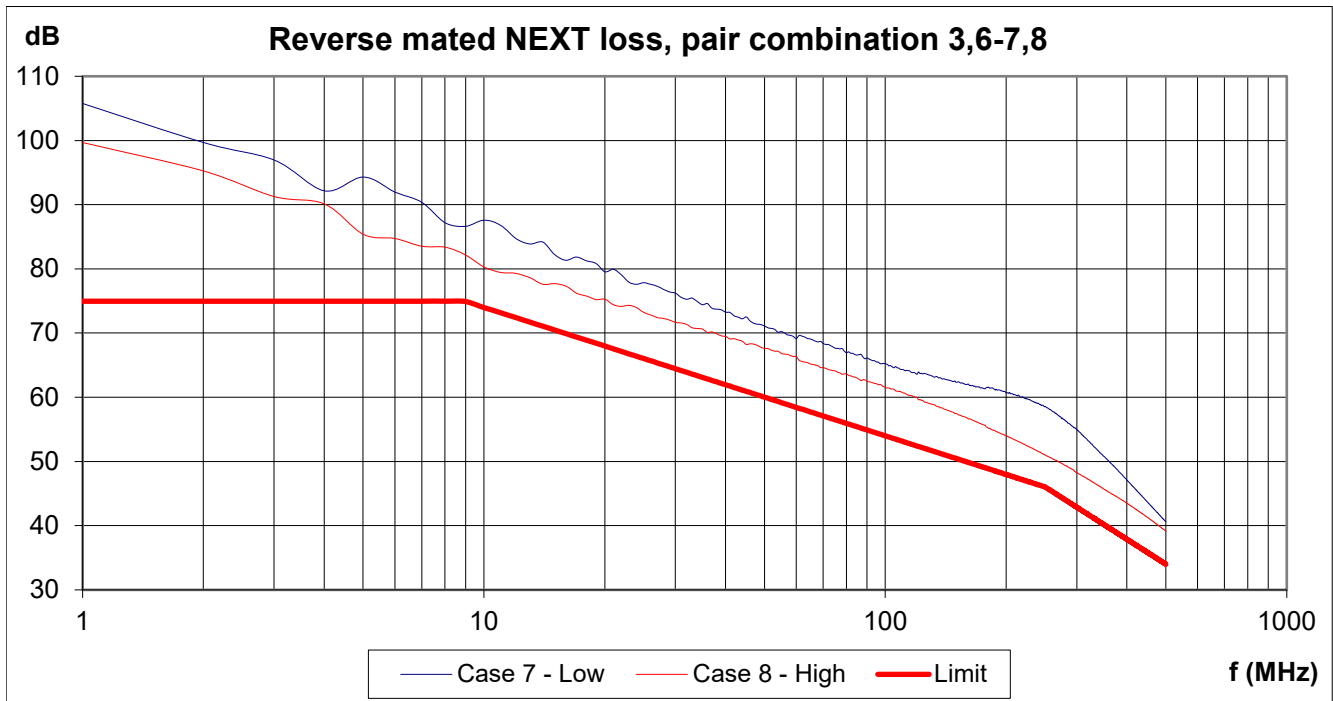
PASS

Summary	Case 1	Case 2	Case 3	Case 4
Margin (dB)	3.83	2.20	1.57	2.18
Freq. (MHz)	73	500	500	500



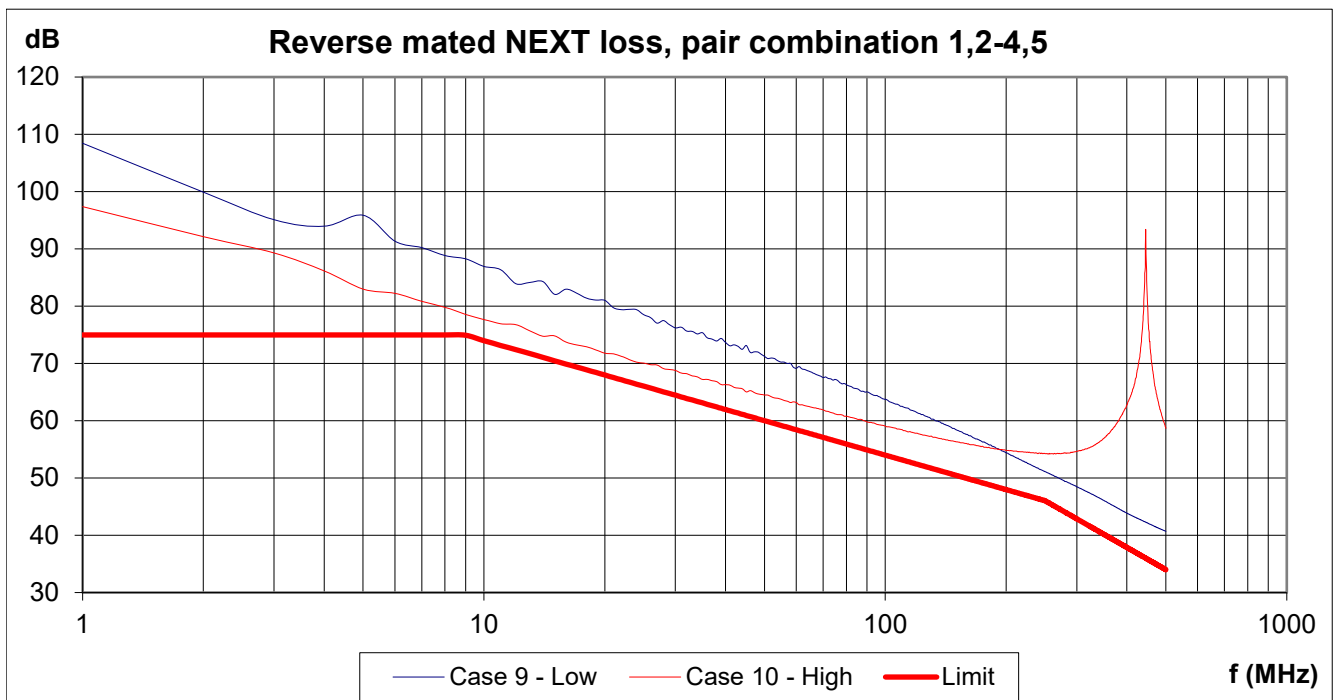
PASS

Summary	Case 5	Case 6
Margin (dB)	3.56	3.46
Freq. (MHz)	500	500



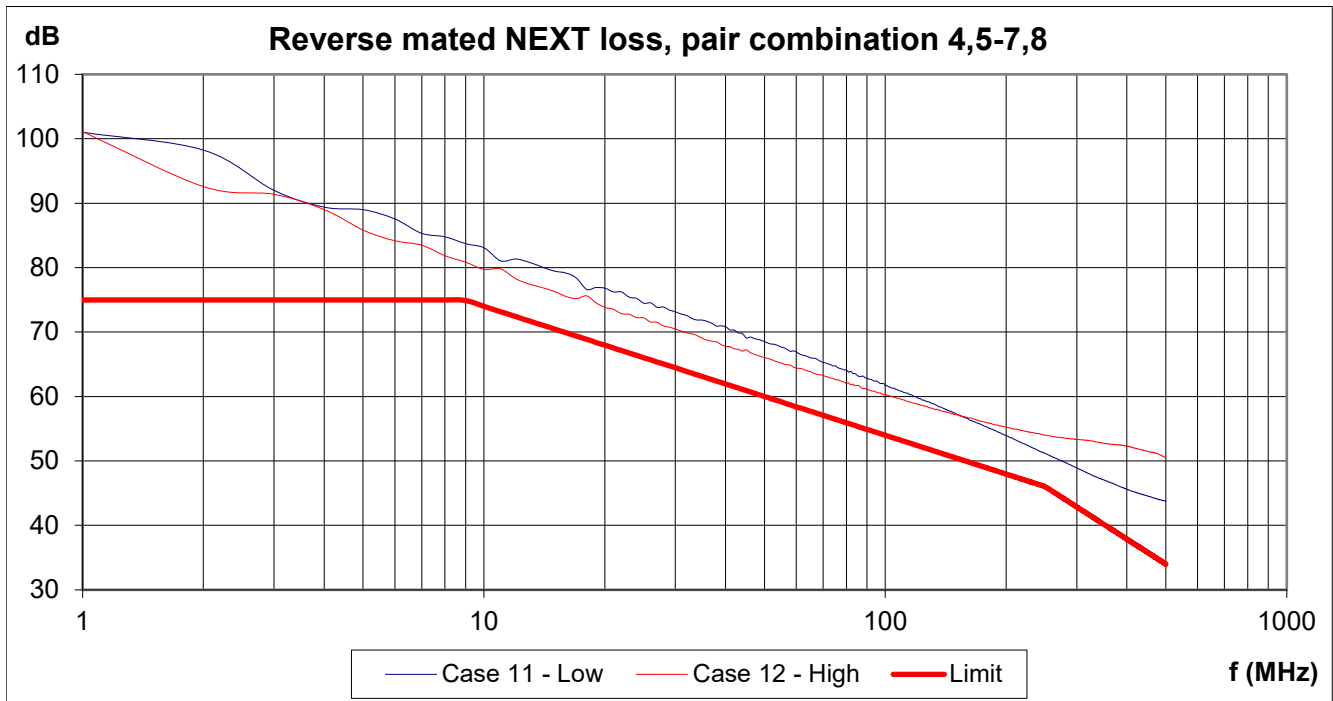
PASS

Summary	Case 7	Case 8
Margin (dB)	6.61	4.98
Freq. (MHz)	500	251



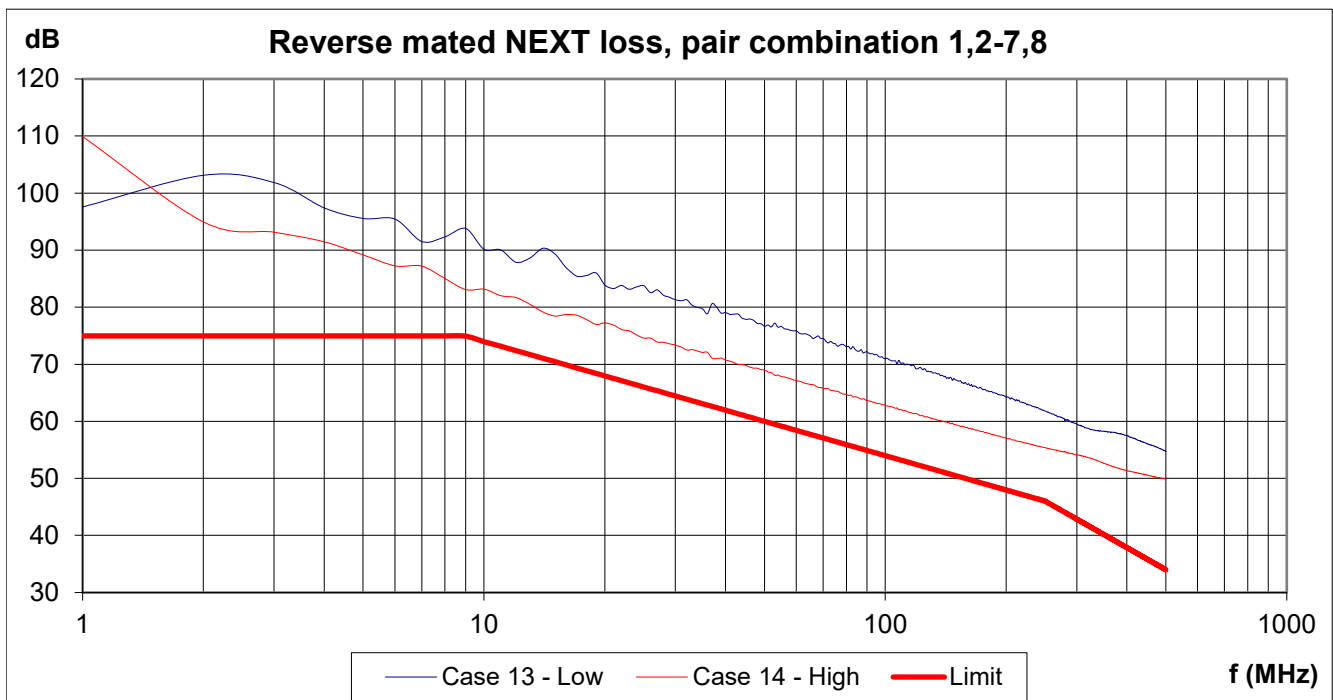
PASS

Summary	Case 9	Case 10
Margin (dB)	5.08	3.67
Freq. (MHz)	250	9



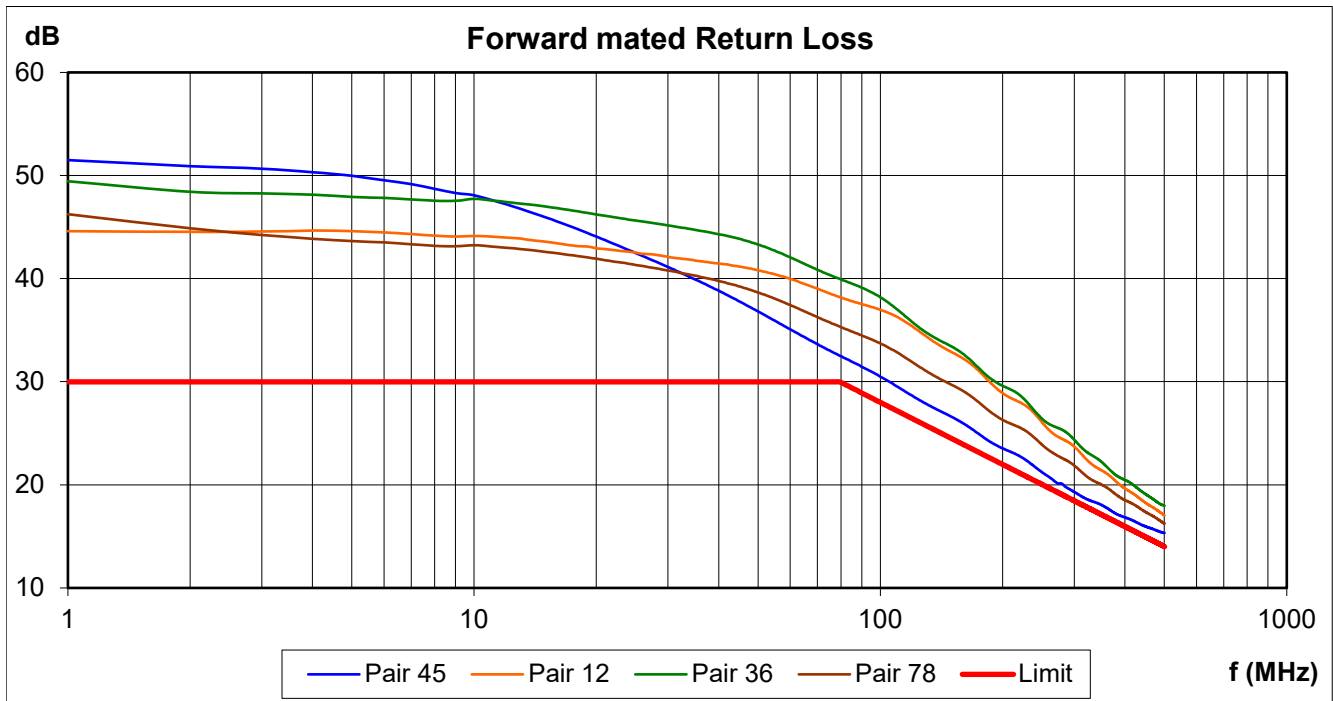
PASS

Summary	Case 11	Case 12
Margin (dB)	5.15	5.64
Freq. (MHz)	250	16



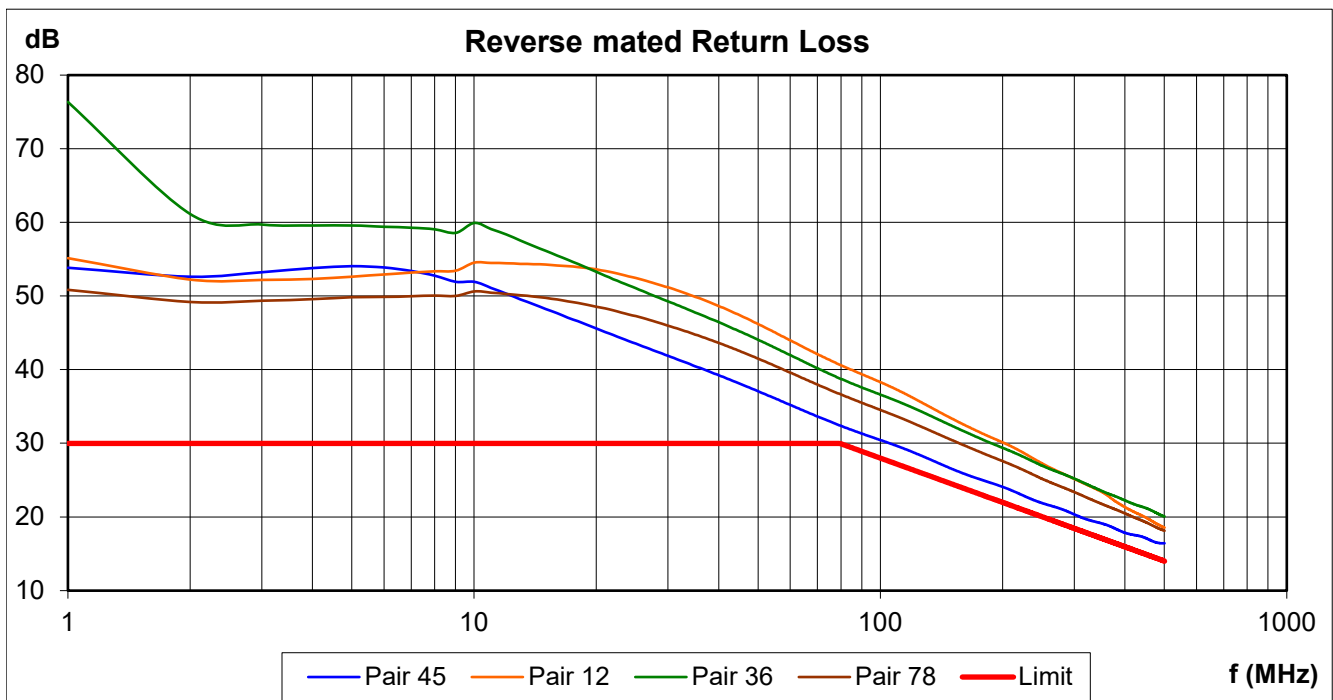
PASS

Summary	Case 13	Case 14
Margin (dB)	15.50	8.01
Freq. (MHz)	12	15



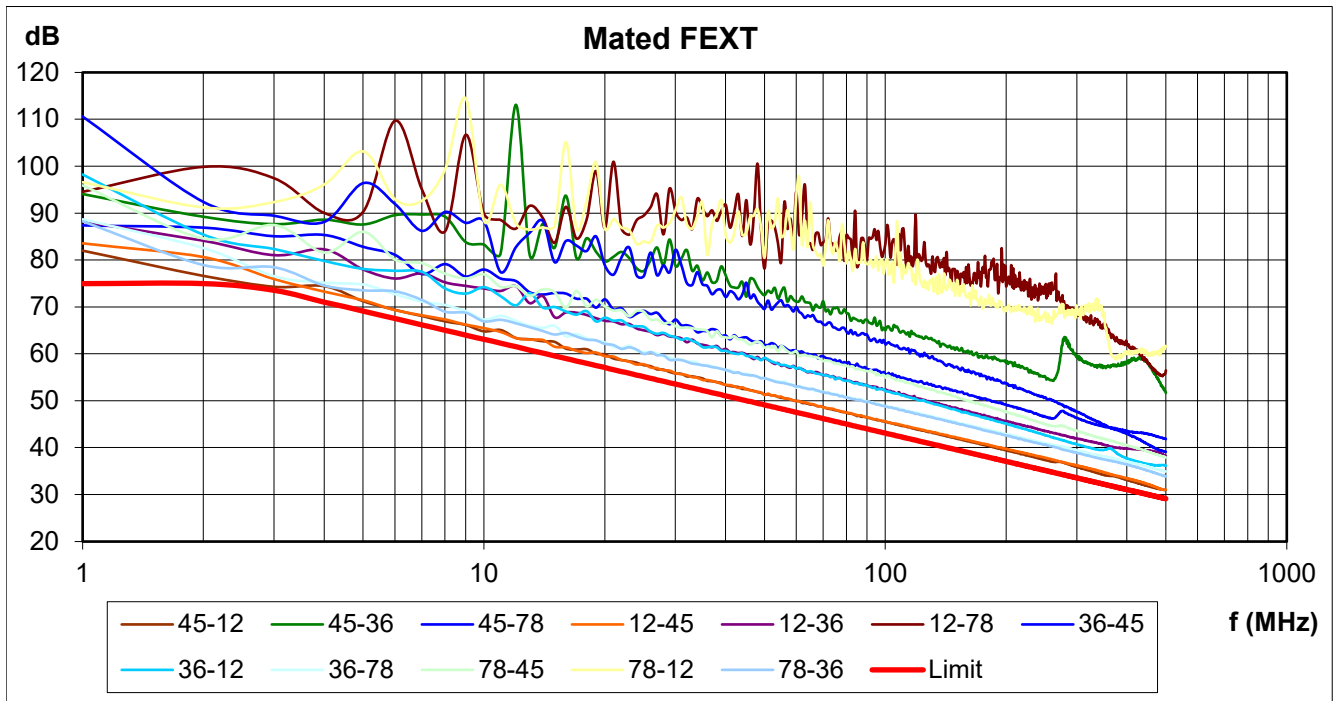
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	0.77	3.01	3.92	2.22
Freq. (MHz)	319	500	490	500



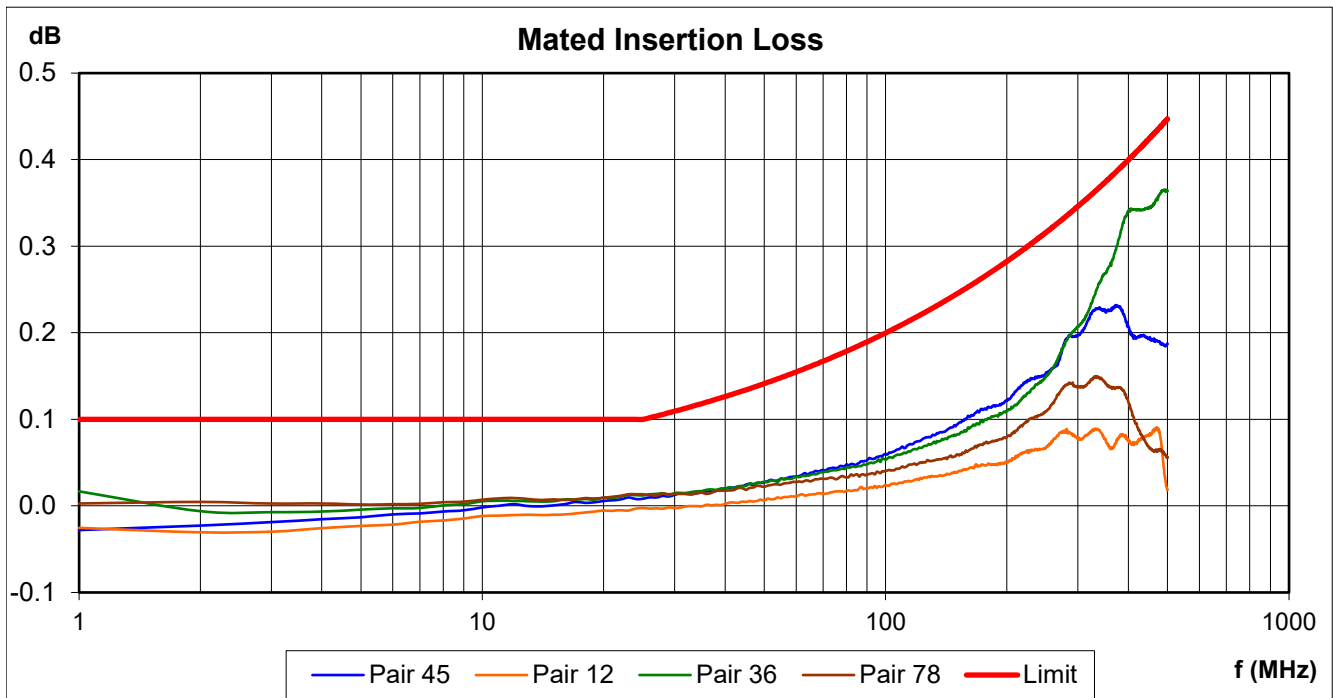
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	1.83	4.54	6.05	4.13
Freq. (MHz)	318	500	497	494



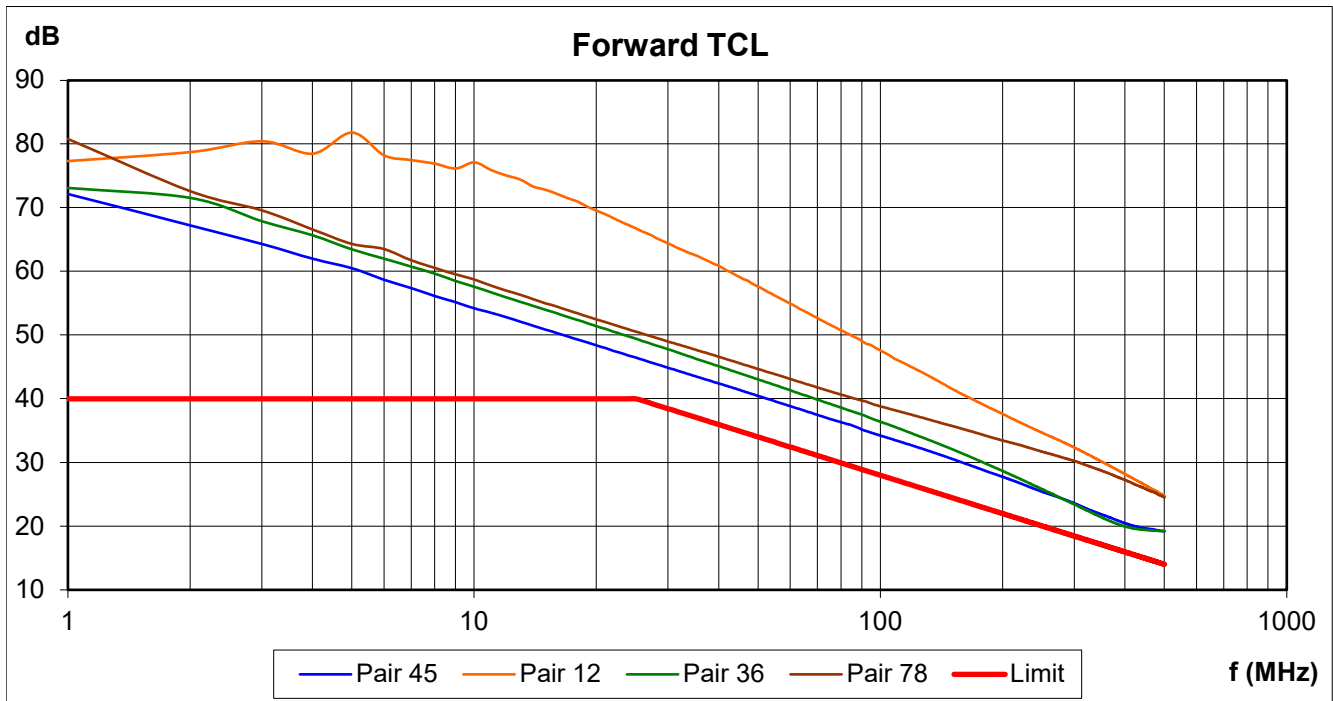
PASS

Summary	45-12	45-36	45-78	12-45	12-36	12-78	36-45	36-12	36-78	78-45	78-12	78-36
Margin (dB)	0.77	14.10	10.84	1.81	7.49	18.99	9.96	6.43	2.98	8.81	16.21	3.50
Freq. (MHz)	3	3	7	6	3	4	496	451	3	498	2	4



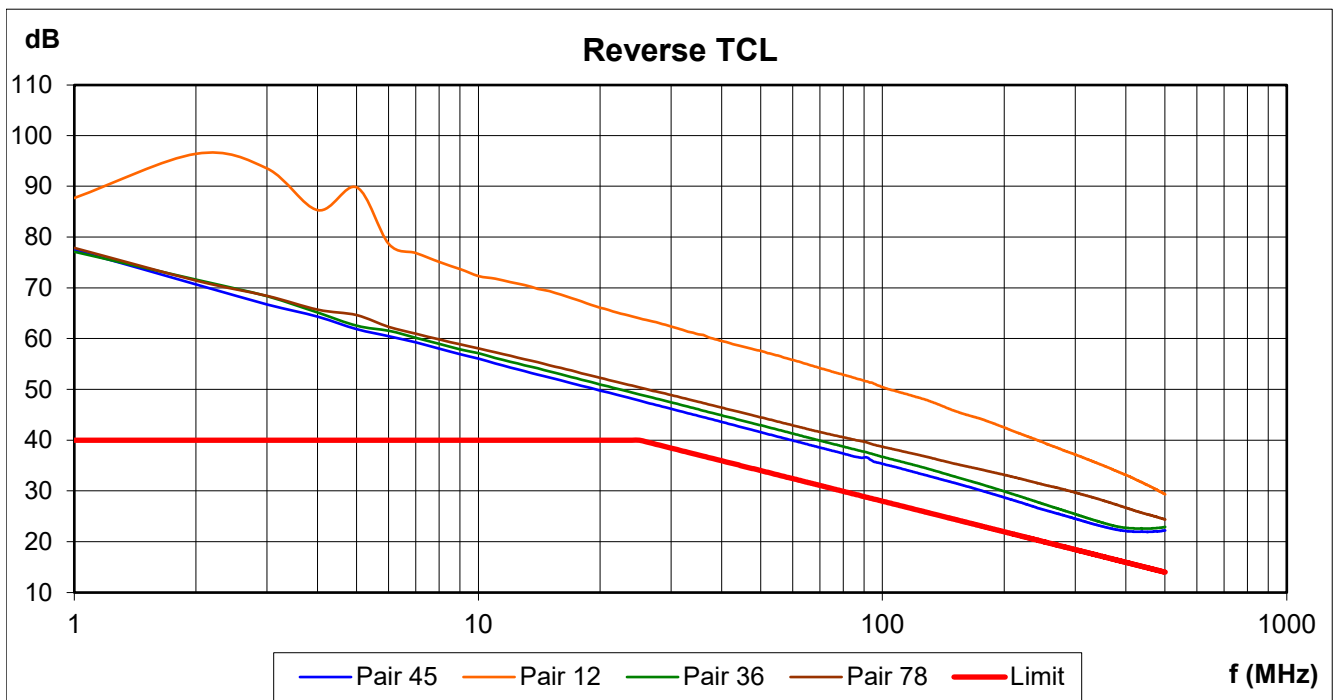
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	0.09	0.10	0.06	0.09
Freq. (MHz)	23	25	401	24



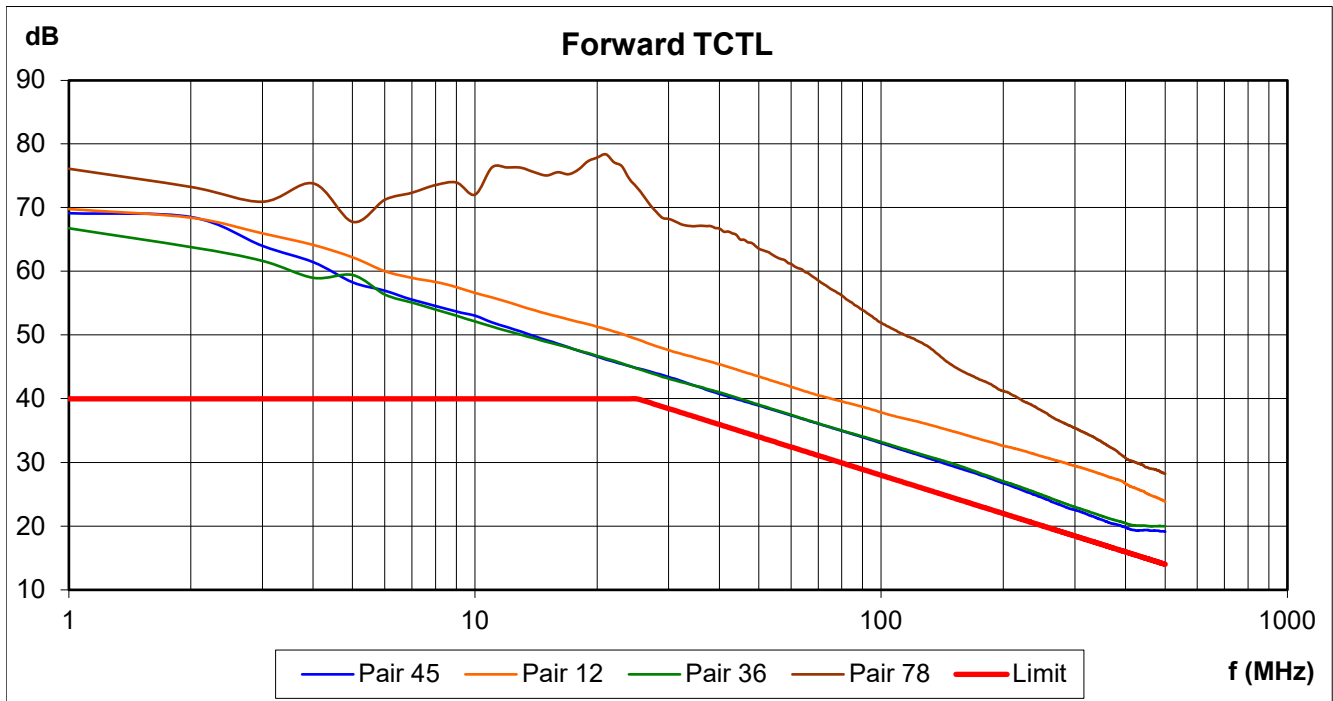
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	4.50	10.71	4.00	10.51
Freq (MHz)	410	500	393	26



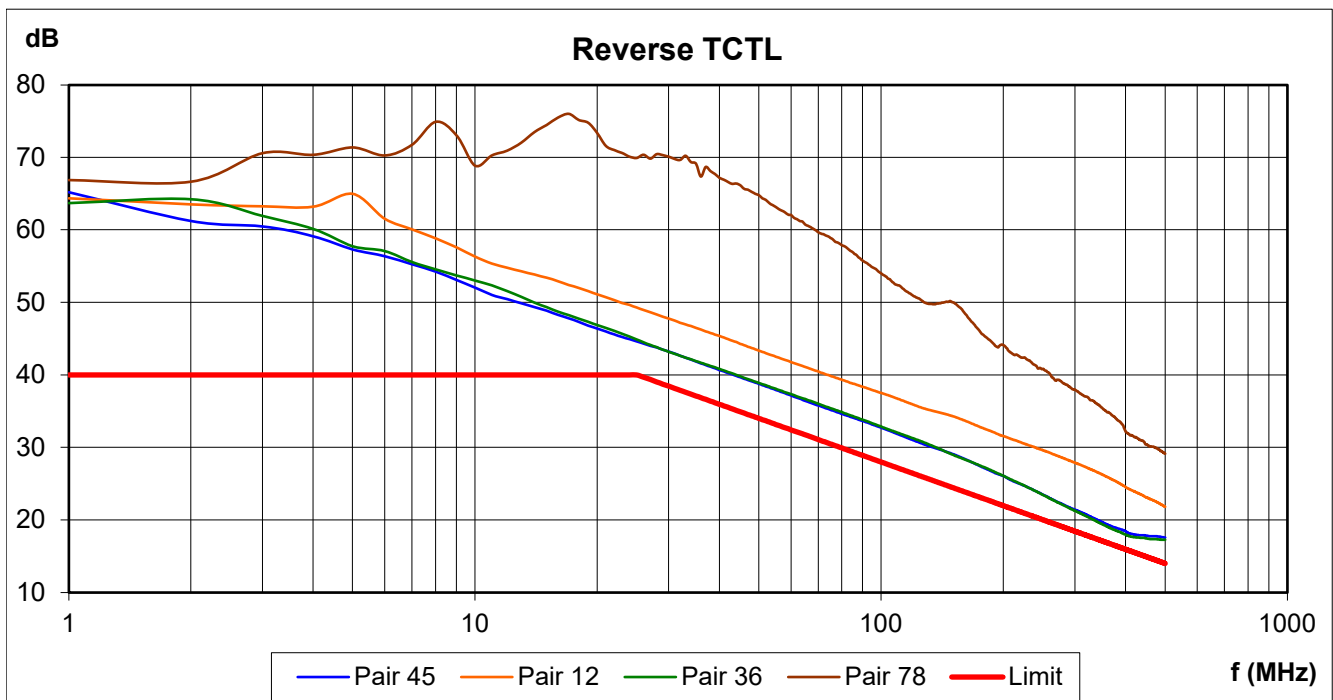
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	5.91	15.32	6.61	10.36
Freq (MHz)	350	500	371	27



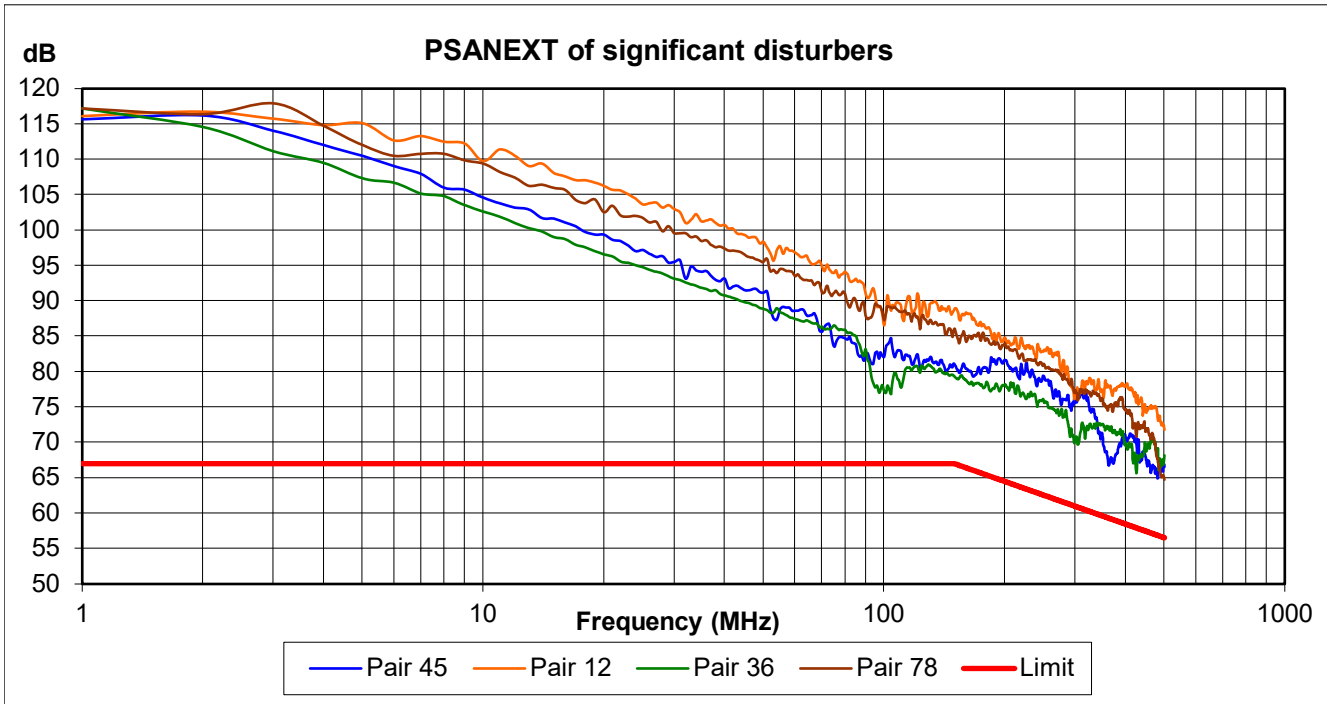
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	3.77	9.17	4.44	14.21
Freq (MHz)	412	29	368	500



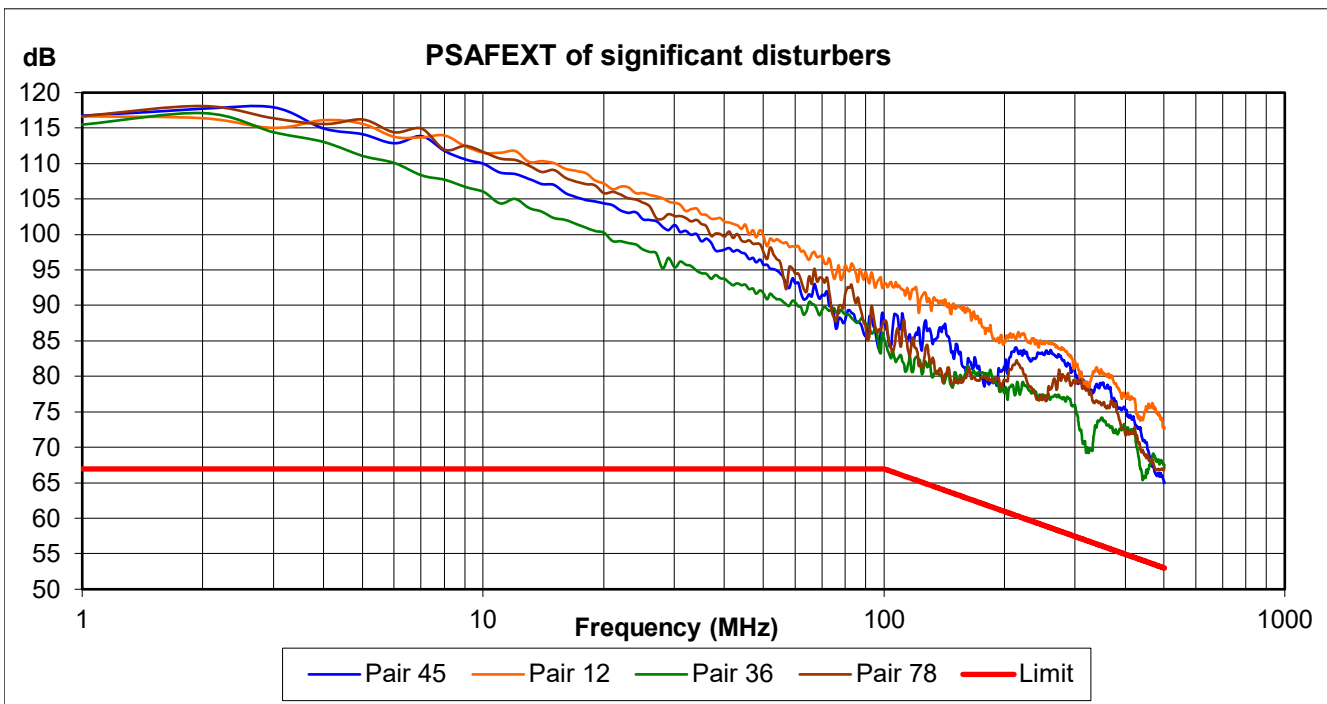
PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	2.37	7.80	2.00	15.12
Freq (MHz)	407	500	407	500



PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	7.45	15.12	7.71	8.17
Freq. (MHz)	363	298	426	500



PASS

Summary	Pair 45	Pair 12	Pair 36	Pair 78
Margin (dB)	11.99	19.58	11.33	13.33
Freq. (MHz)	499	435	442	476