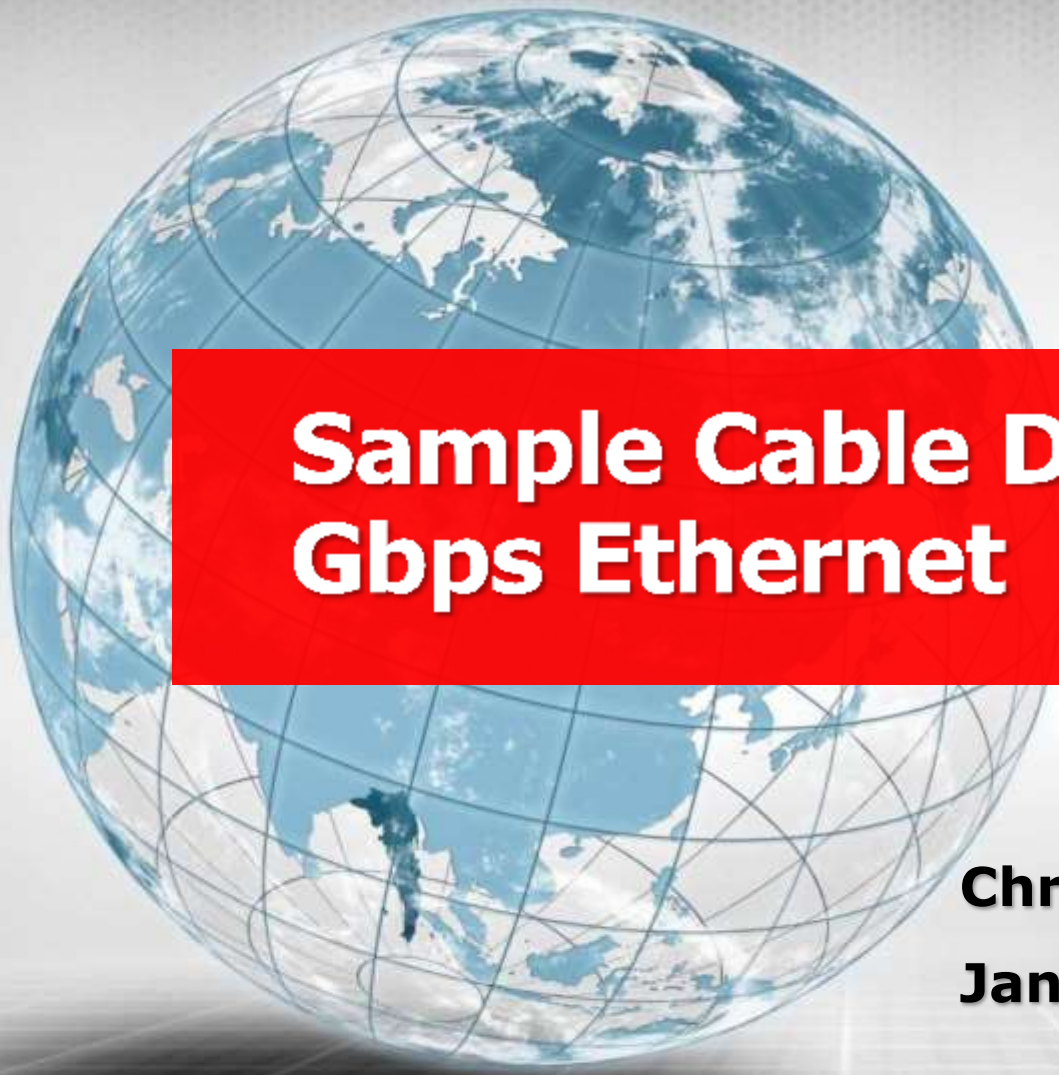

Sample Cable Data for 50 Gbps Ethernet

Chris Roth

Jan, 2015

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Supporters

- Andy Zambell – Amphenol - FCI
- Chris DiMinico - MC Communications/PHY-SI
- Daniel Dillow – Amphenol - FCI
- Erdem Matoglu – Amphenol
- Mike Andrewartha - Microsoft
- Mike Dudek – QLogic
- Nathan Tracy – TE Connectivity
- Rich Mellitz – Intel
- Scott Sommers - Molex
- Tom Palkert – Molex

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Background

- **5 sample cables built**
  - .5m 32 awg
  - 1m 30 awg
  - 1m,2m,3m 26 awg
- **Built using readily available materials and manufacturing techniques**
- **Tested using PHY-SI zQSFP+ MCB's with current generation connectors**
- **All measurements shown are TP1-TP4**

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Background

- **S-parameter limits shown are from IEEE 802.3bj clause 92-10**
- **COM ran using 2 different configurations**
- **Calculated first using ran_com_3bj_3bm_01_1114 with config_com_ieee8023_93a=100GBASE-CR4.xls**
  - Easy reference point to existing channels
- **Then calculated using mellitz_02_011116_elect with config_com_ieee8023_93a=CDAUI-8-C2C_D1p1_mellitz_01_0116.xls**
  - Packages and PCBs used on both ends

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0.5m 32 awg

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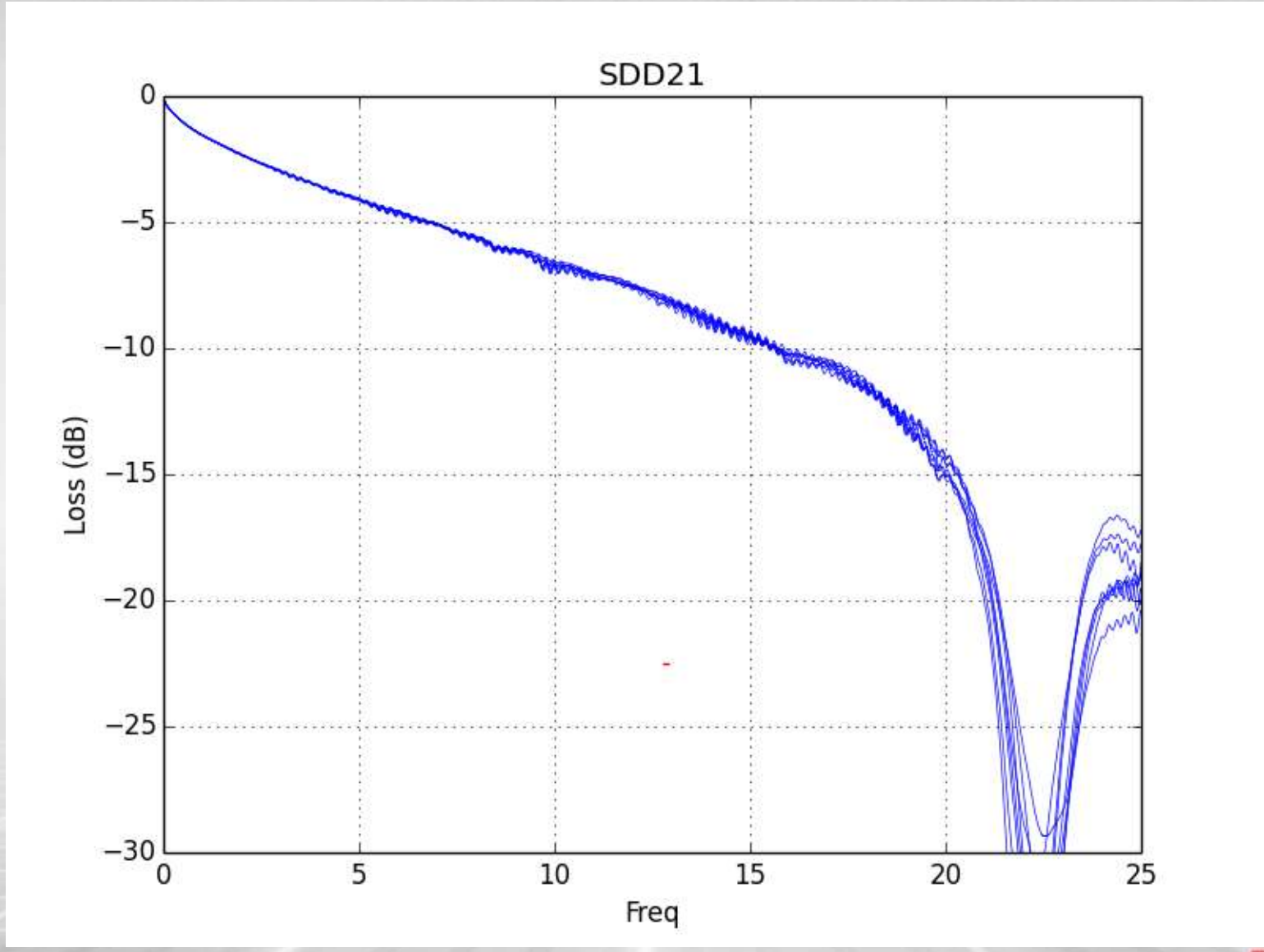
.5m 32 awg – IL (~8.4dB @ 13.28GHz)



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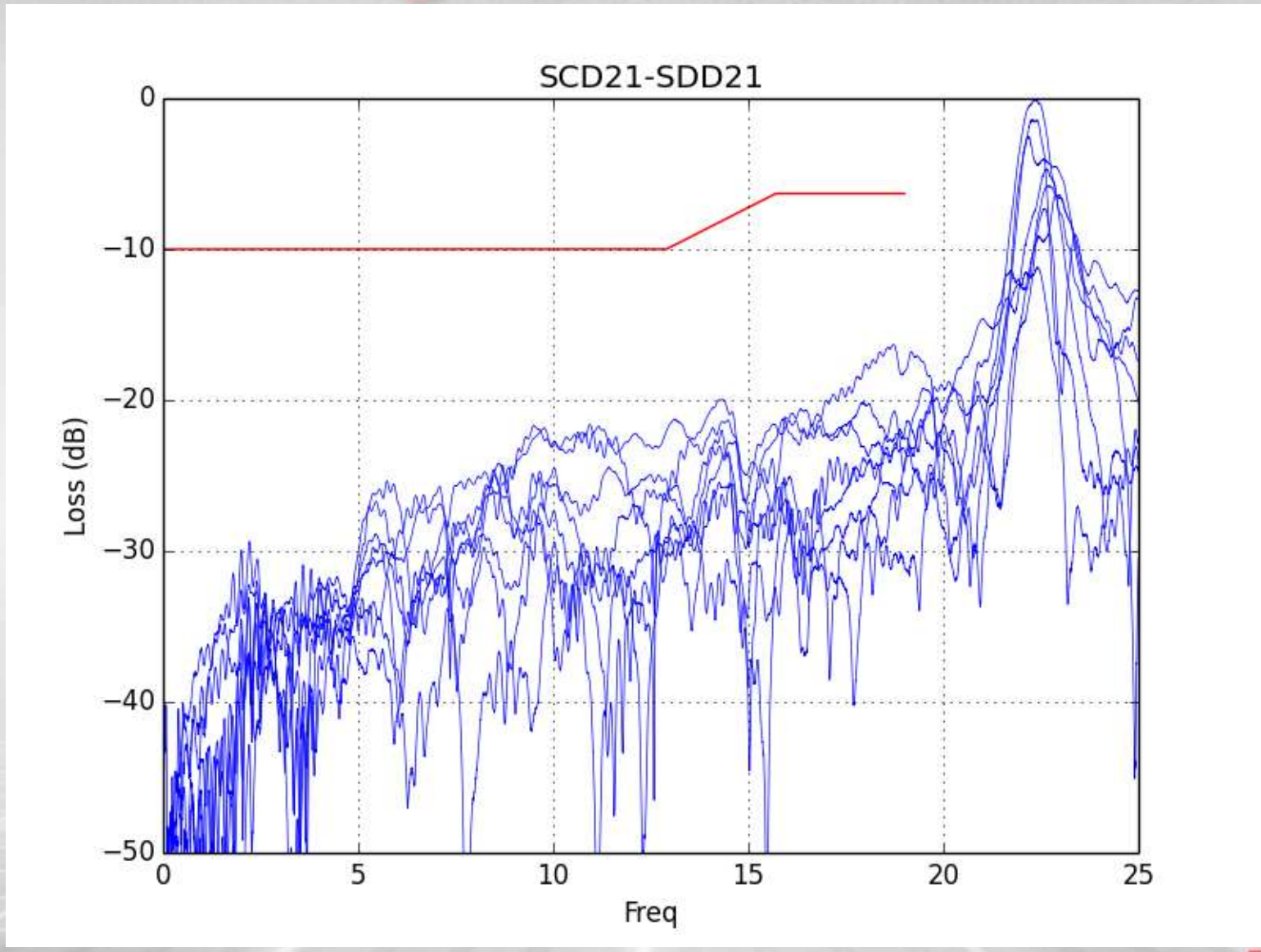
.5m 32 awg – Conversion Loss



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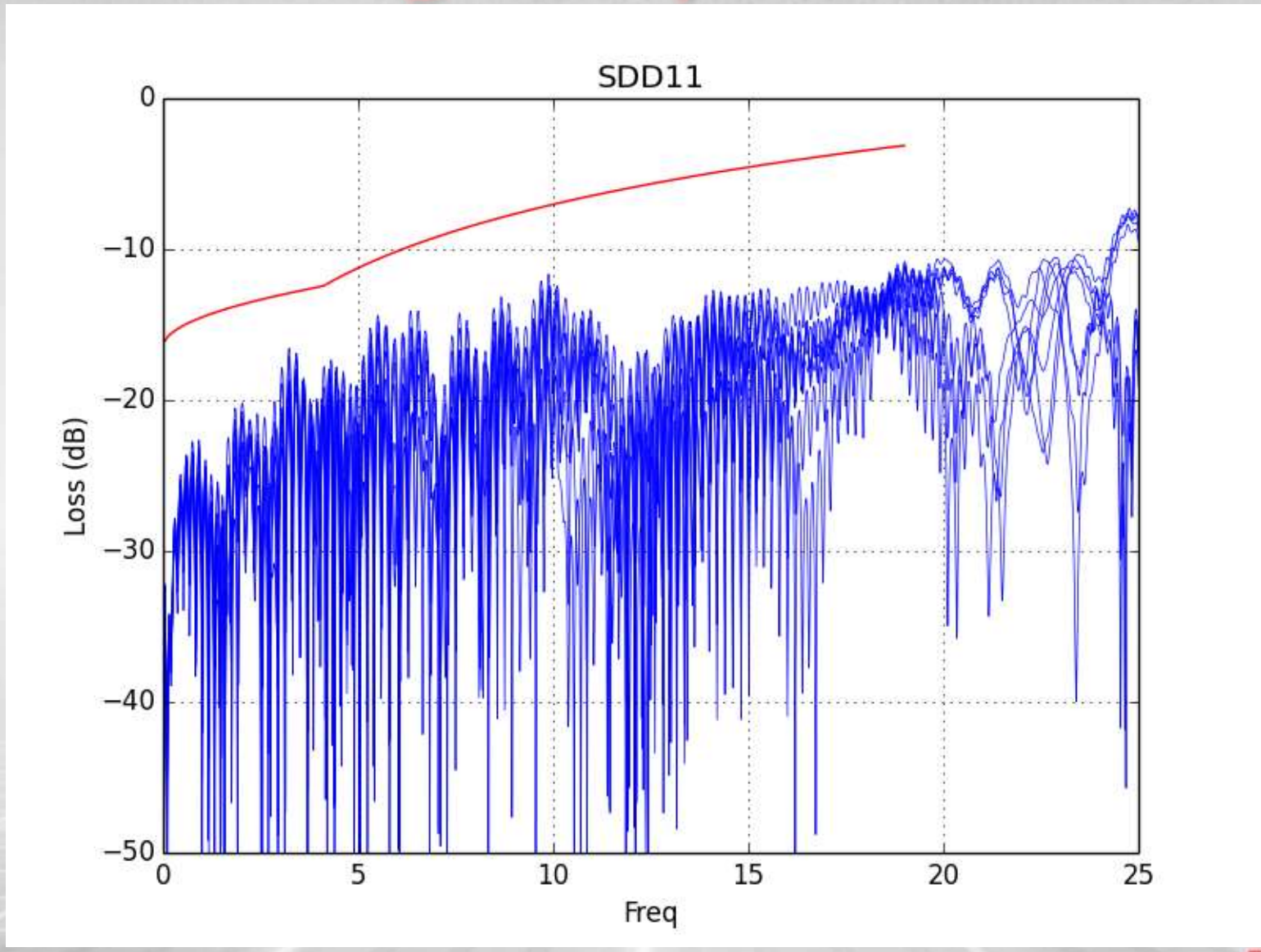
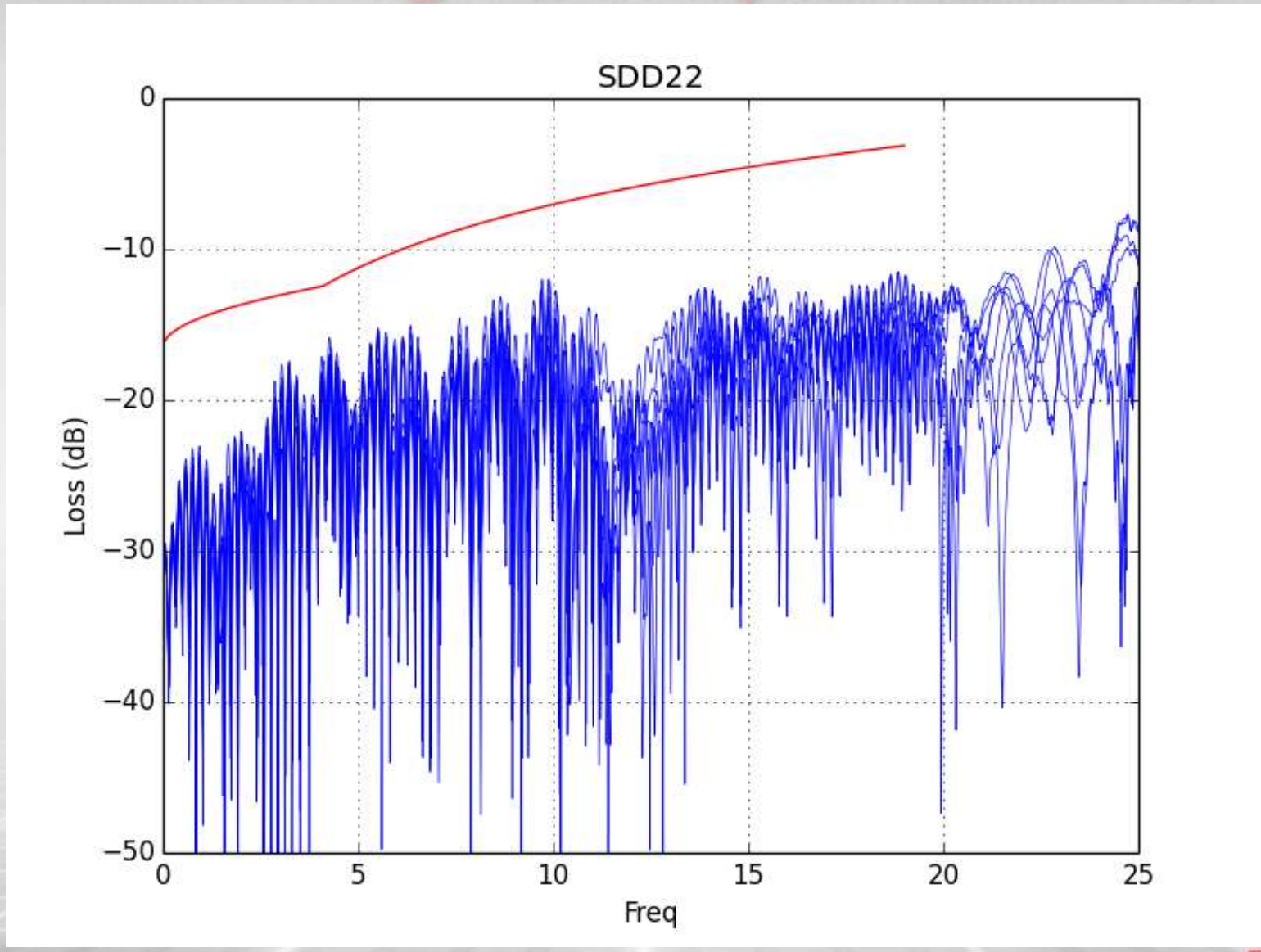
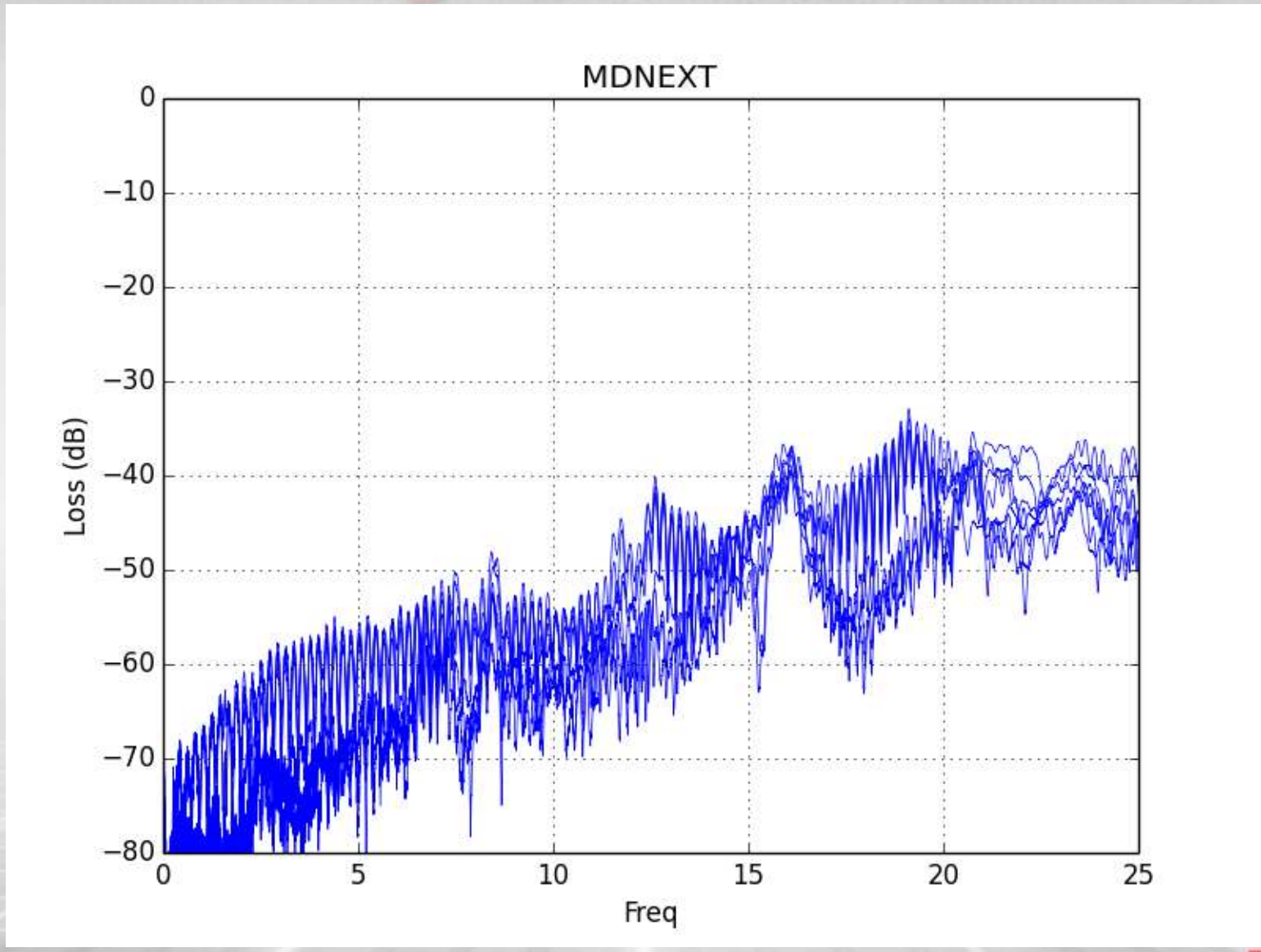
.5m 32 awg – Input RL



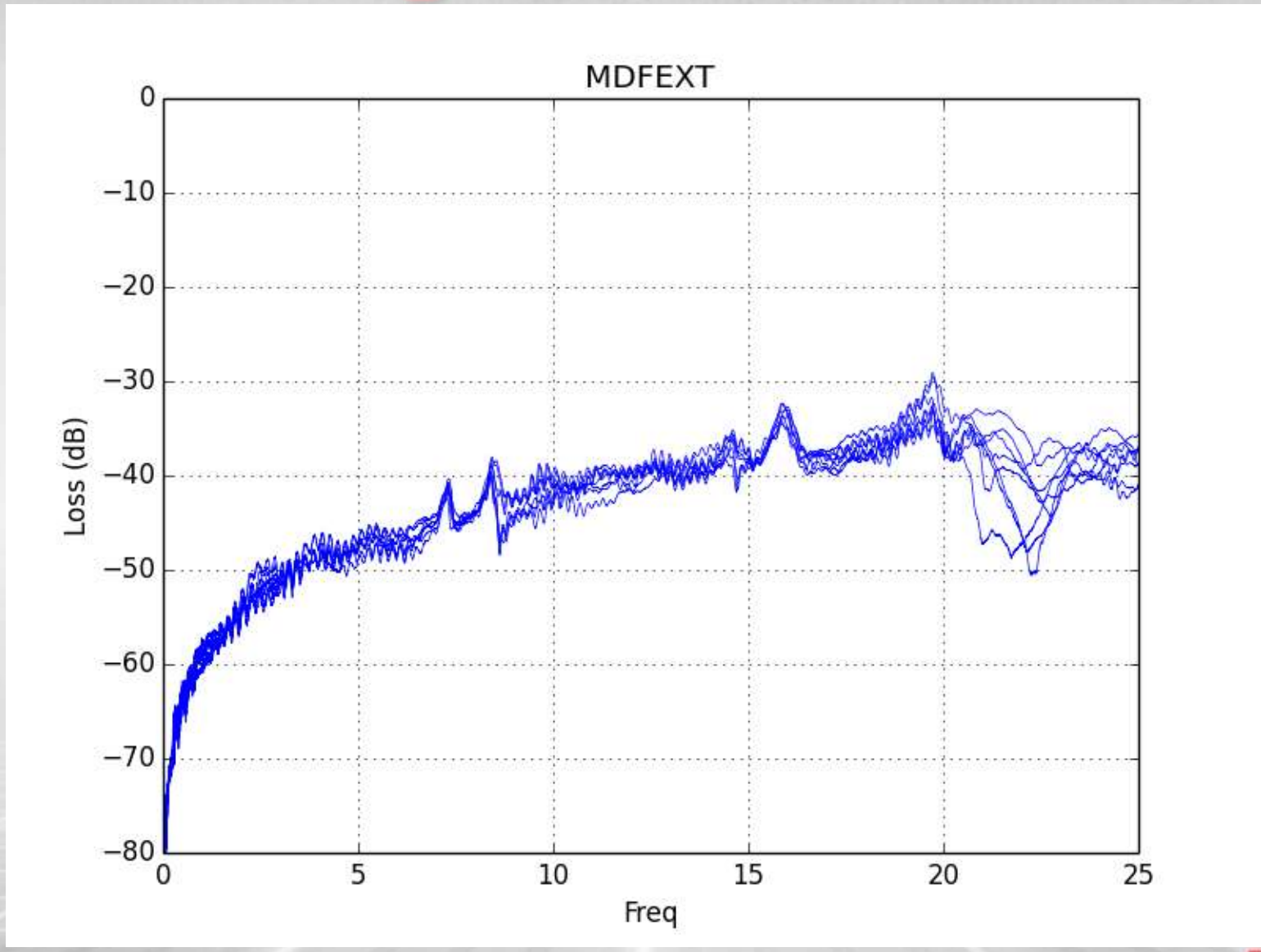
.5m 32 awg – Output RL



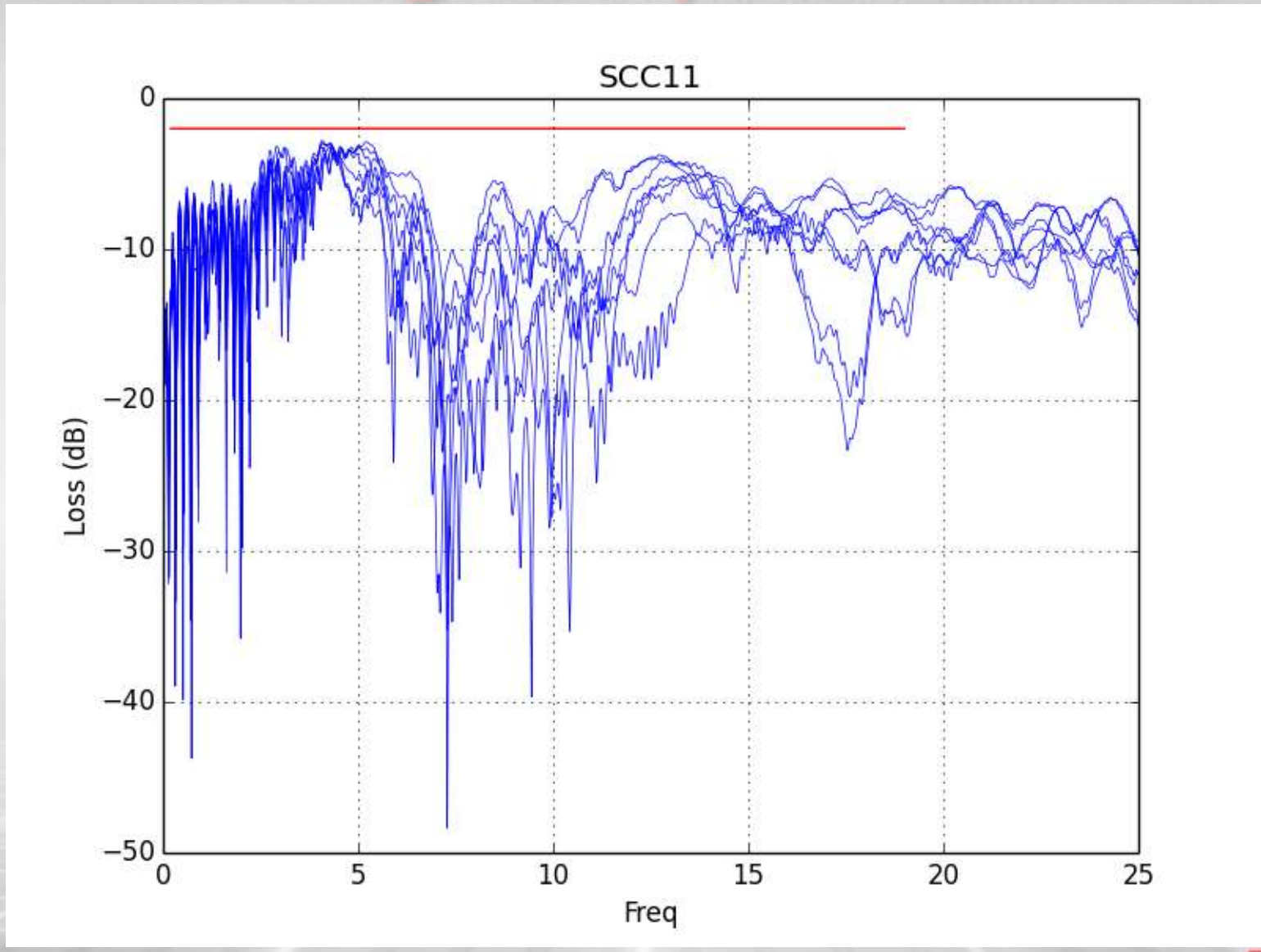
.5m 32 awg – MDNEXT



.5m 32 awg – MDFEXT



.5m 32 awg – Input CM RL



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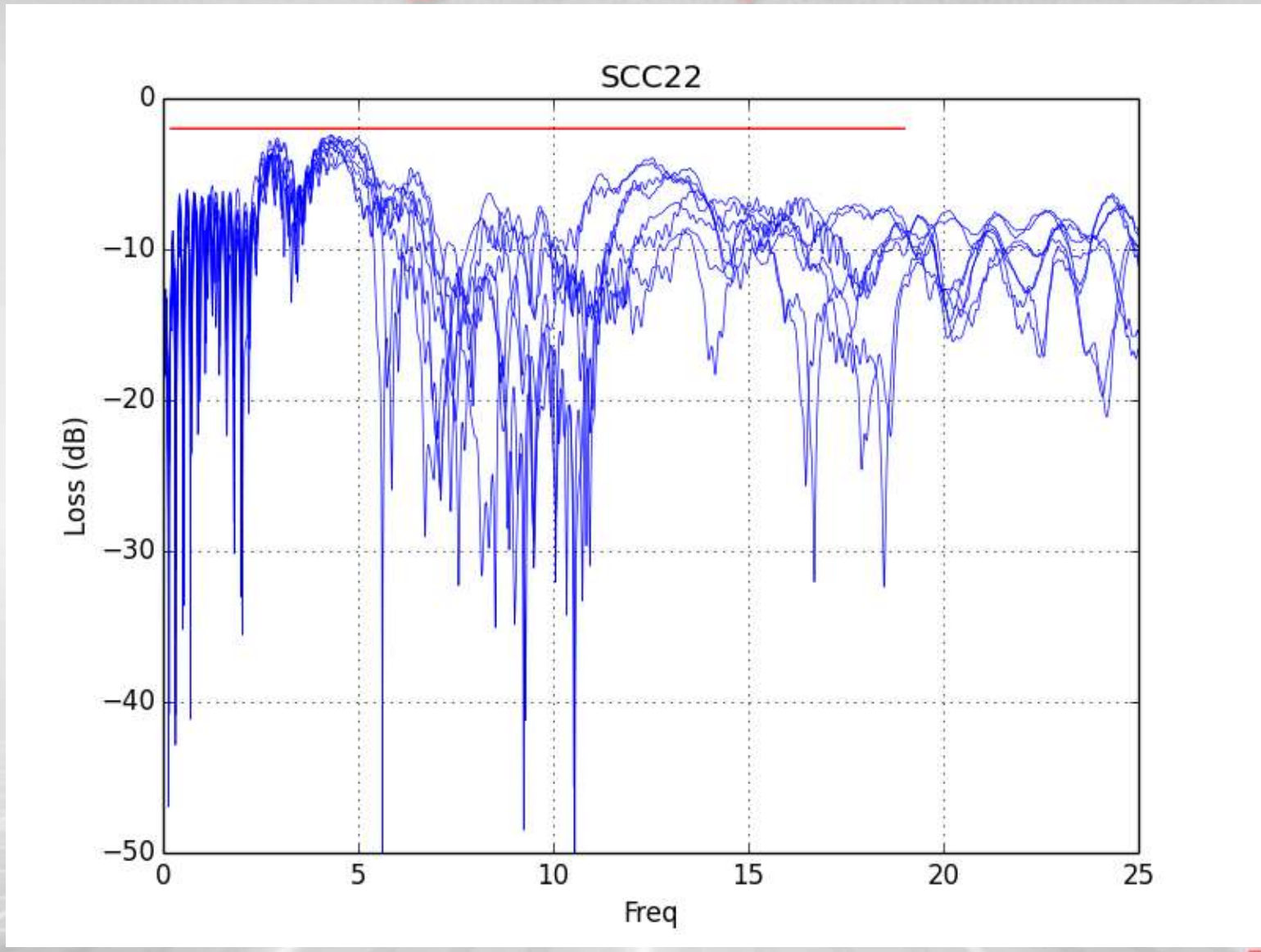
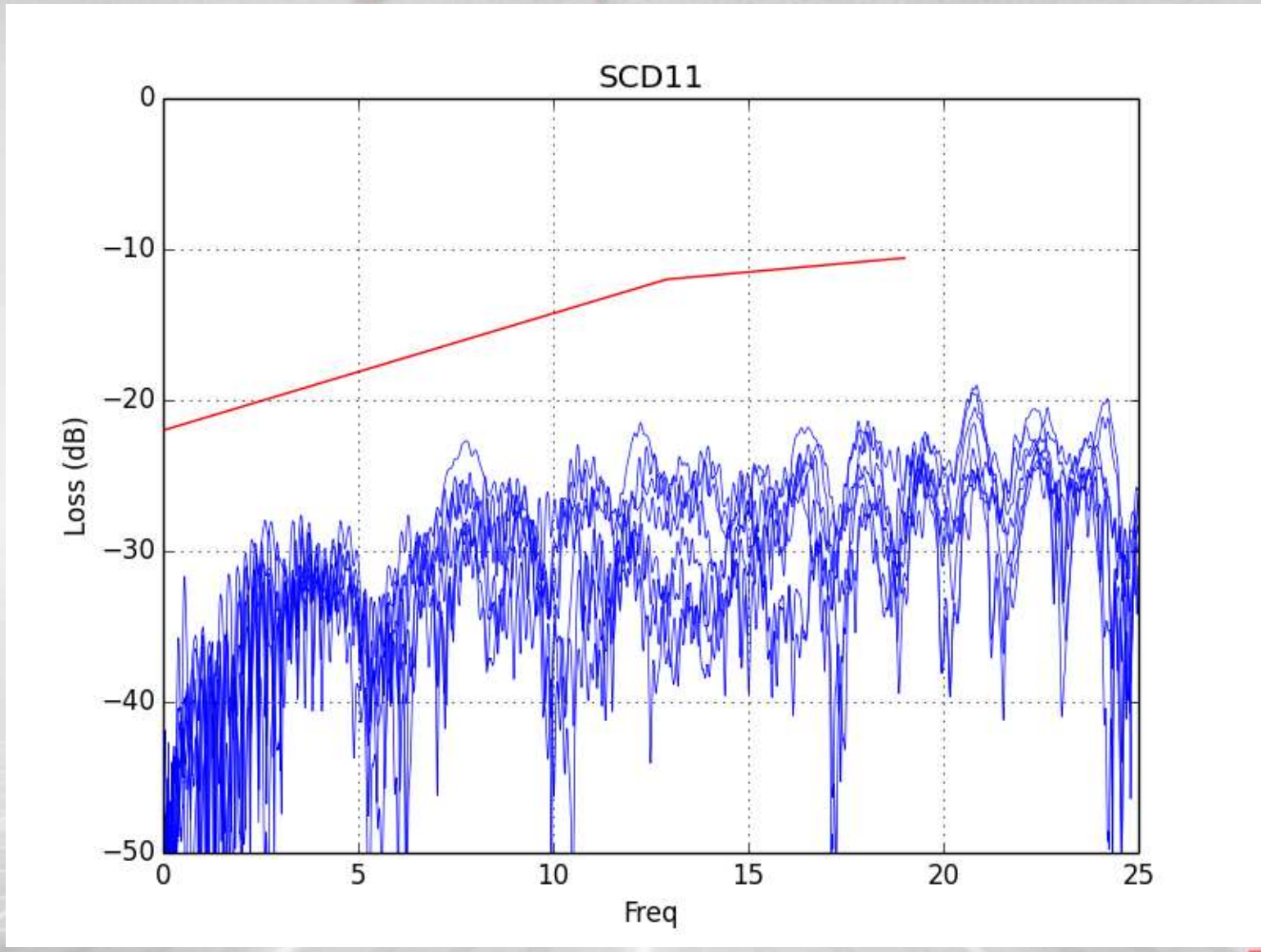
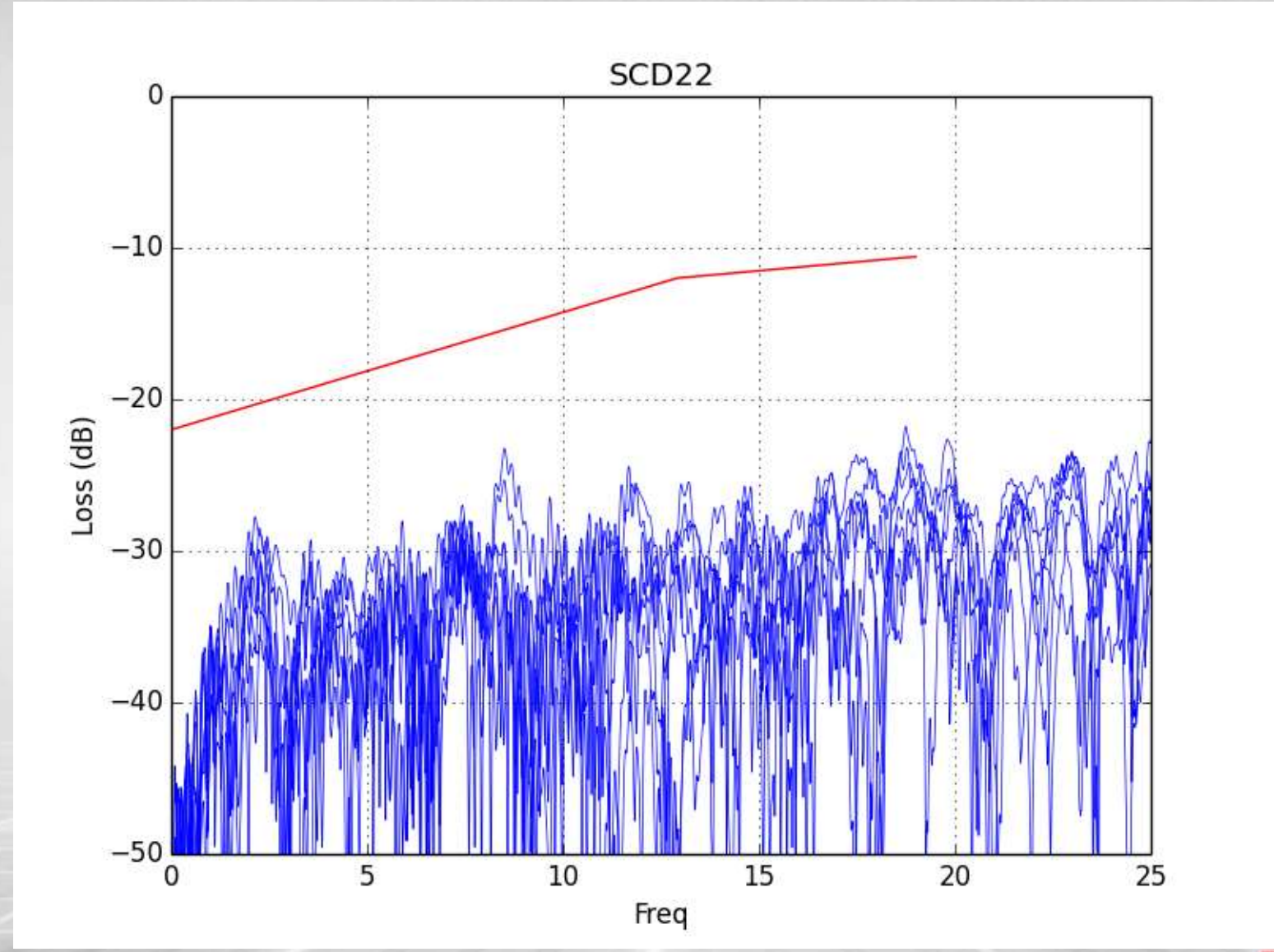
.5m 32 awg – Output CM RL



.5m 32 awg – Input CM to DIFF RL



.5m 32 awg – Output CM to DIFF RL



COM – CR4 (25G NRZ)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	8.39	7.77
P1Tx2 P2Rx2	8.38	7.80
P1Tx3 P2Rx3	8.27	7.64
P1Tx4 P2Rx4	8.28	7.69
P2Tx1 P1Rx1	8.31	7.64
P2Tx2 P1Rx2	8.41	7.76
P2Tx3 P1Rx3	8.22	7.64
P2Tx4 P1Rx4	8.37	7.74

COM – CDAUI-8 (50G PAM-4)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	3.58	1.68
P1Tx2 P2Rx2	3.71	1.84
P1Tx3 P2Rx3	3.46	1.72
P1Tx4 P2Rx4	3.41	1.60
P2Tx1 P1Rx1	3.60	1.72
P2Tx2 P1Rx2	3.80	1.77
P2Tx3 P1Rx3	3.28	1.43
P2Tx4 P1Rx4	3.65	1.72

1m 30 awg

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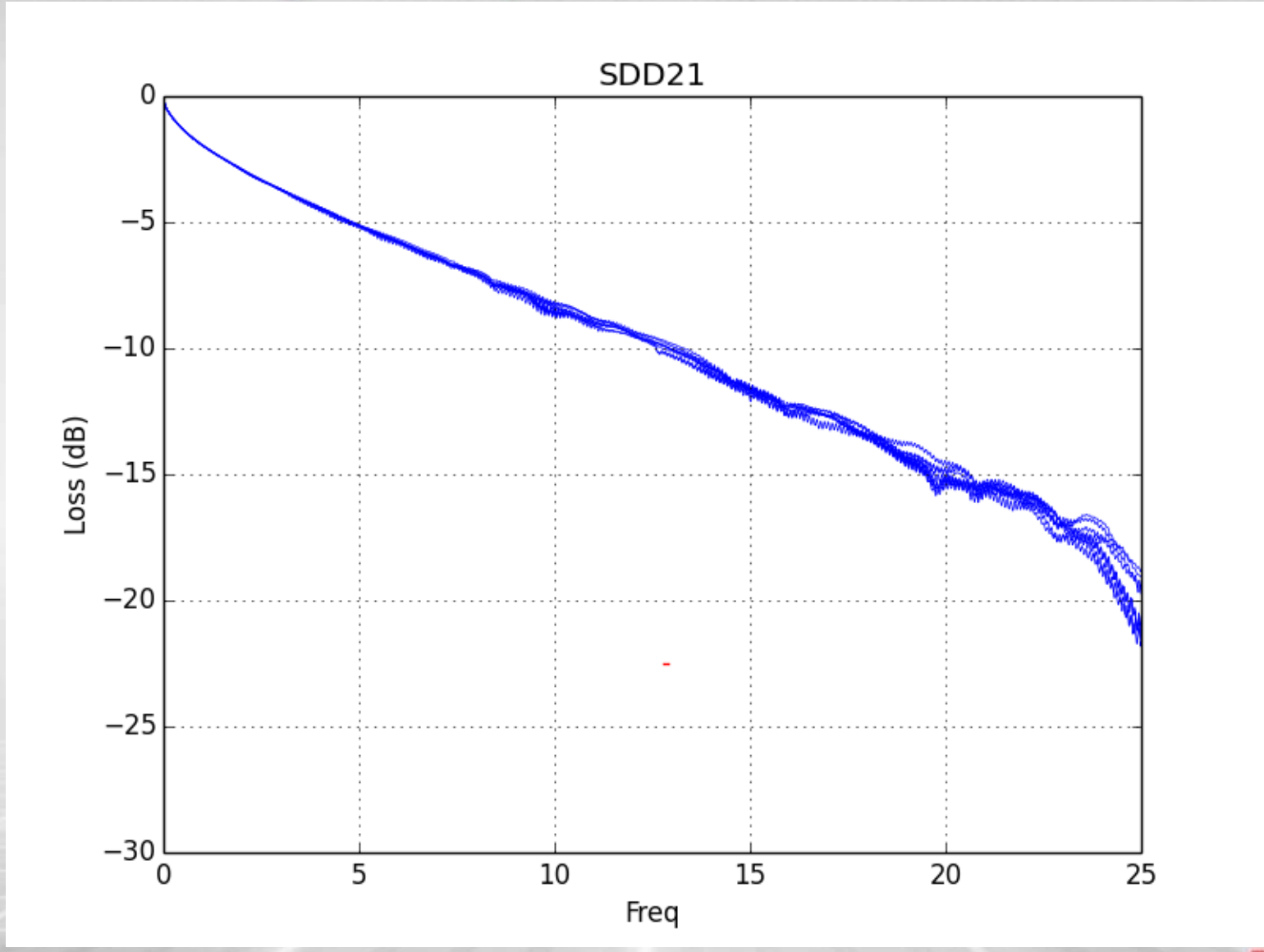
1m 30 awg - IL (~10.2dB @ 13.28GHz)



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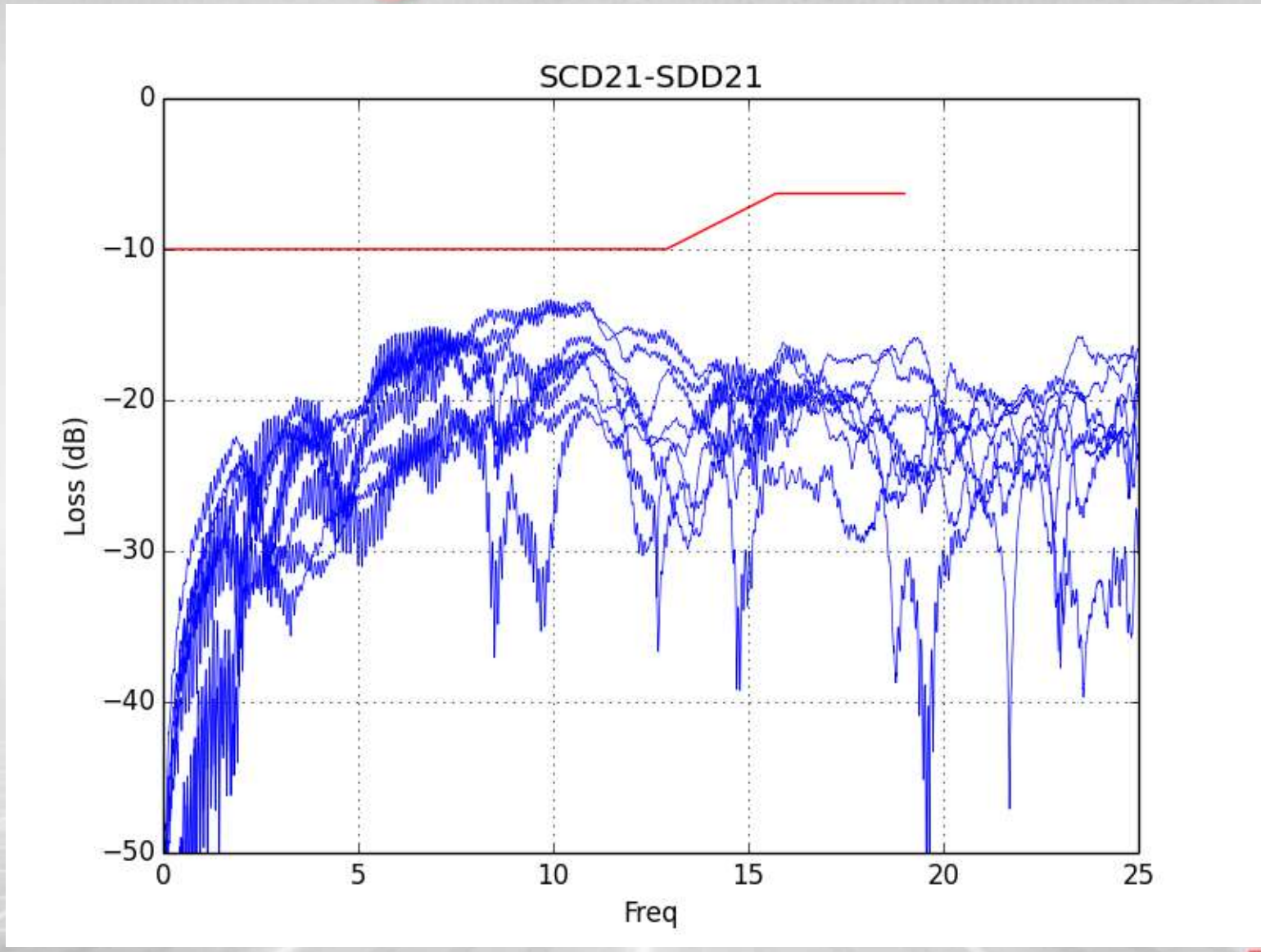
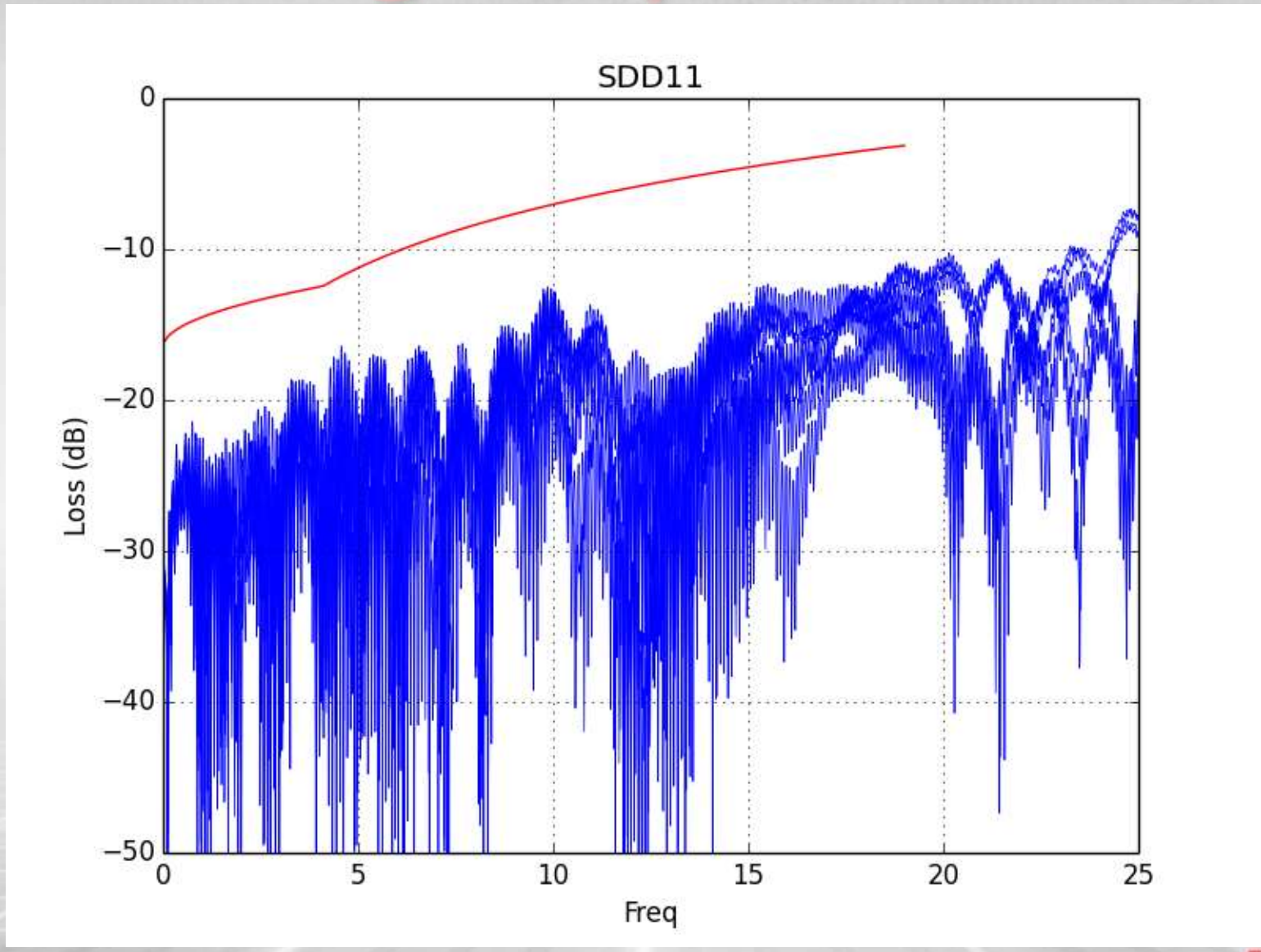
1m 30 awg – Conversion Loss



1m 30 awg – Input RL



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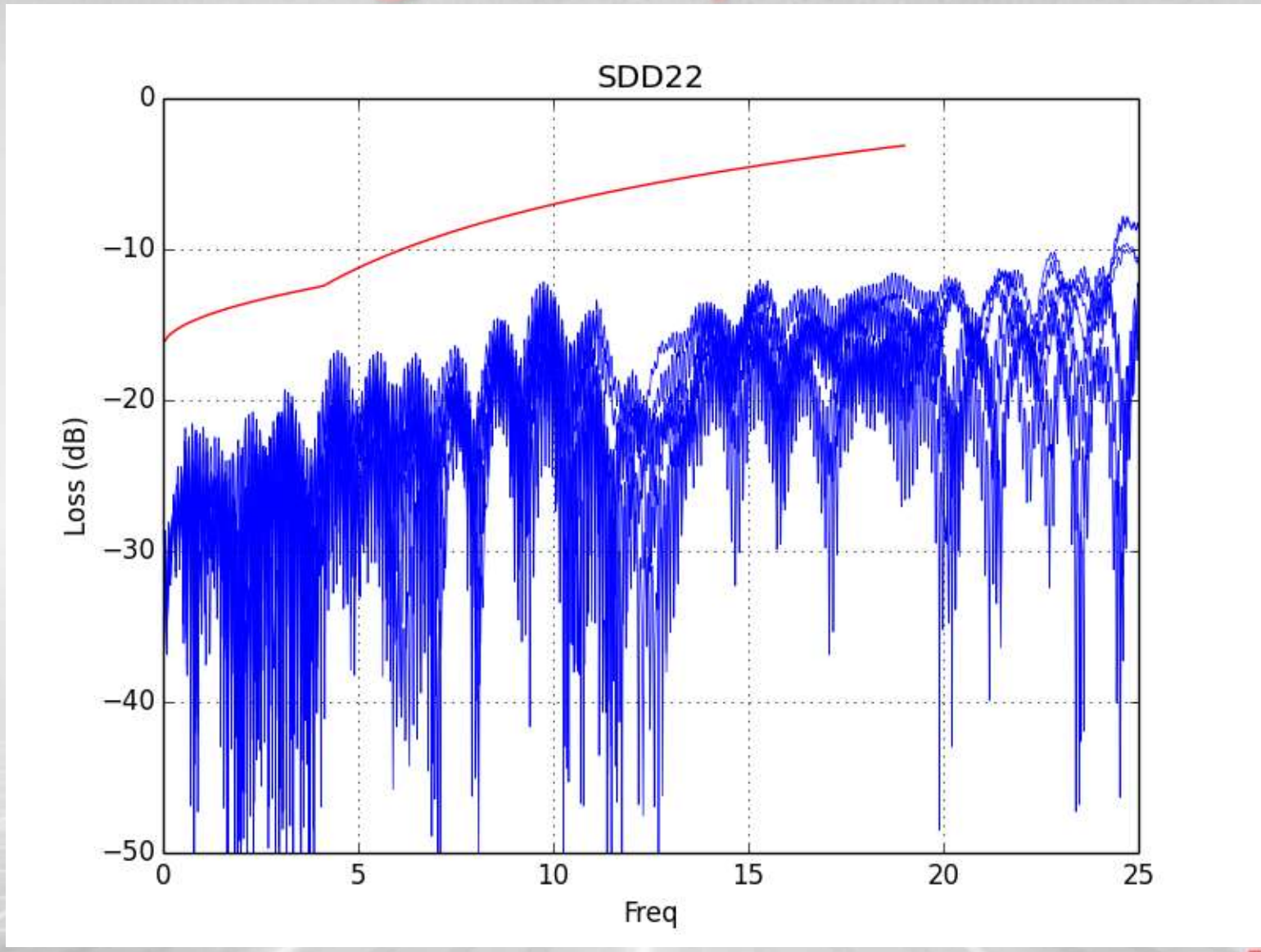
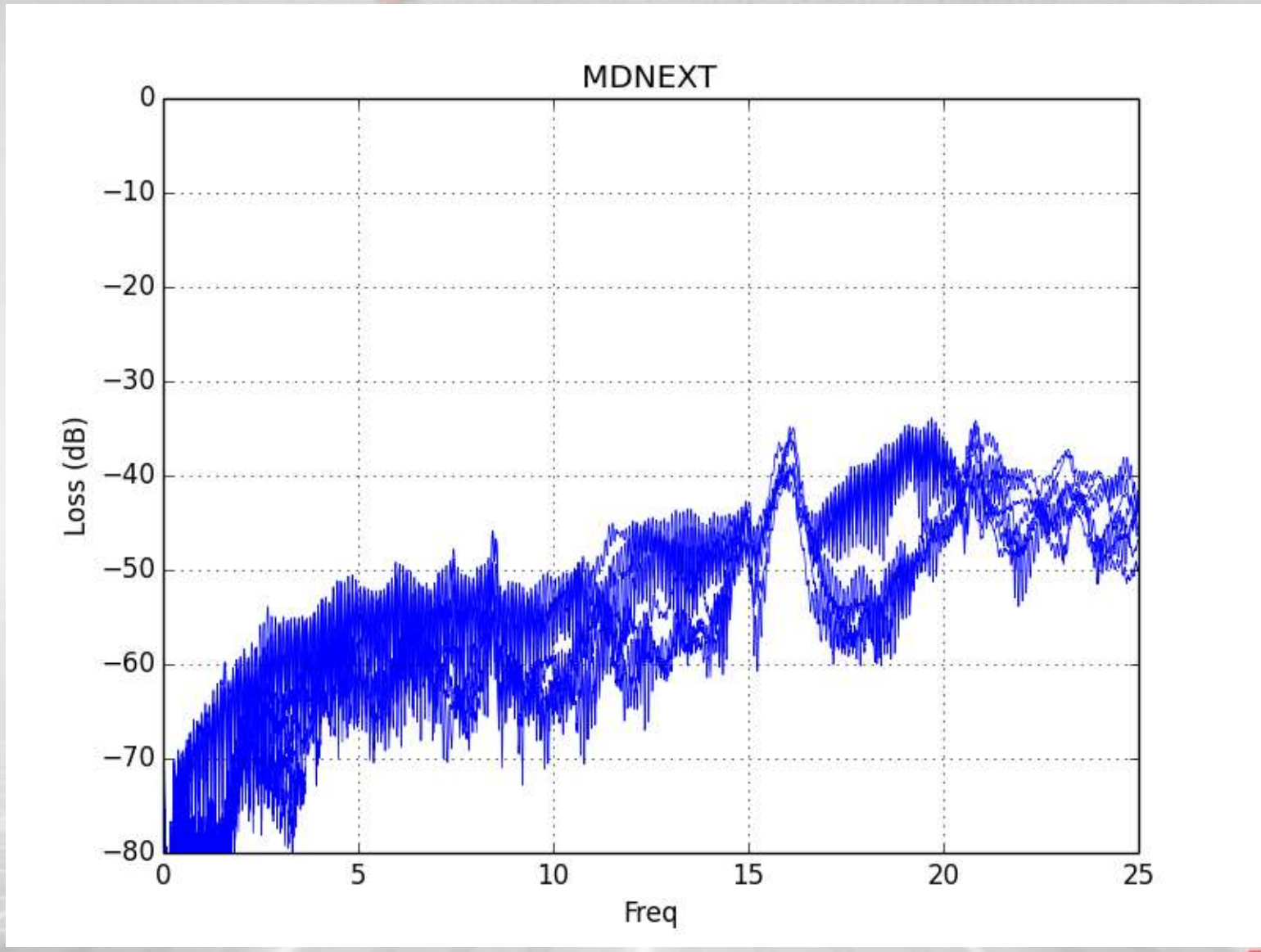
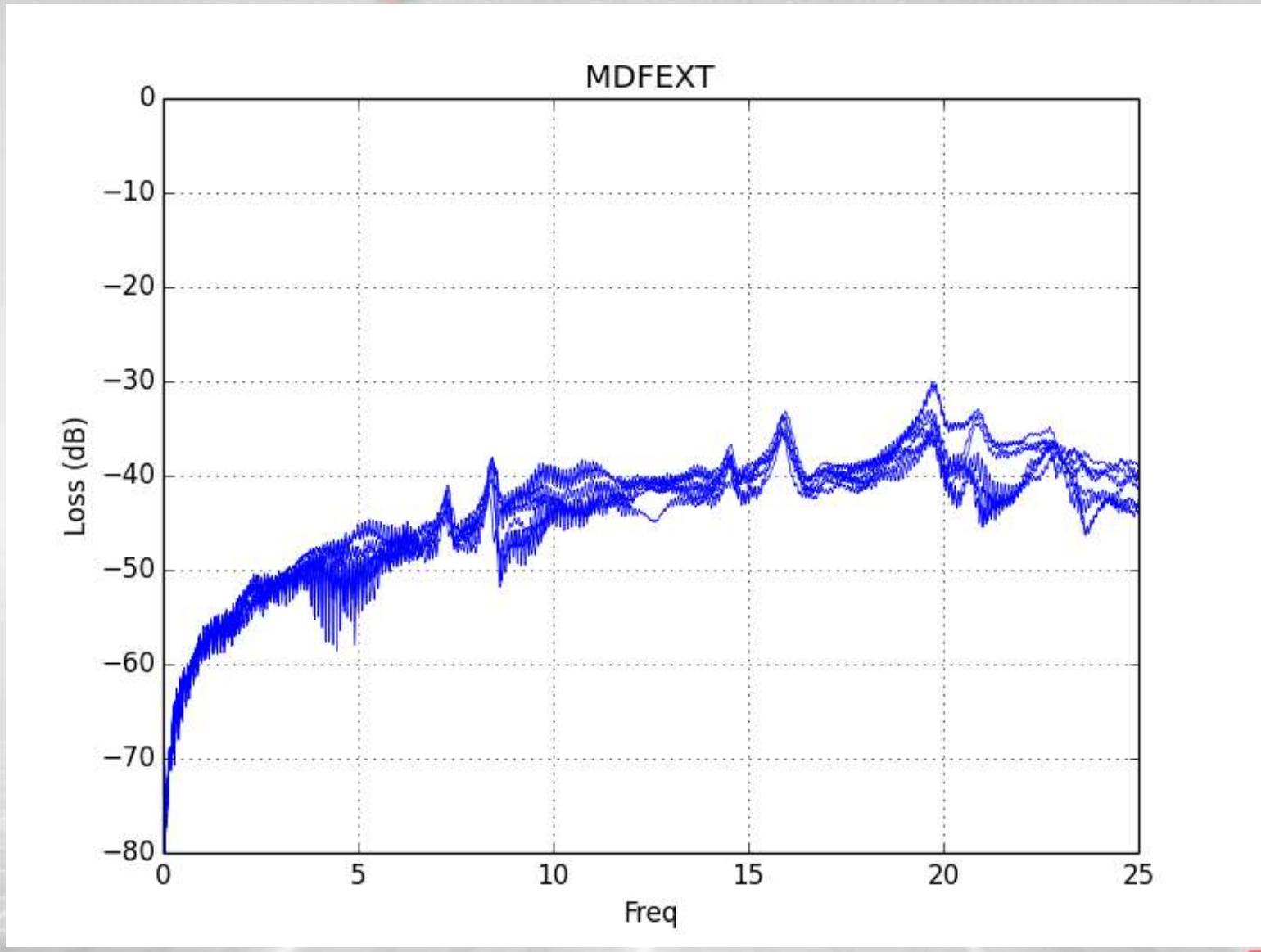
1m 30 awg – Output RL



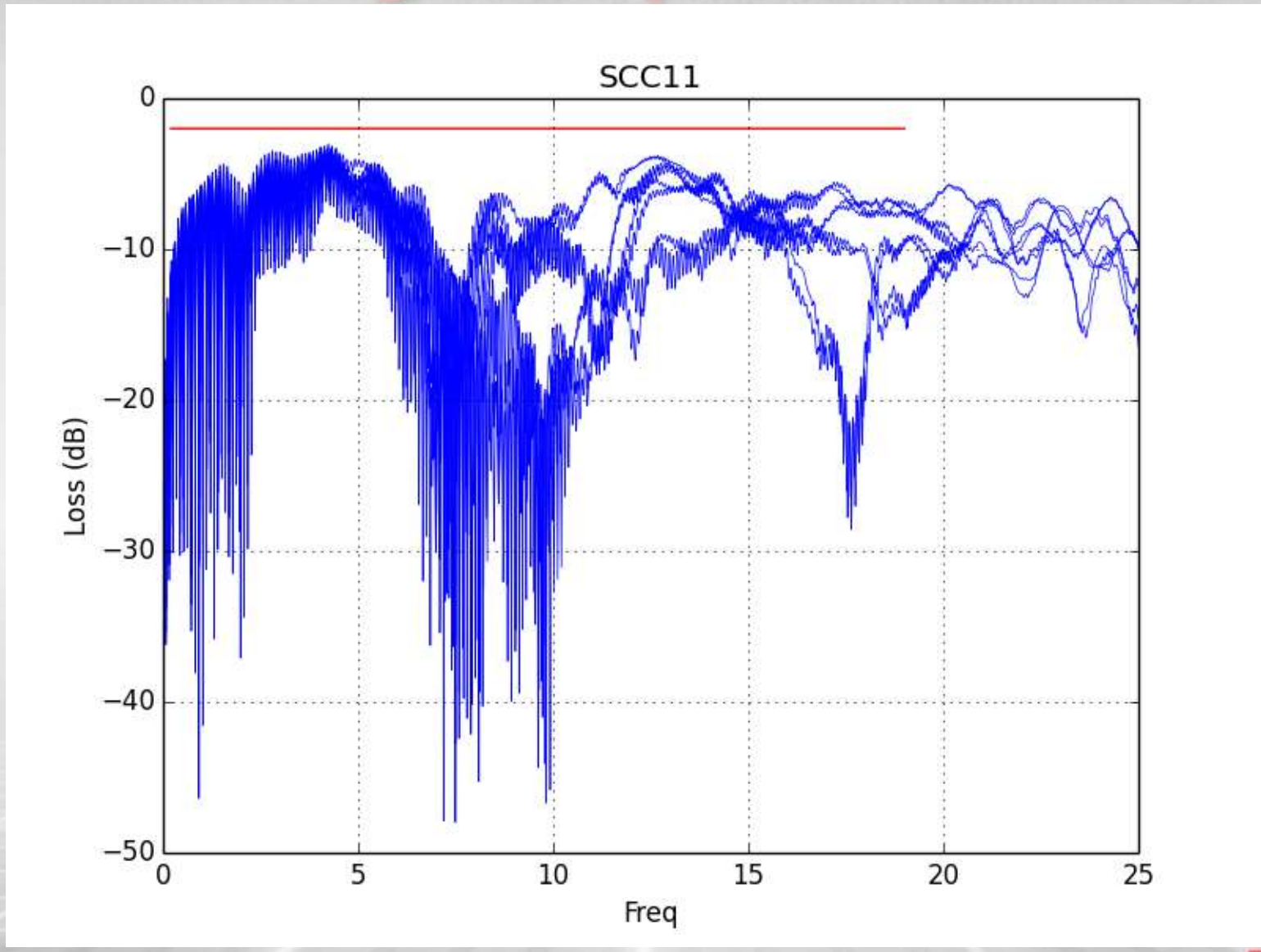
1m 30 awg – MDNEXT



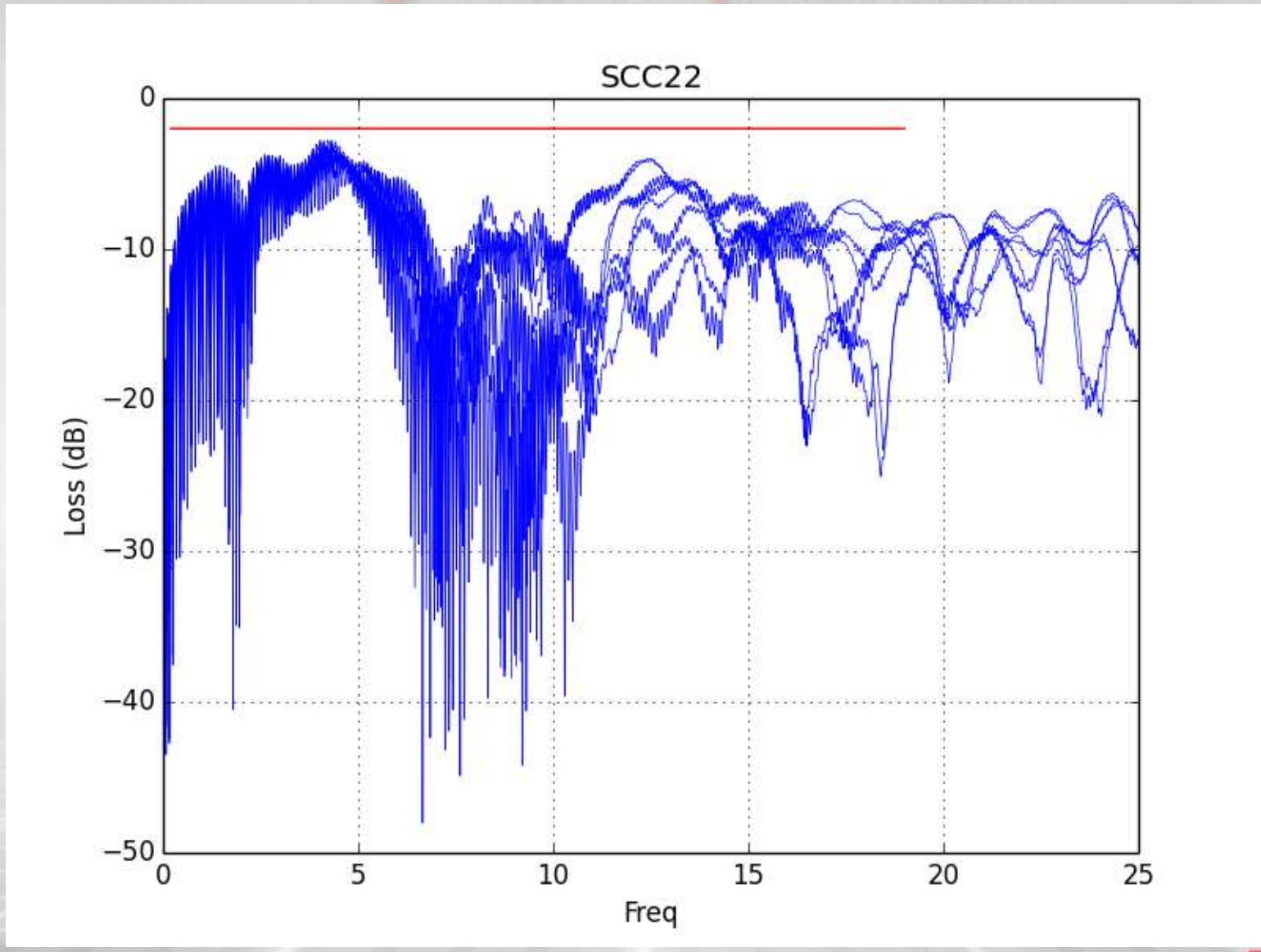
1m 30 awg – MDFEXT



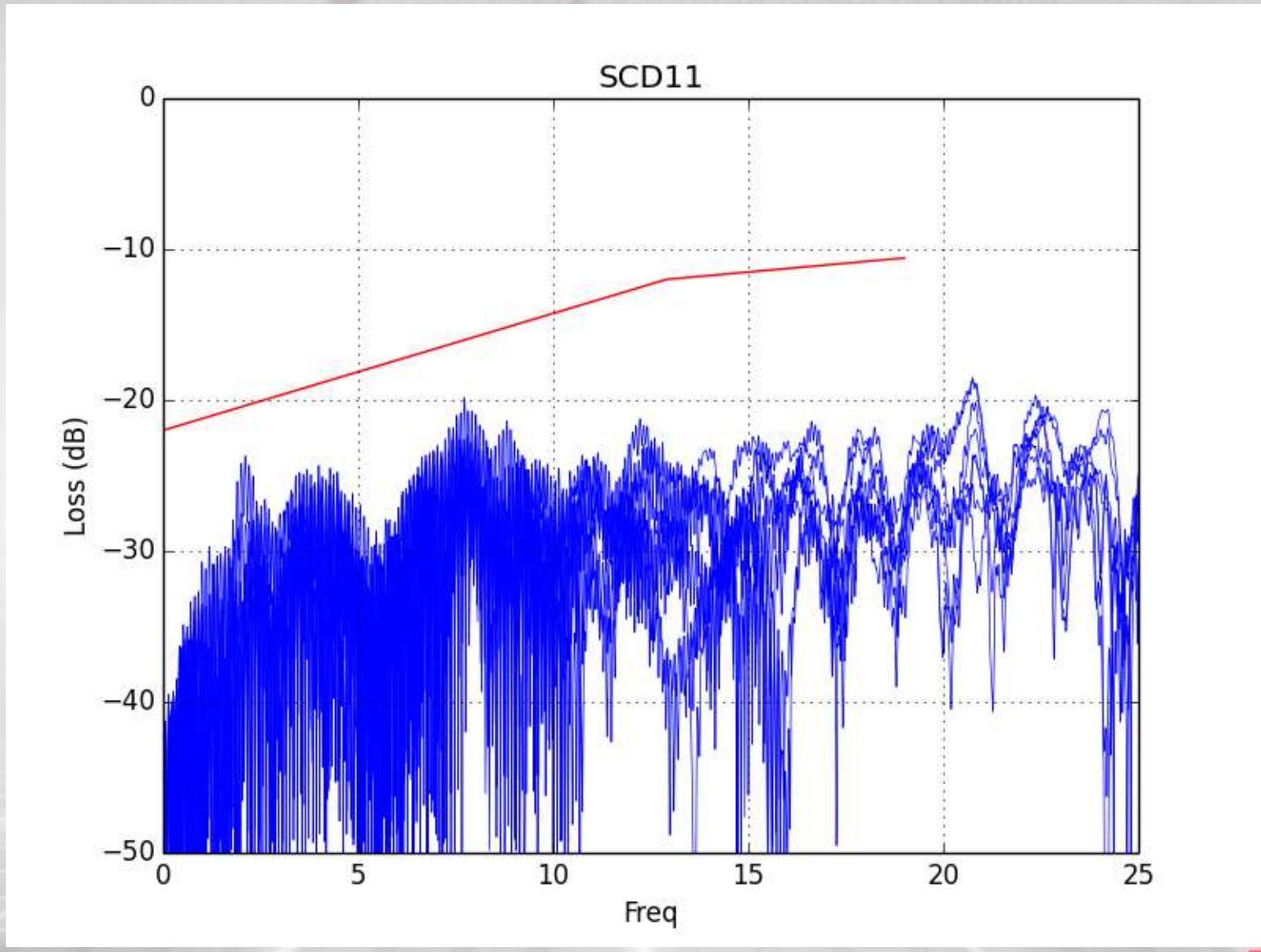
1m 30 awg – Input CM RL



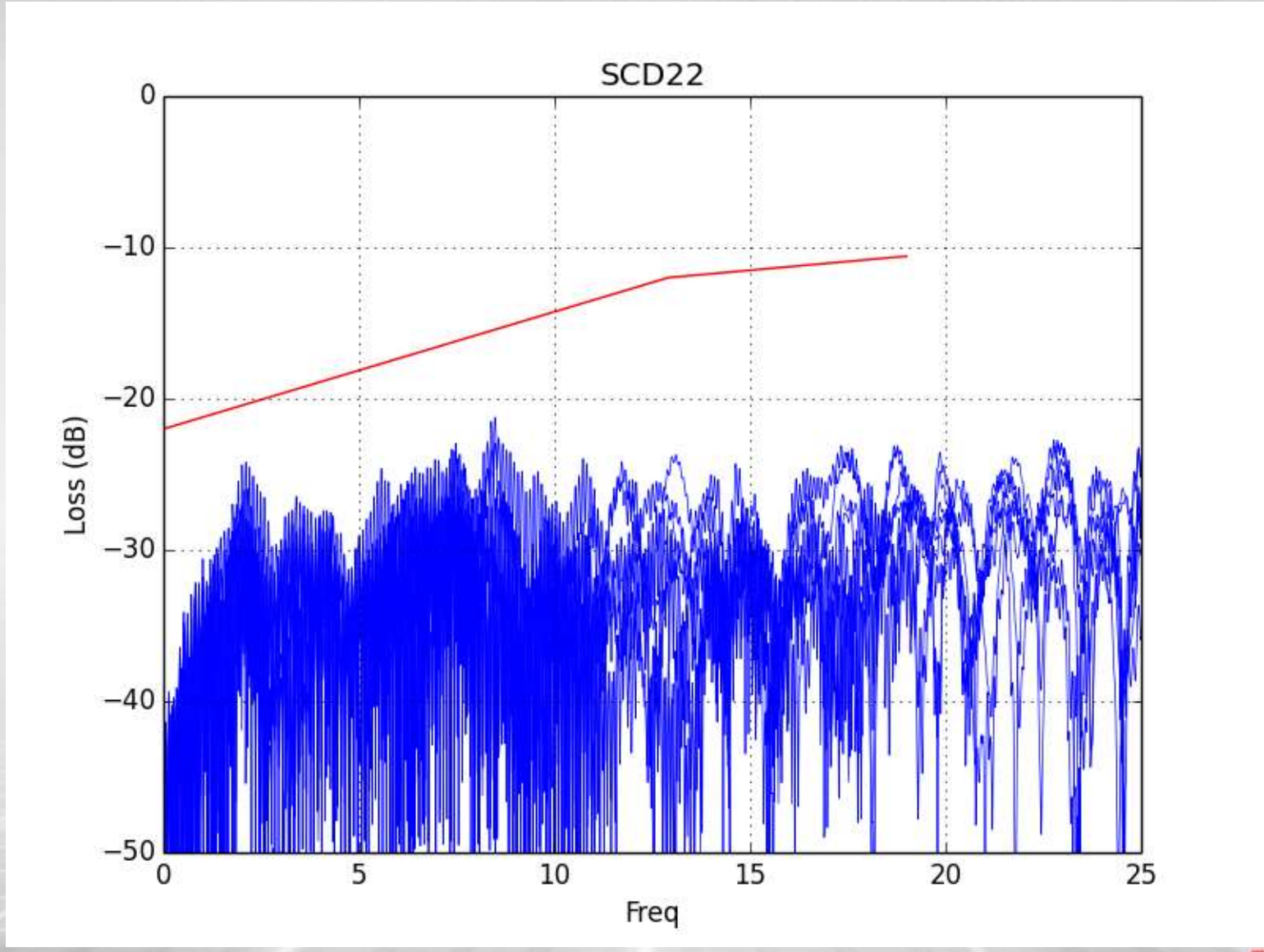
1m 30 awg – Output CM RL



1m 30 awg – Input CM to DIFF RL



1m 30 awg – Output CM to DIFF RL



COM – CR4 (25G NRZ)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	8.38	7.63
P1Tx2 P2Rx2	8.31	7.61
P1Tx3 P2Rx3	8.20	7.41
P1Tx4 P2Rx4	8.14	7.41
P2Tx1 P1Rx1	8.32	7.61
P2Tx2 P1Rx2	8.33	7.60
P2Tx3 P1Rx3	8.17	7.52
P2Tx4 P1Rx4	8.25	7.52

COM – CDAUI-8 (50G PAM-4)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	3.94	1.87
P1Tx2 P2Rx2	3.85	1.89
P1Tx3 P2Rx3	3.61	1.61
P1Tx4 P2Rx4	3.56	1.64
P2Tx1 P1Rx1	3.86	1.83
P2Tx2 P1Rx2	3.88	1.82
P2Tx3 P1Rx3	3.50	1.63
P2Tx4 P1Rx4	3.84	1.76

1m 26 awg

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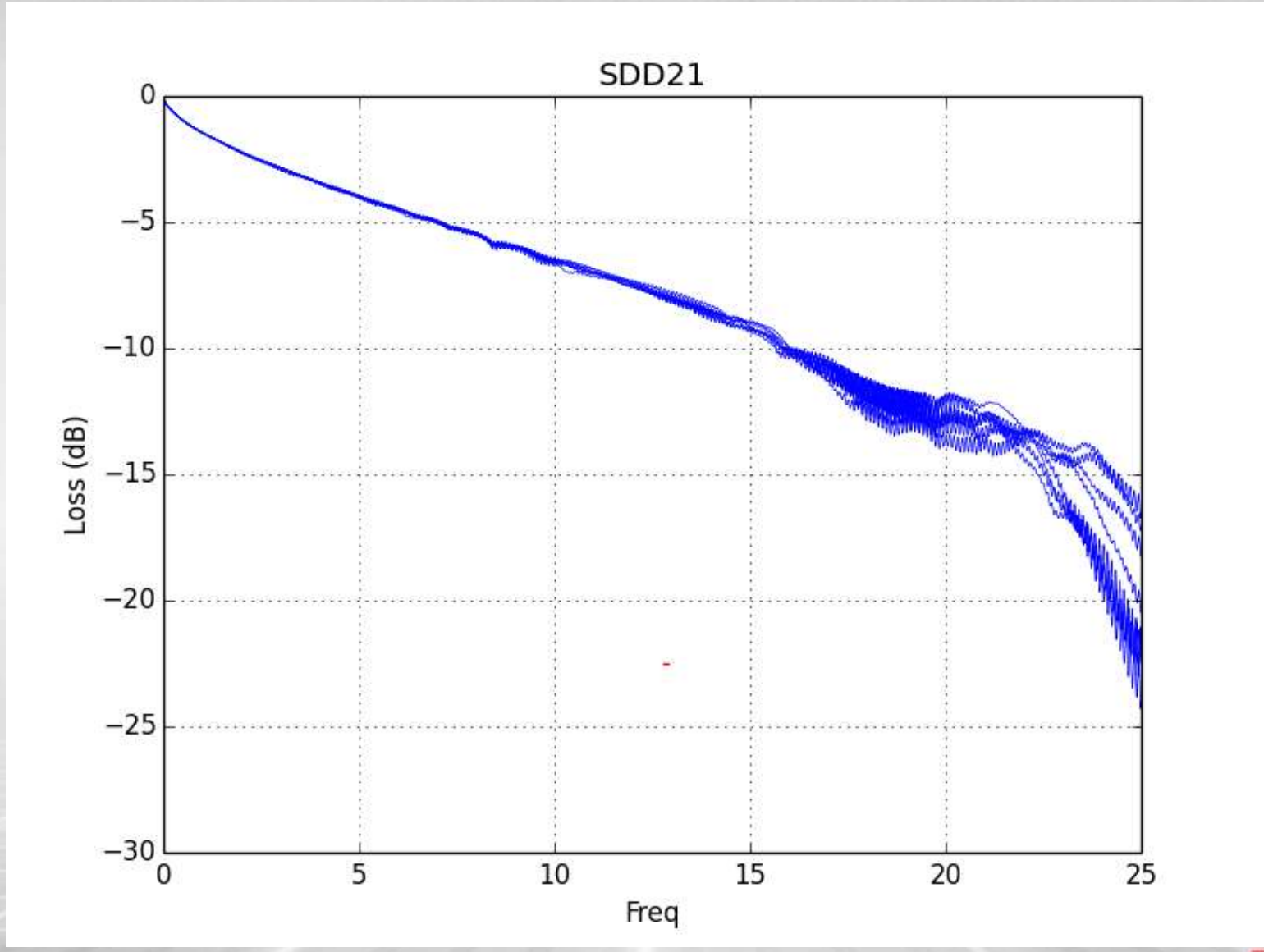
1m 26 awg - IL (~8.2dB @ 13.28GHz)



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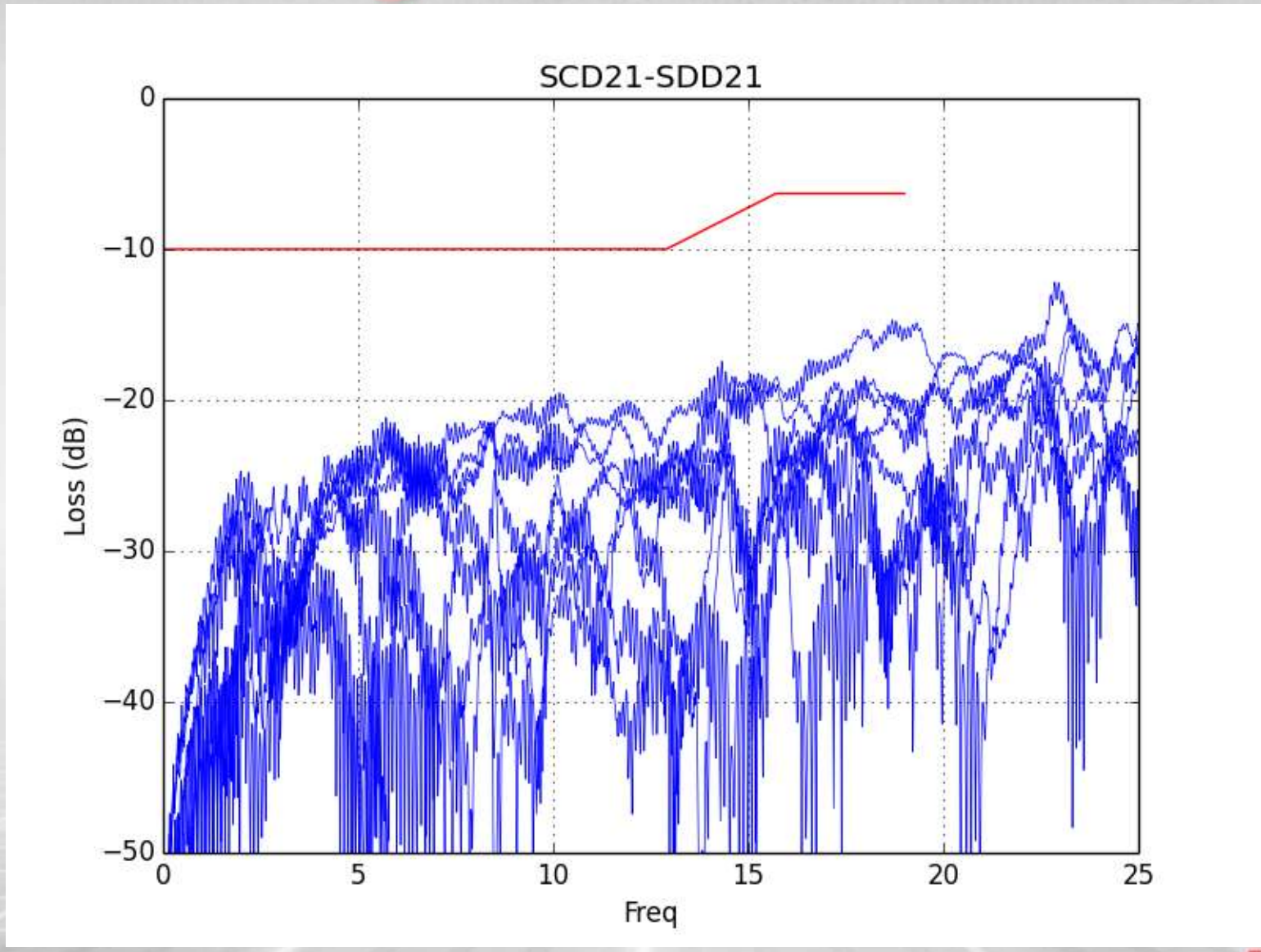
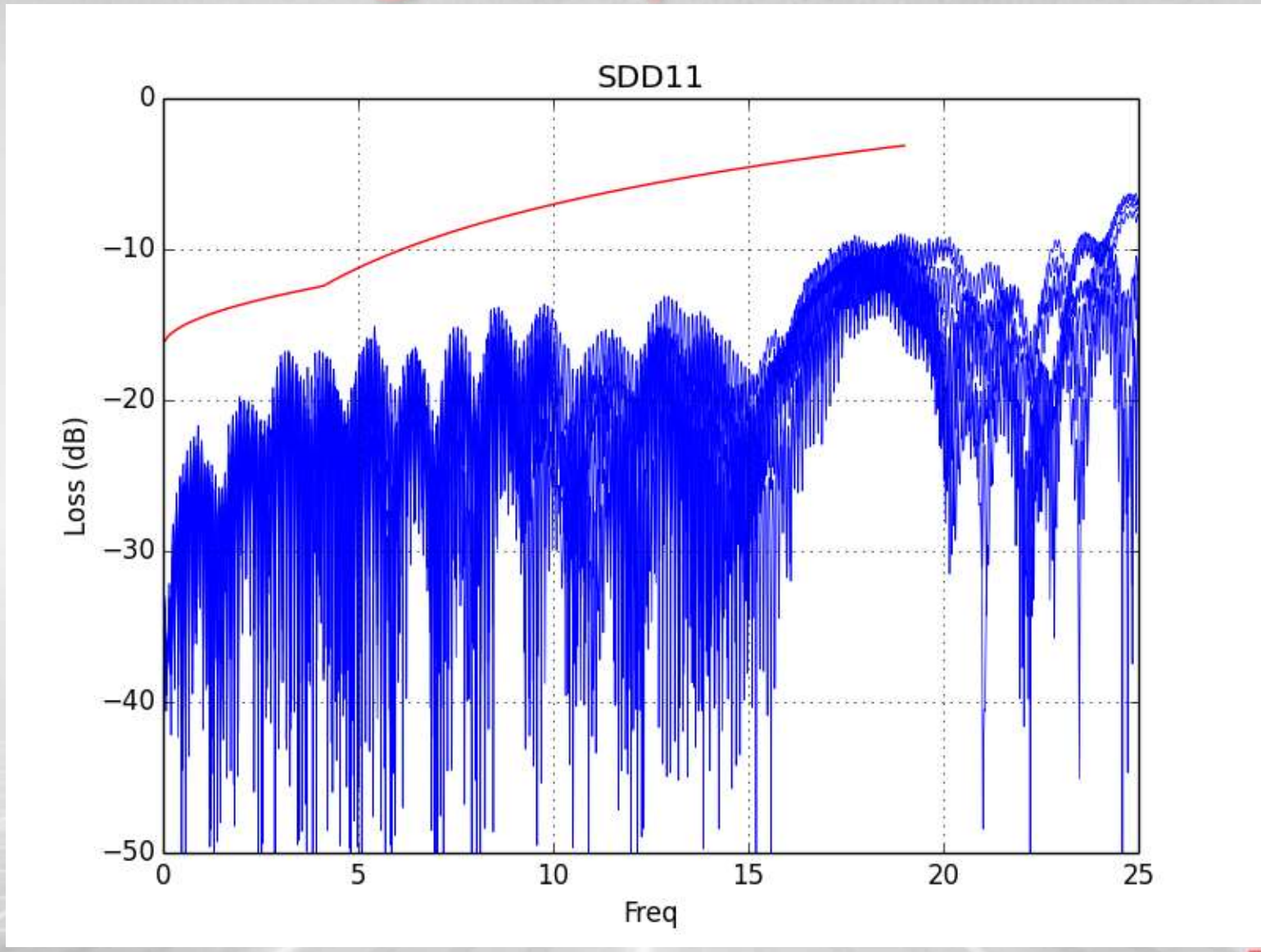
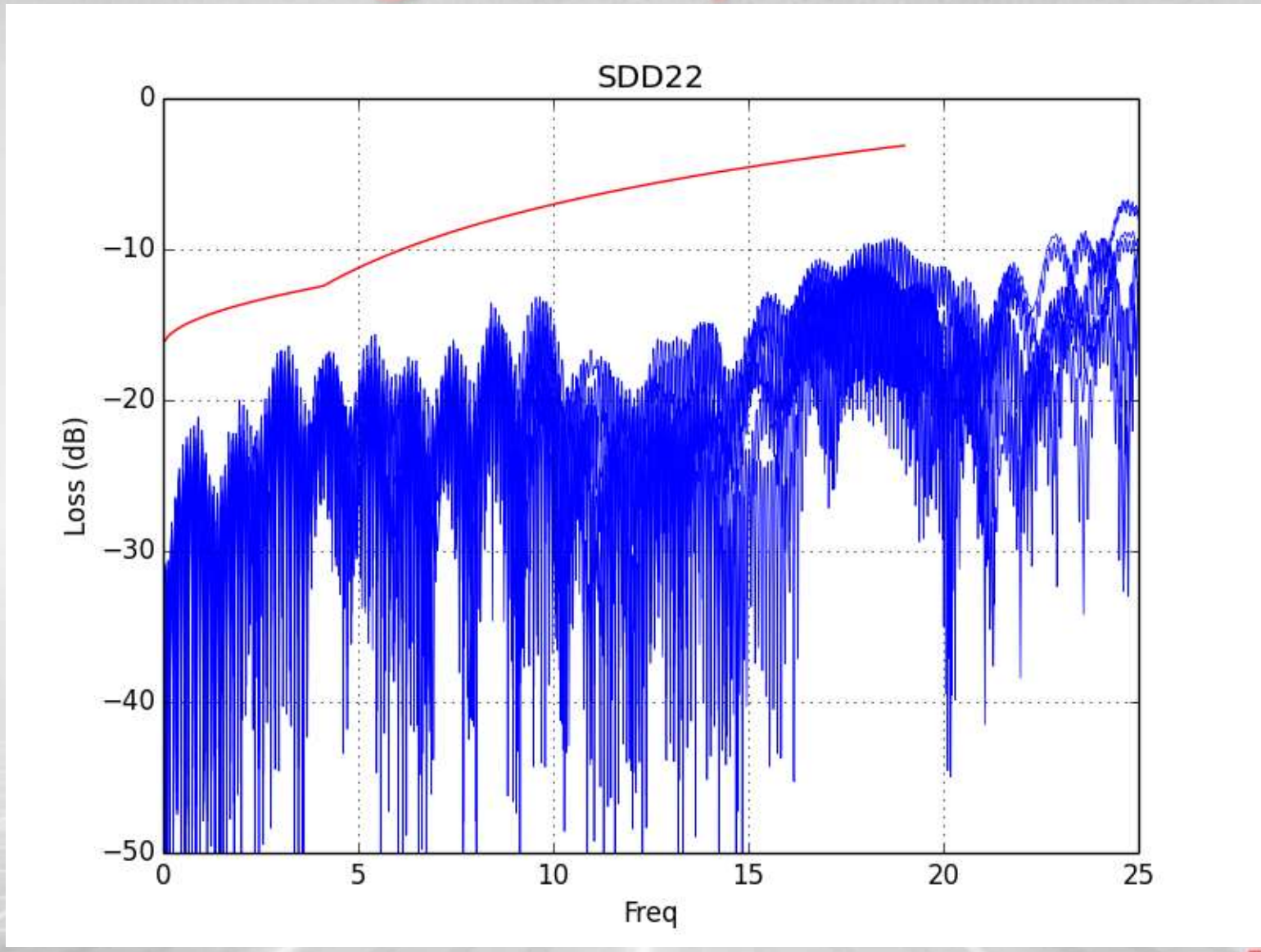
1m 26 awg – Conversion Loss



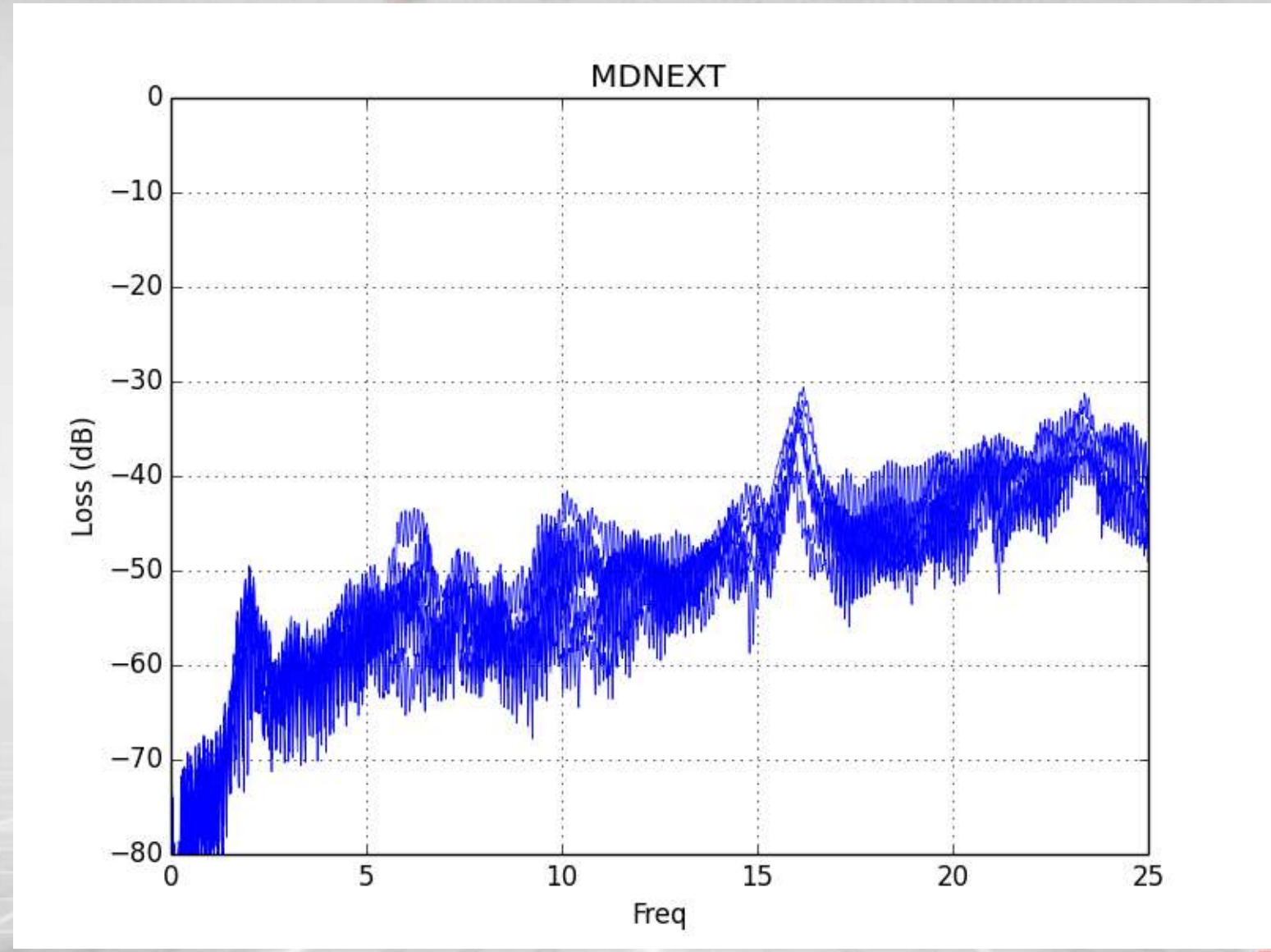
1m 26 awg – Input RL



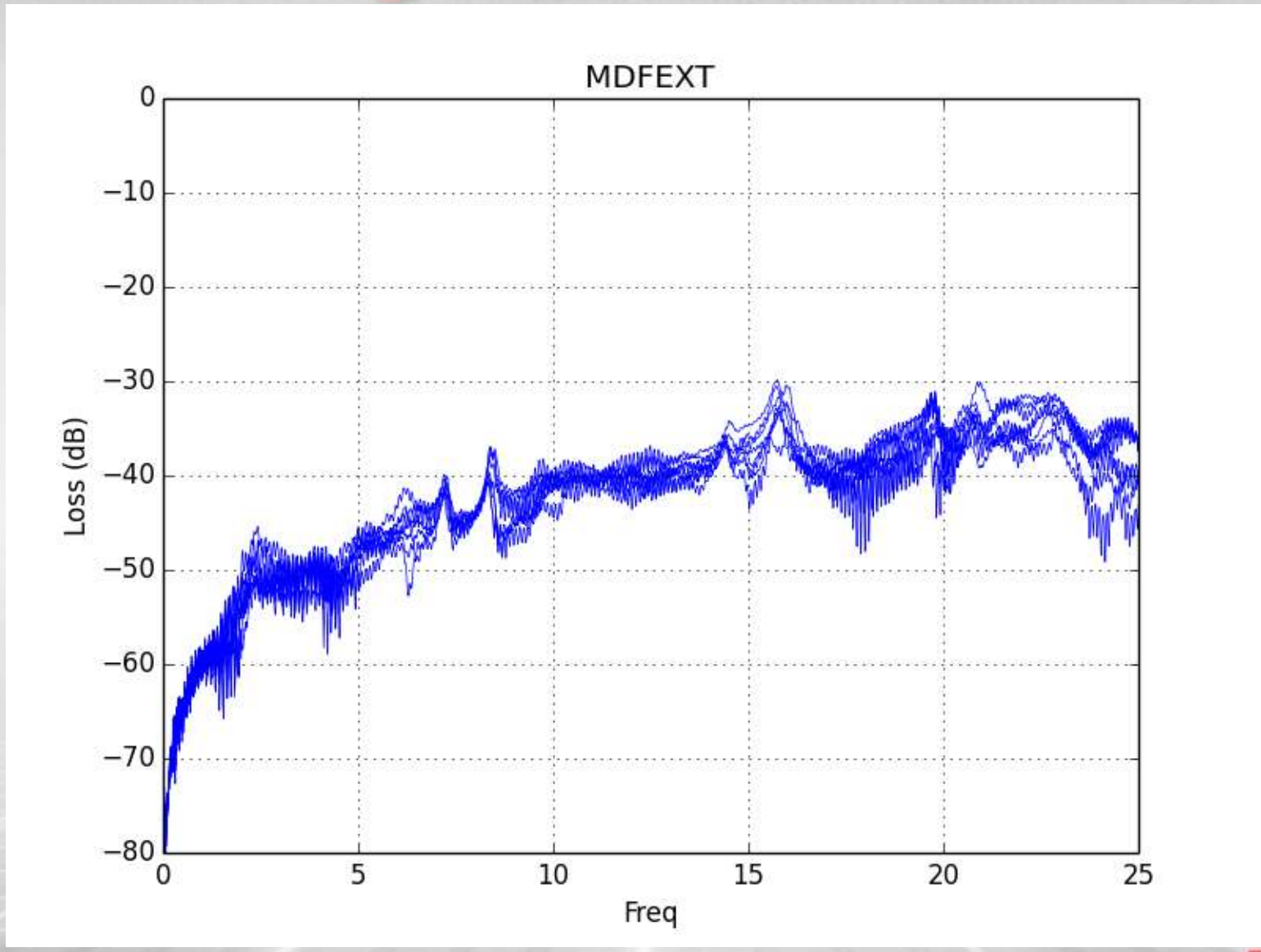
1m 26 awg – Output RL



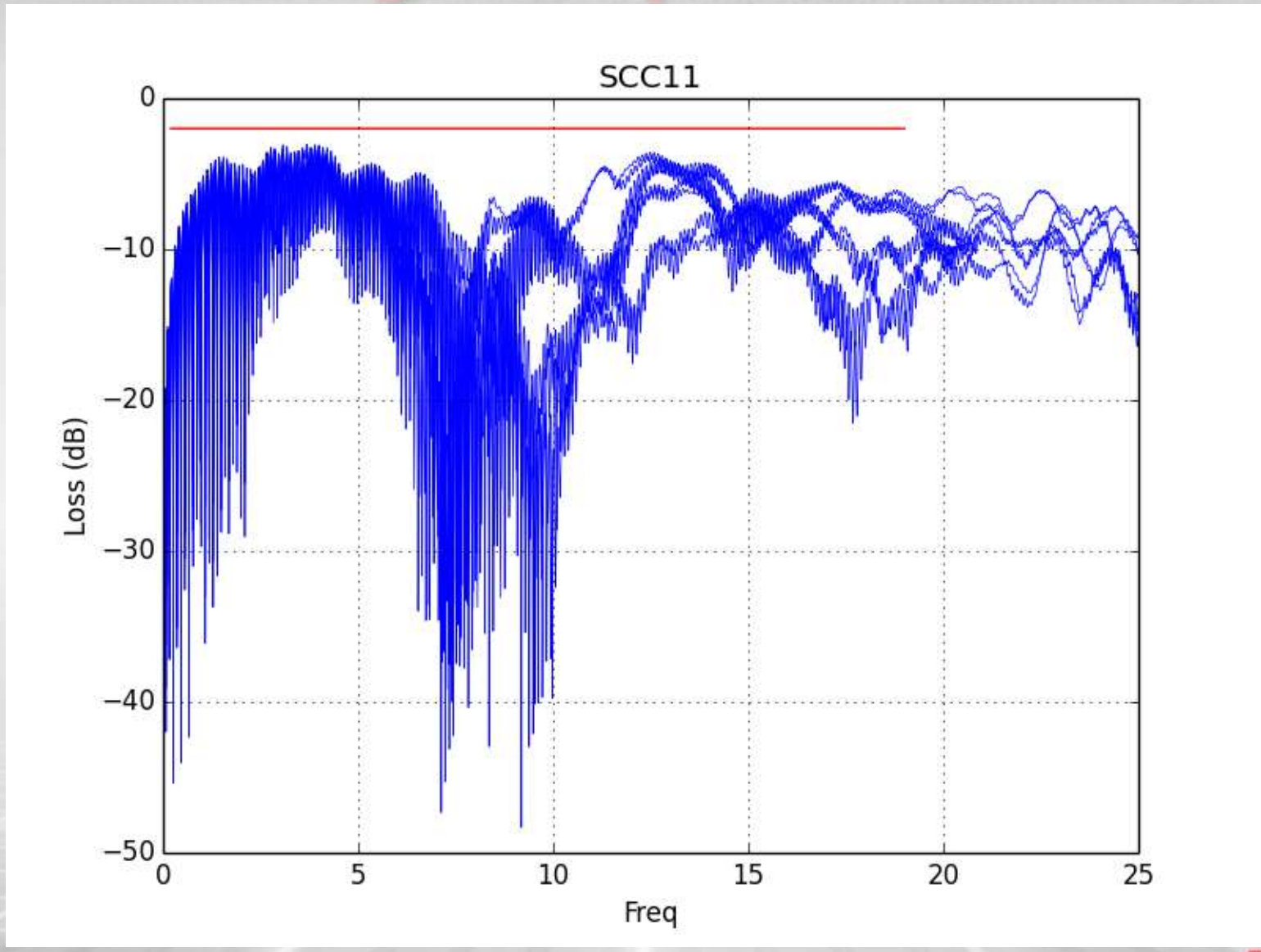
1m 26 awg – MDNEXT



1m 26 awg – MDFEXT



1m 26 awg – Input CM RL



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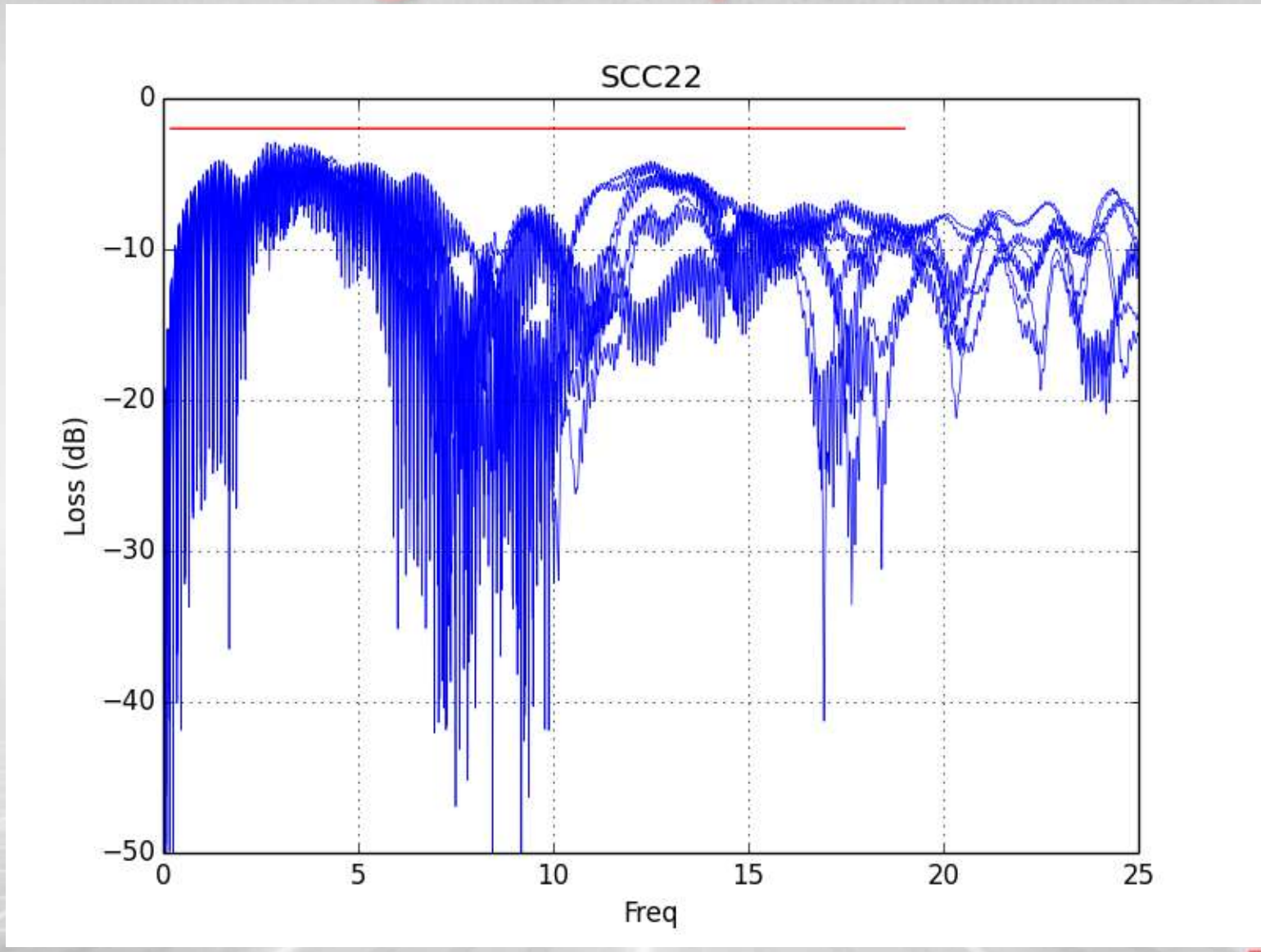
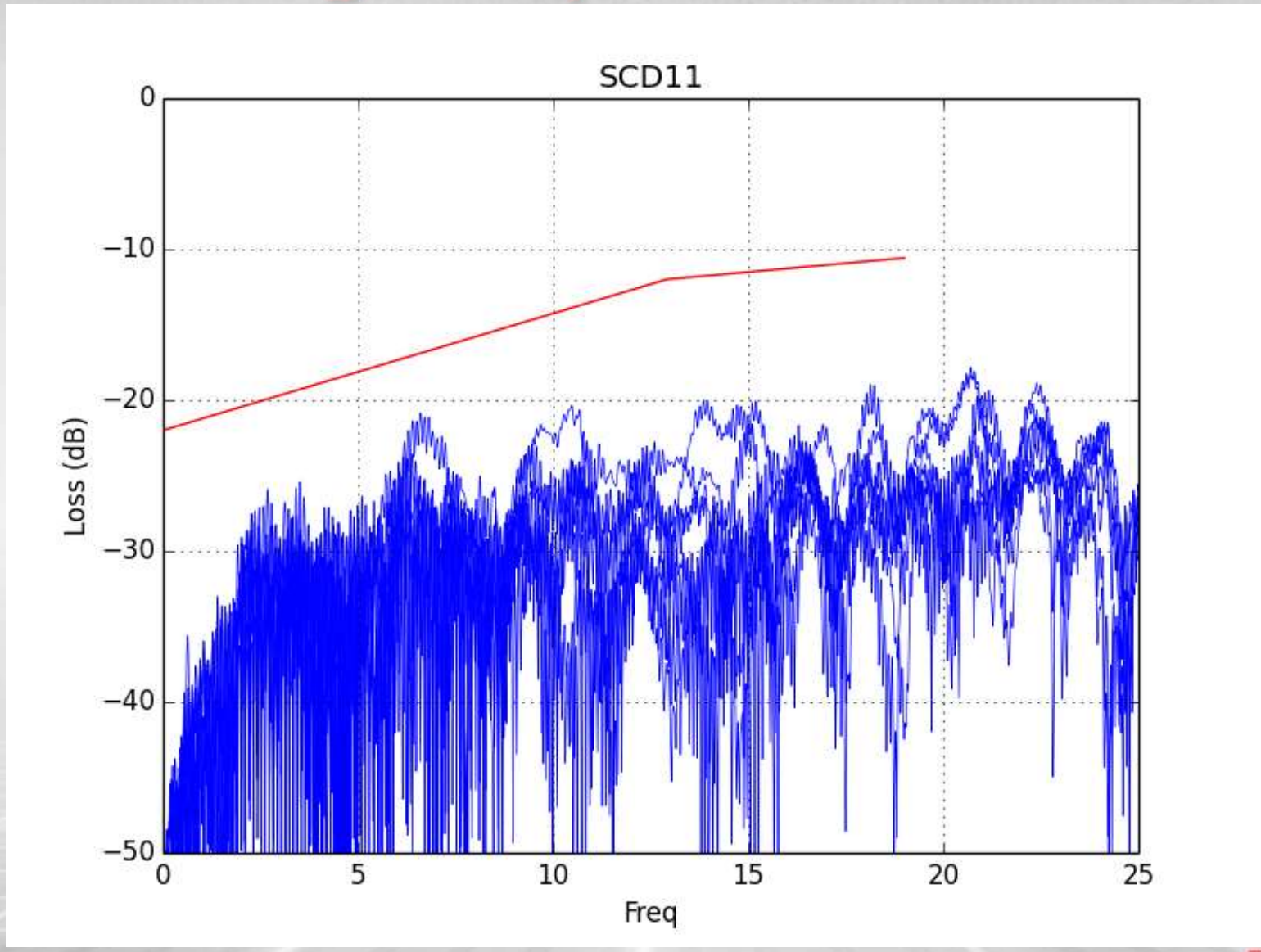
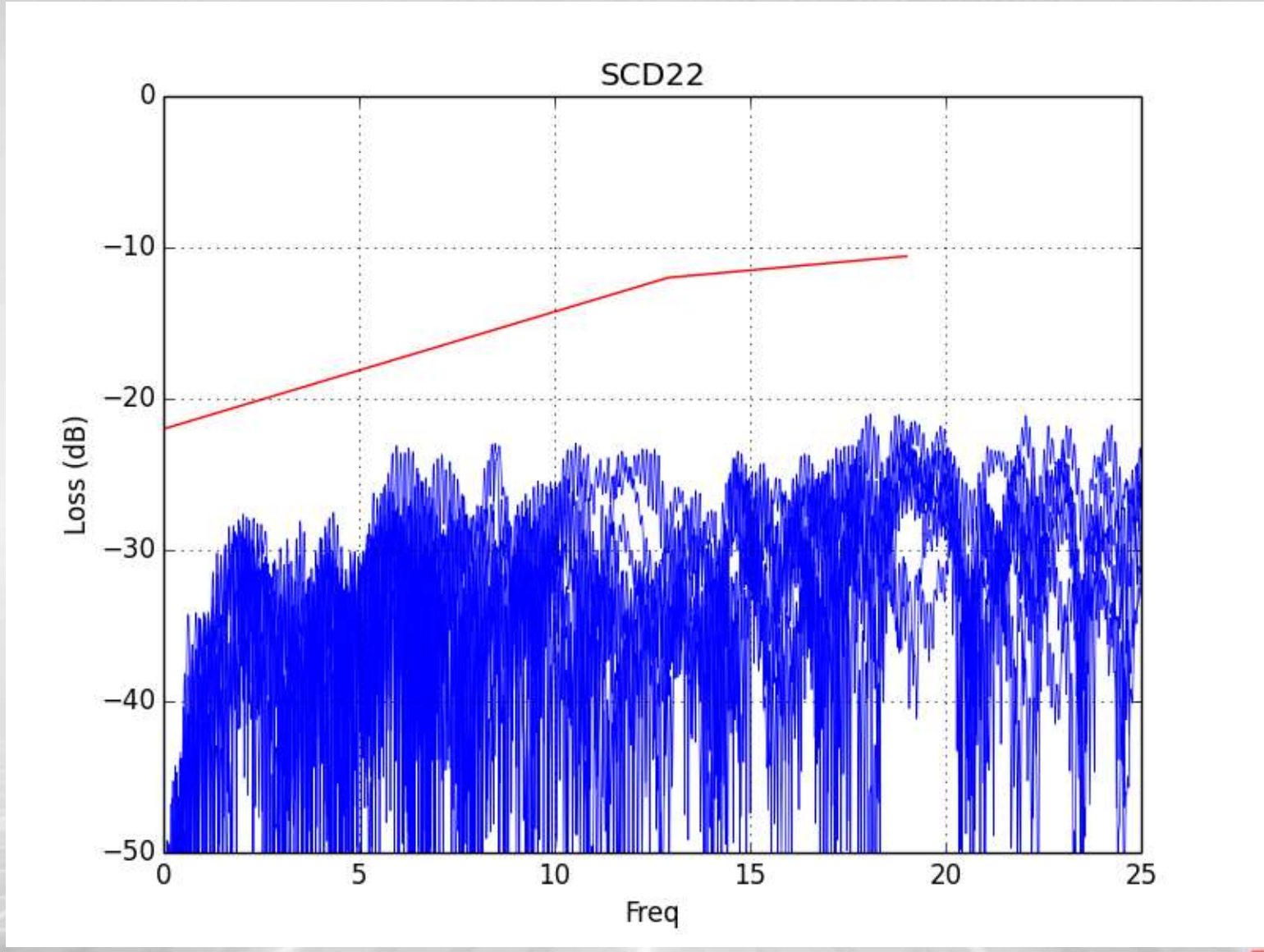
1m 26 awg – Output CM RL



1m 26 awg – Input CM to DIFF RL



1m 26 awg – Output CM to DIFF RL



COM – CR4 (25G NRZ)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	8.45	7.84
P1Tx2 P2Rx2	8.45	7.85
P1Tx3 P2Rx3	8.48	7.81
P1Tx4 P2Rx4	8.43	7.88
P2Tx1 P1Rx1	8.46	7.86
P2Tx2 P1Rx2	8.53	7.89
P2Tx3 P1Rx3	8.50	7.82
P2Tx4 P1Rx4	8.52	7.83

COM – CDAUI-8 (50G PAM-4)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	3.89	1.96
P1Tx2 P2Rx2	3.85	1.96
P1Tx3 P2Rx3	3.89	2.00
P1Tx4 P2Rx4	3.86	2.00
P2Tx1 P1Rx1	3.92	1.99
P2Tx2 P1Rx2	3.95	2.09
P2Tx3 P1Rx3	3.89	2.00
P2Tx4 P1Rx4	4.01	2.03

2m 26 awg

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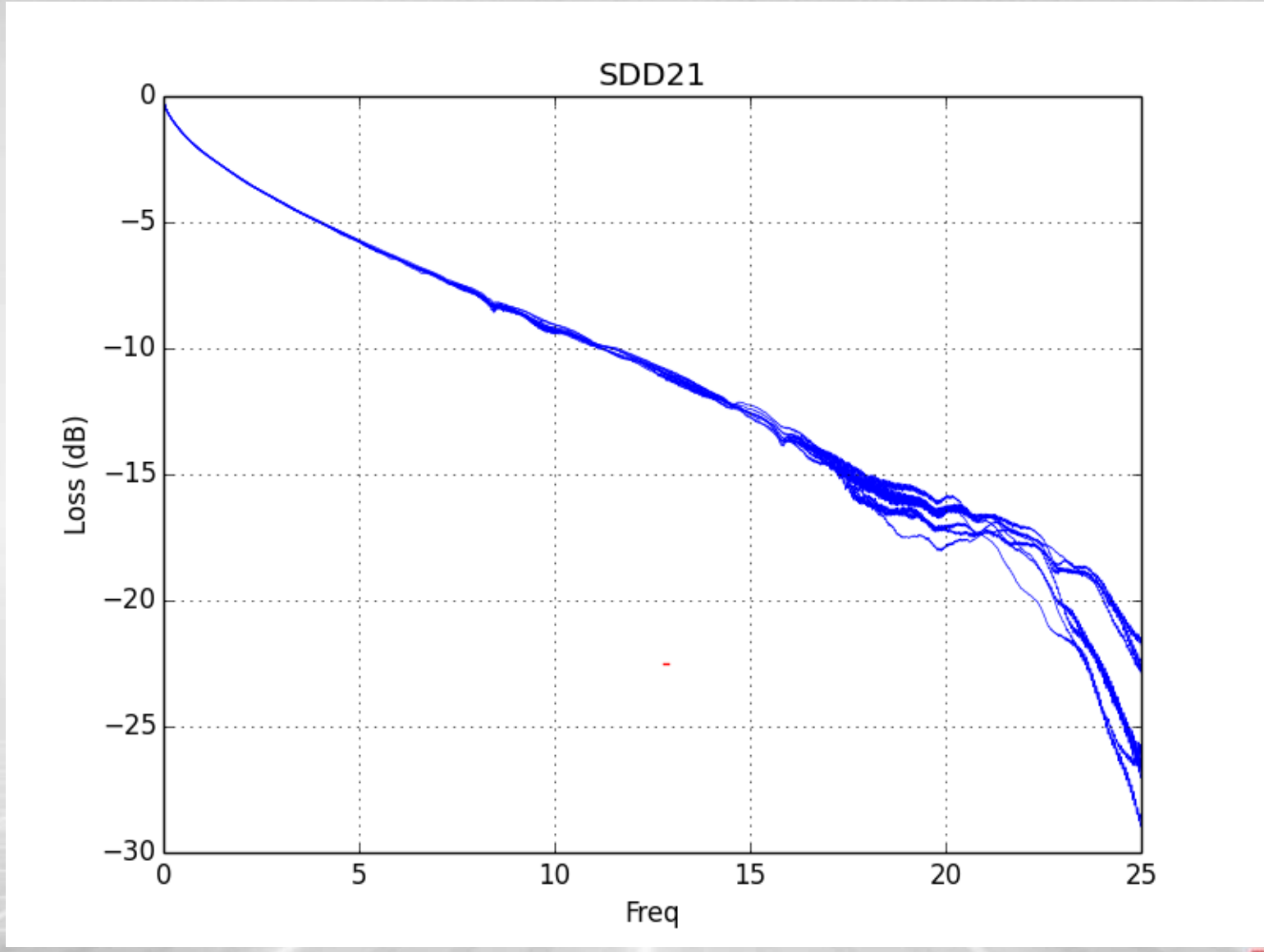
2m 26 awg - IL (~11.3dB @ 13.28GHz)



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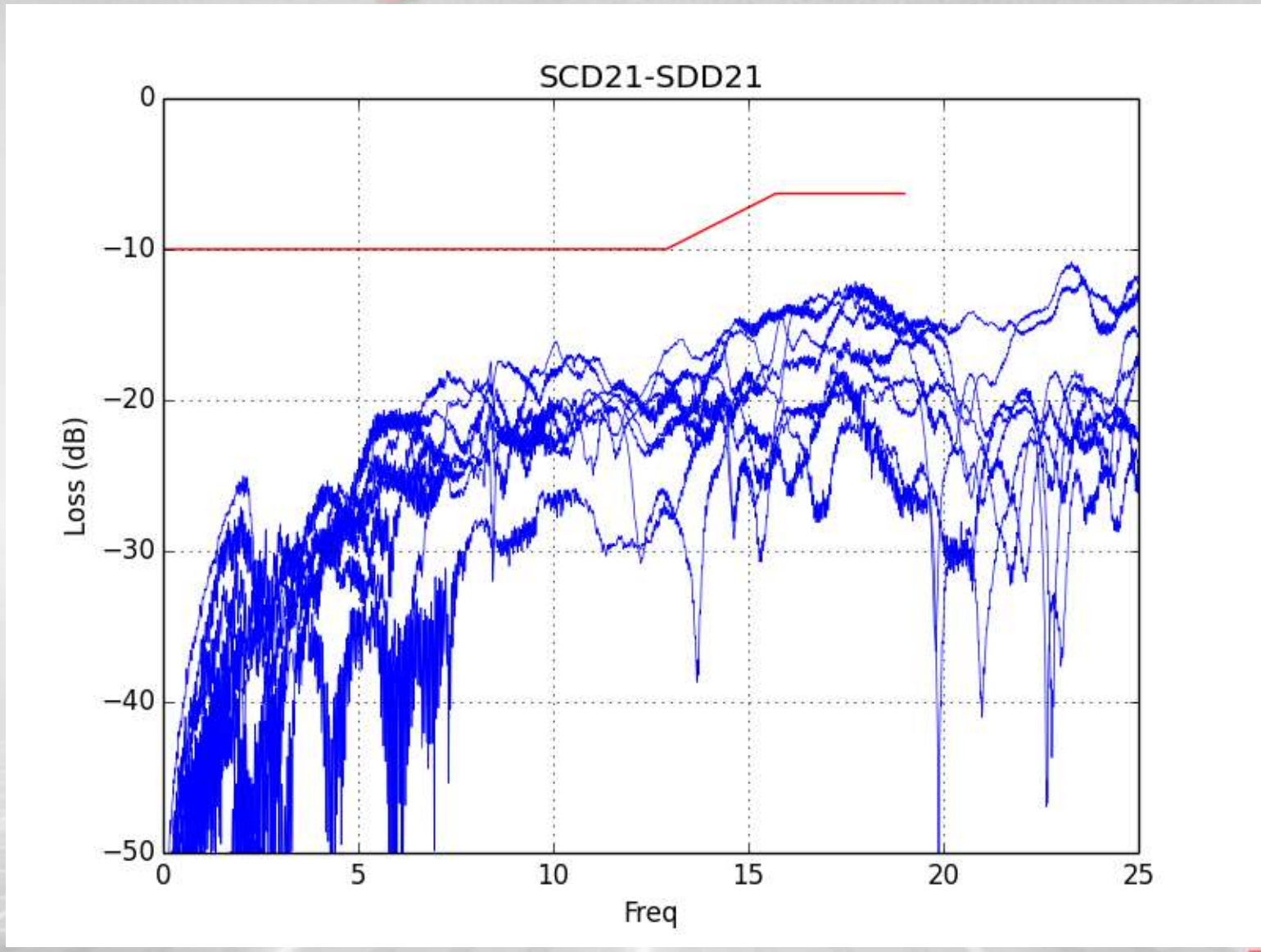
2m 26 awg – Conversion Loss



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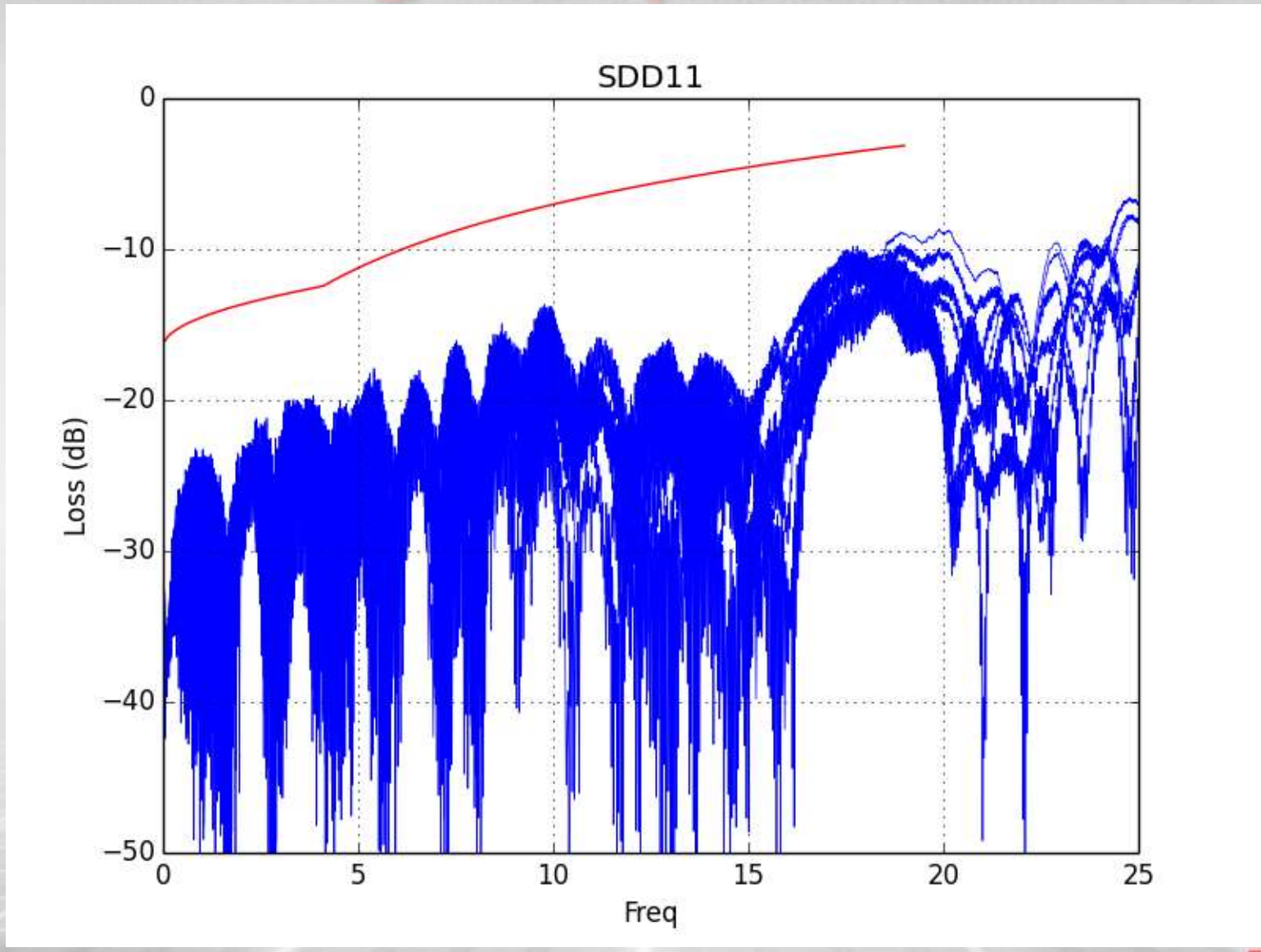
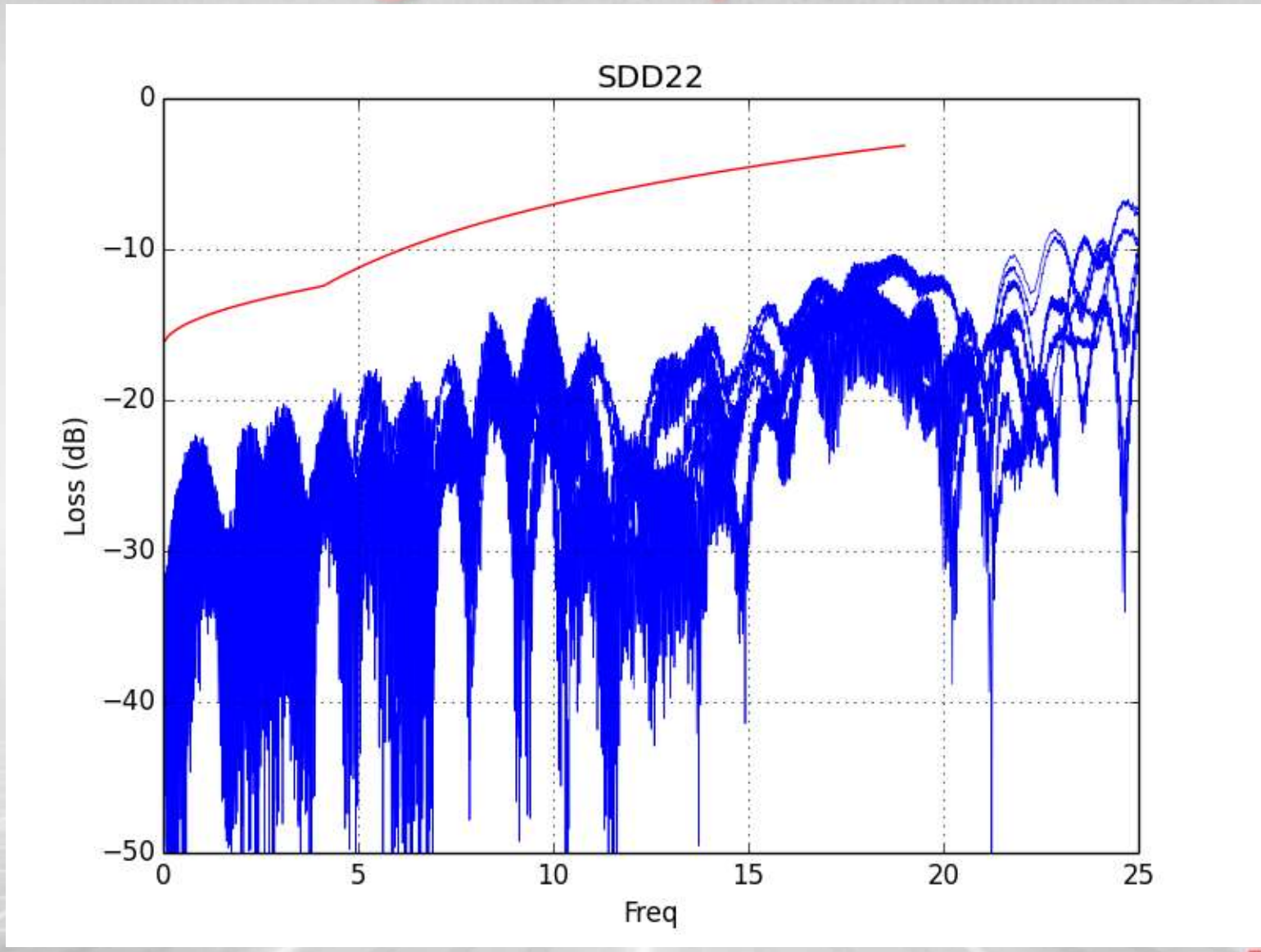
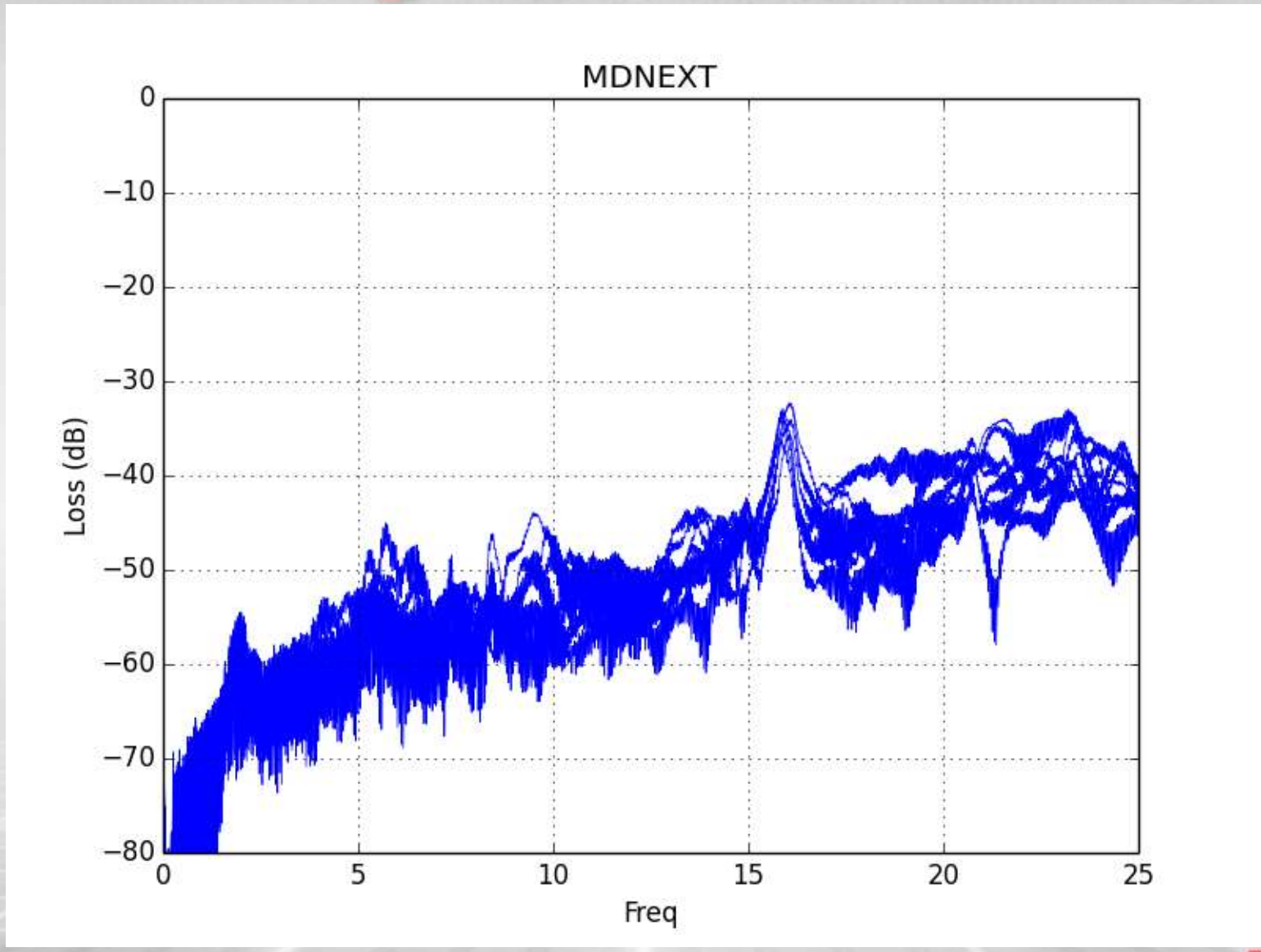
2m 26 awg – Input RL



2m 26 awg – Output RL



2m 26 awg – MDNEXT



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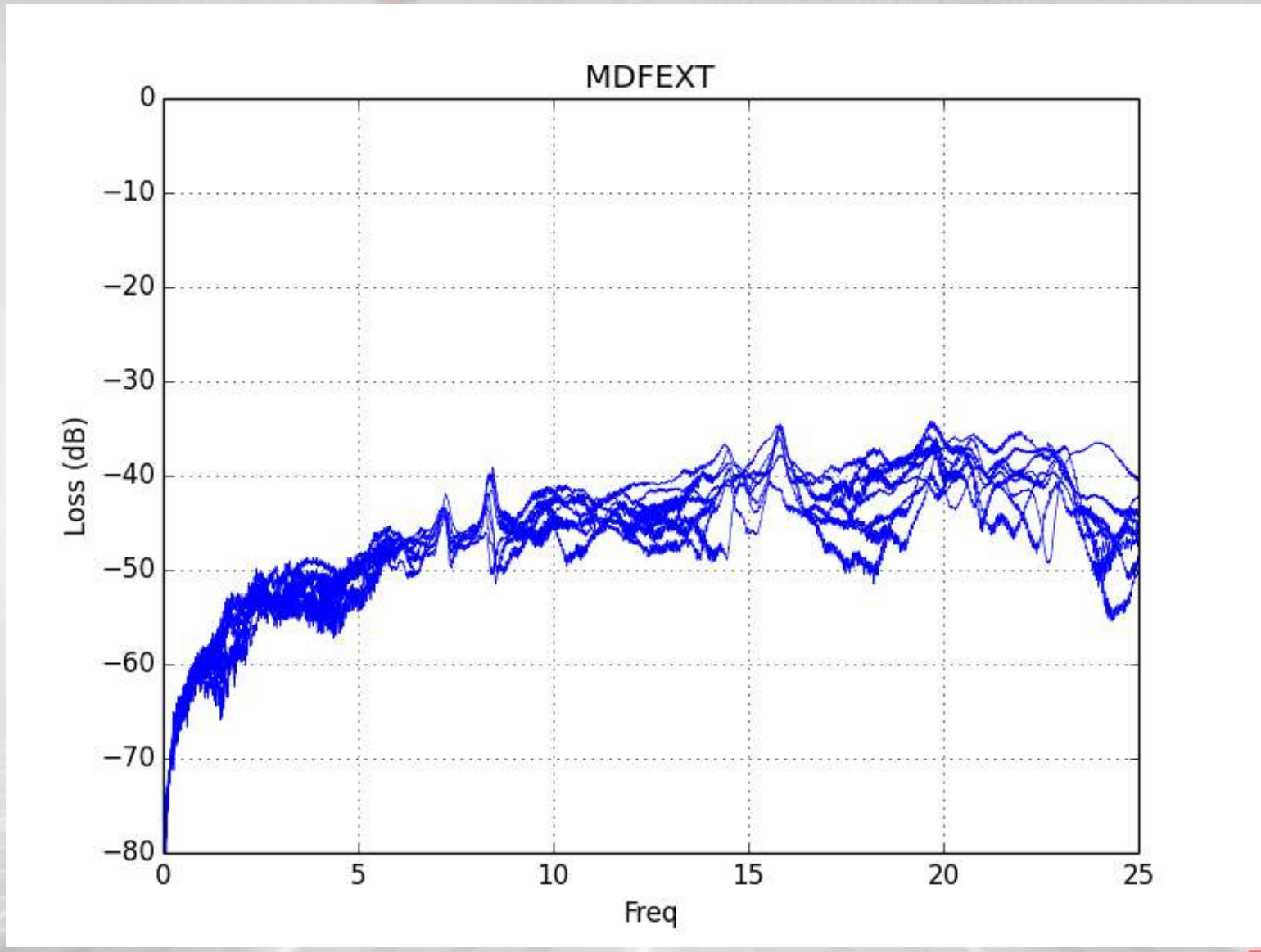
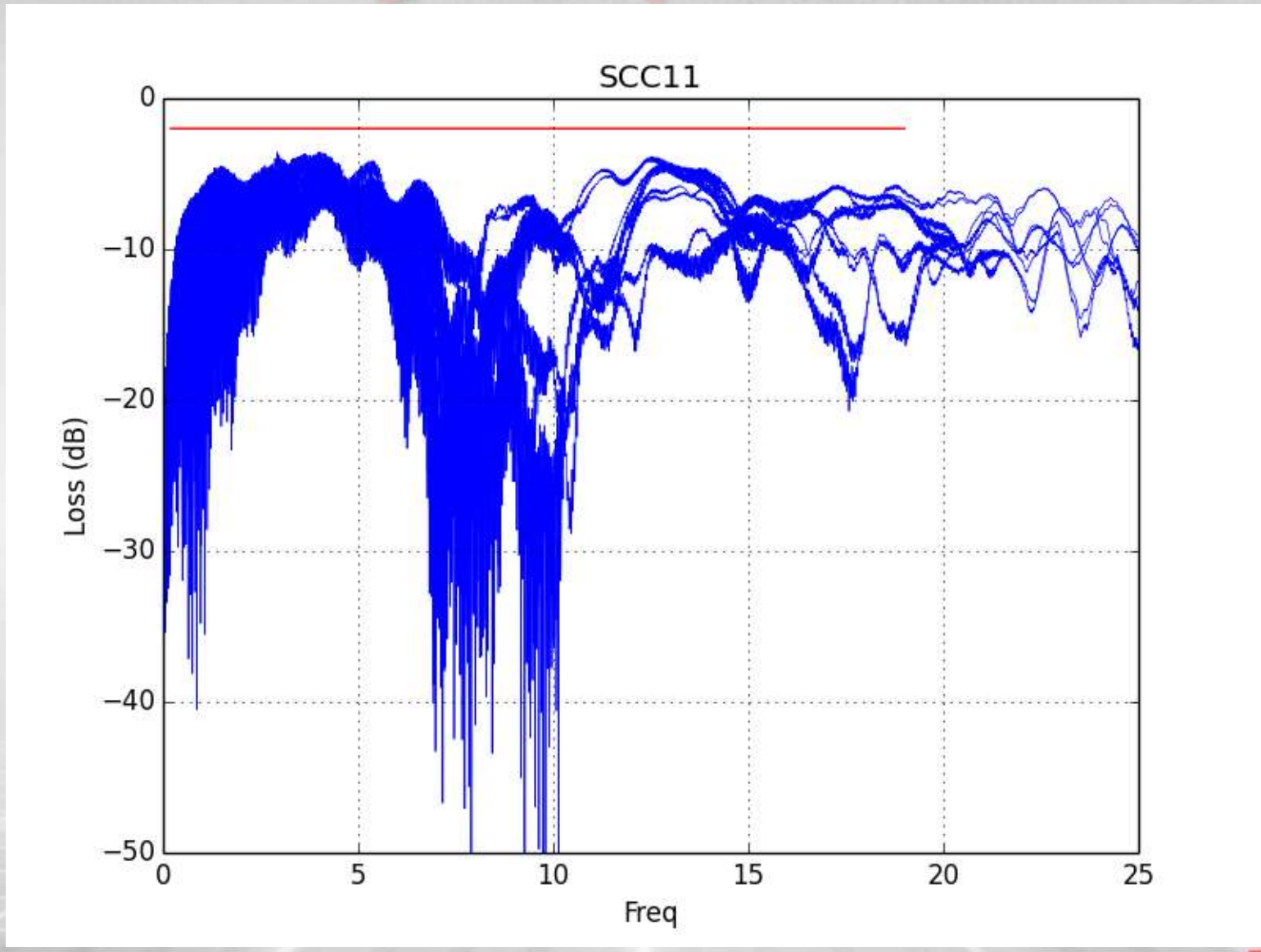
2m 26 awg – MDFEXT



2m 26 awg – Input CM RL



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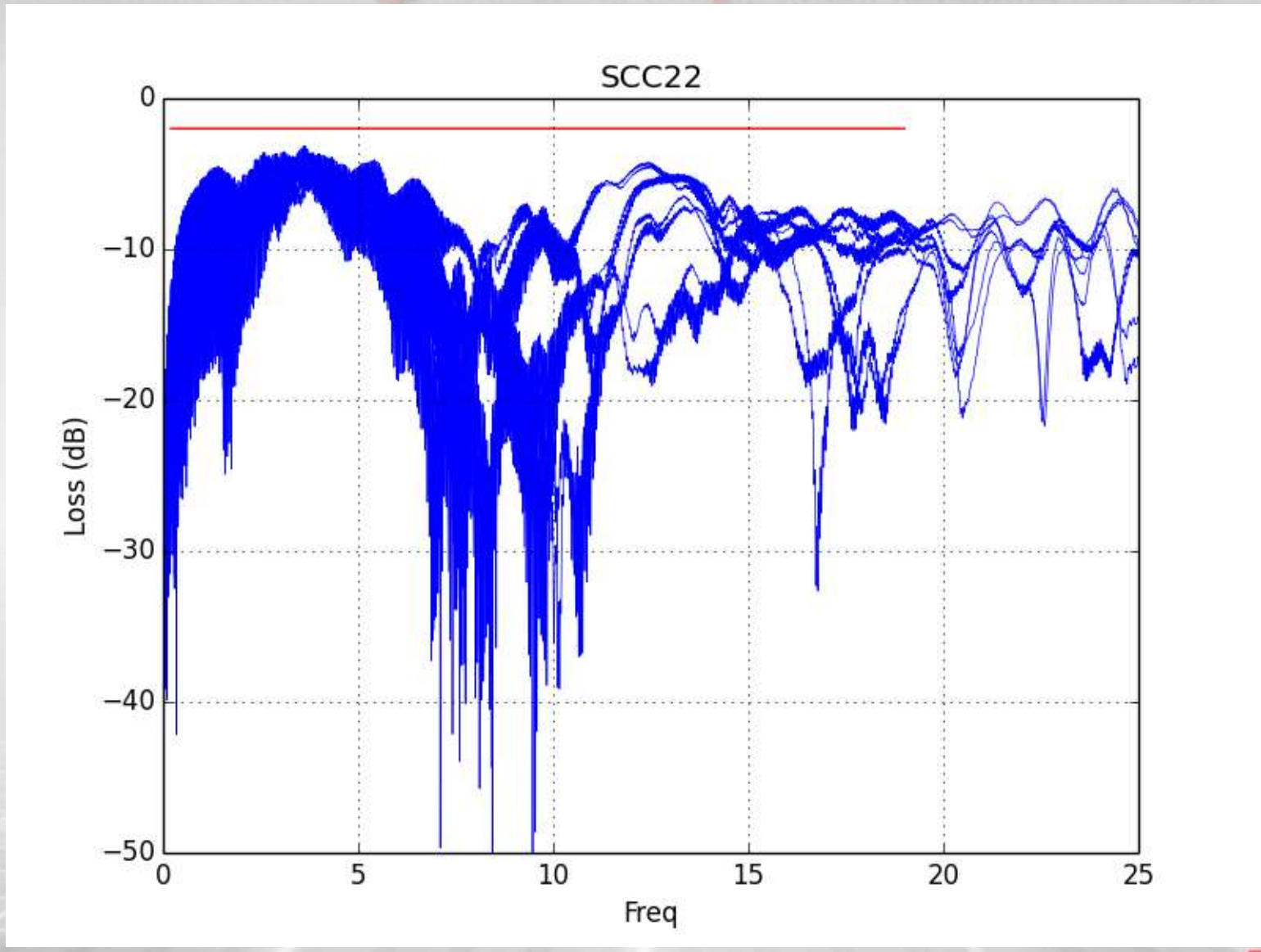
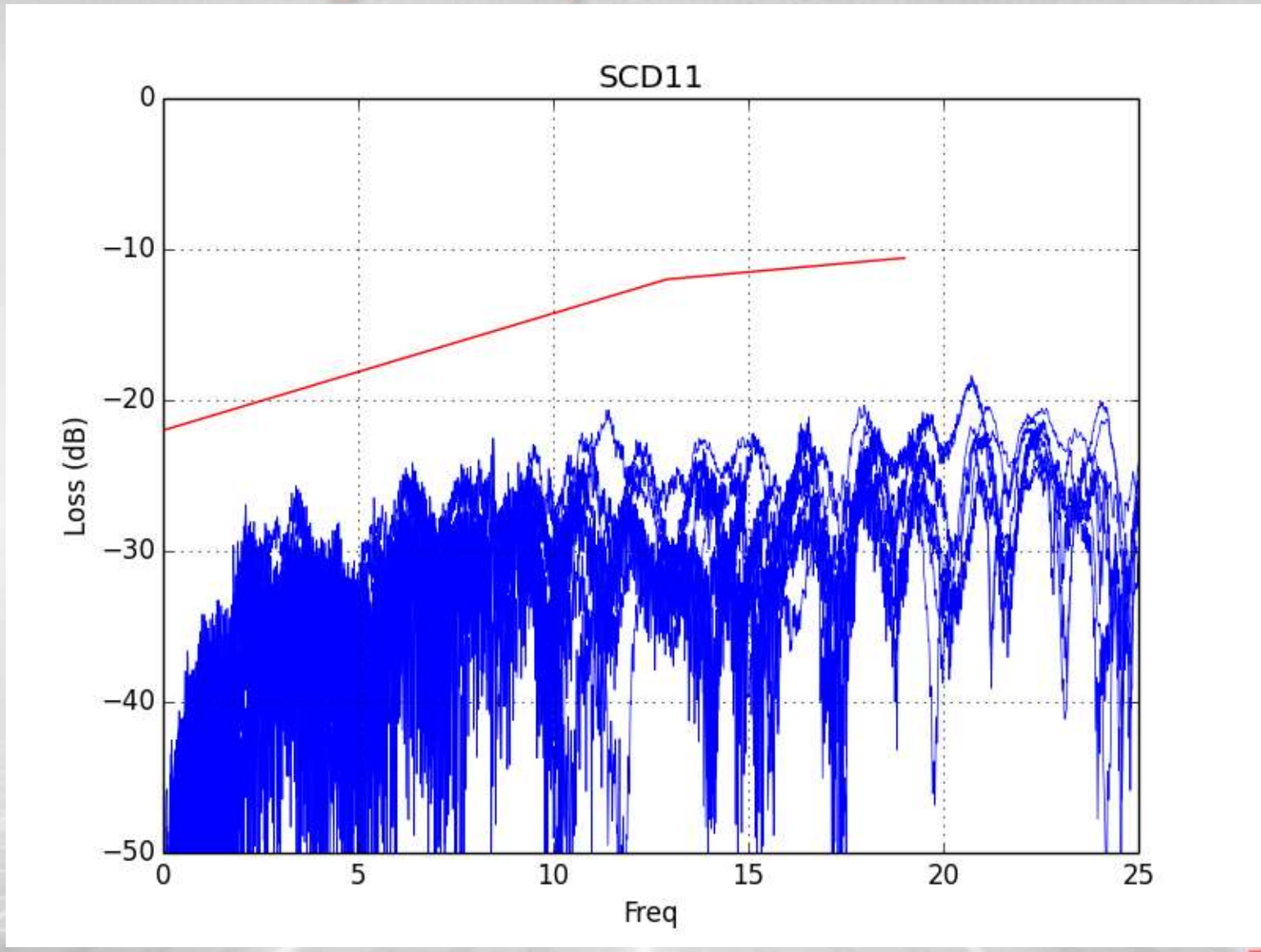
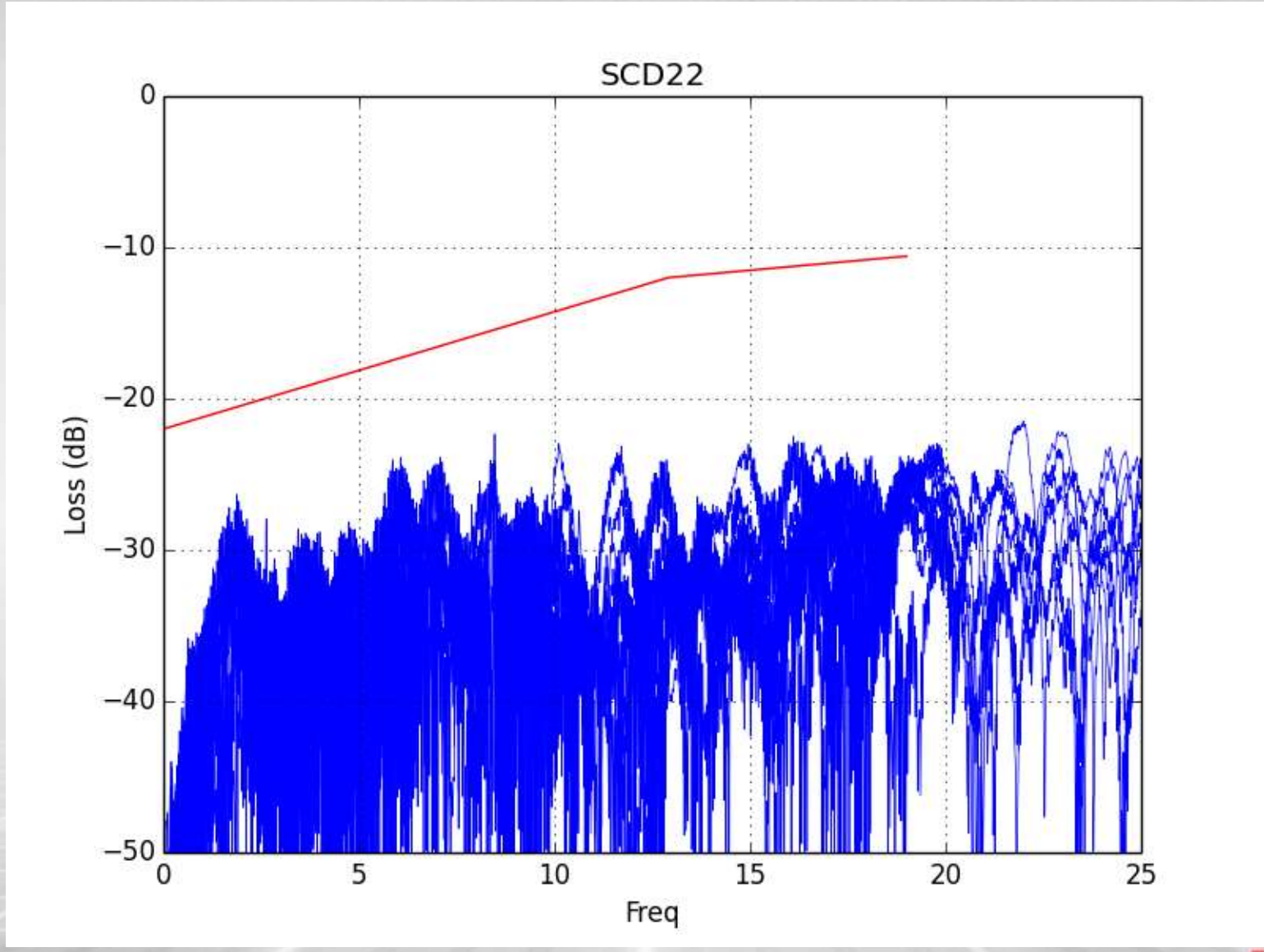
2m 26 awg – Output CM RL



2m 26 awg – Input CM to DIFF RL



2m 26 awg – Output CM to DIFF RL



COM – CR4 (25G NRZ)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	8.02	7.33
P1Tx2 P2Rx2	7.92	7.23
P1Tx3 P2Rx3	7.93	7.25
P1Tx4 P2Rx4	8.01	7.26
P2Tx1 P1Rx1	8.00	7.33
P2Tx2 P1Rx2	7.98	7.29
P2Tx3 P1Rx3	8.04	7.38
P2Tx4 P1Rx4	7.95	7.30

COM – CDAUI-8 (50G PAM-4)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	3.48	1.46
P1Tx2 P2Rx2	3.41	1.46
P1Tx3 P2Rx3	3.36	1.42
P1Tx4 P2Rx4	3.43	1.32
P2Tx1 P1Rx1	3.69	1.51
P2Tx2 P1Rx2	3.56	1.42
P2Tx3 P1Rx3	3.52	1.48
P2Tx4 P1Rx4	3.54	1.54

3m 26 awg

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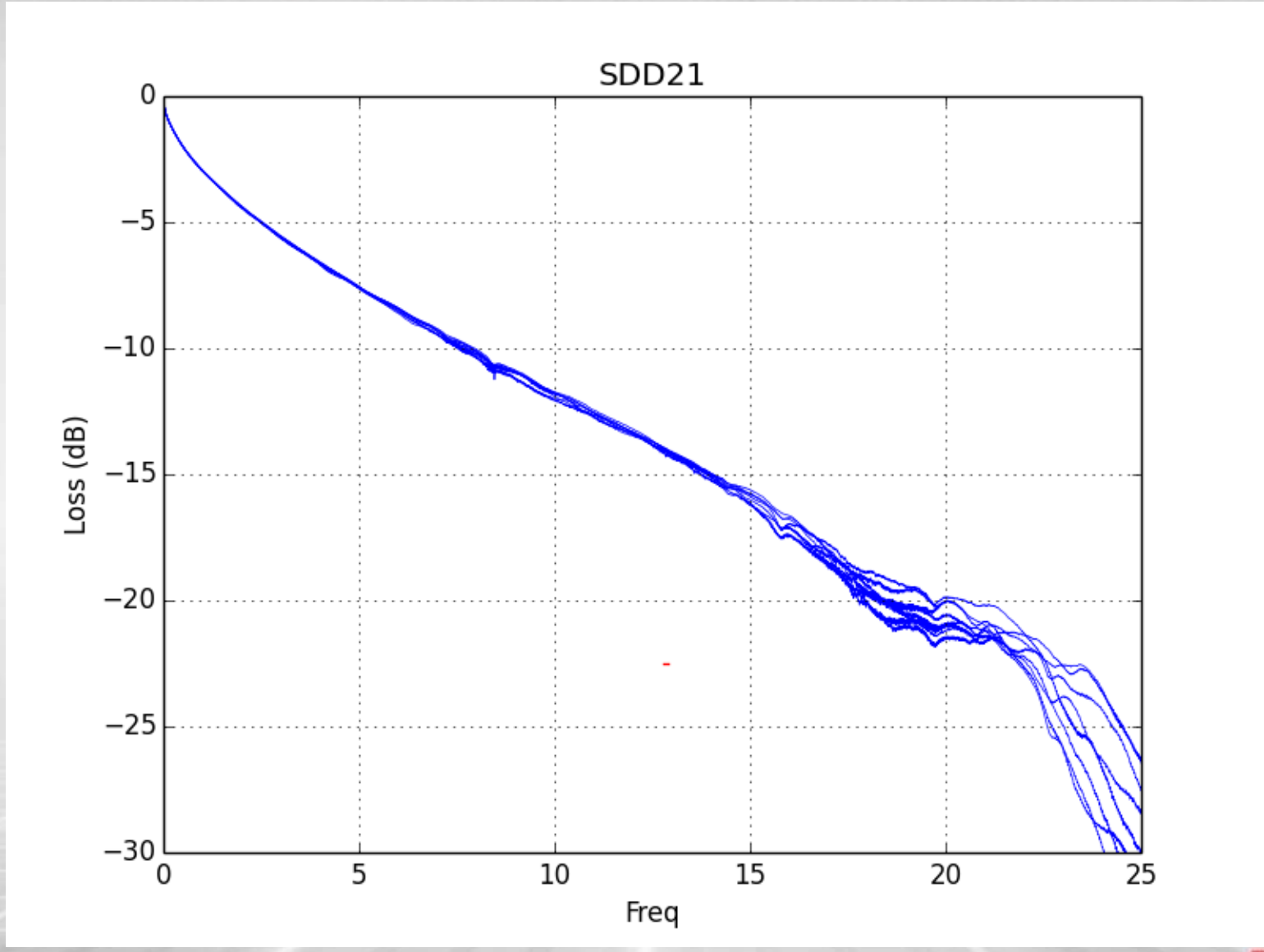
3m 26 awg – IL (~14.4dB @ 13.28GHz)



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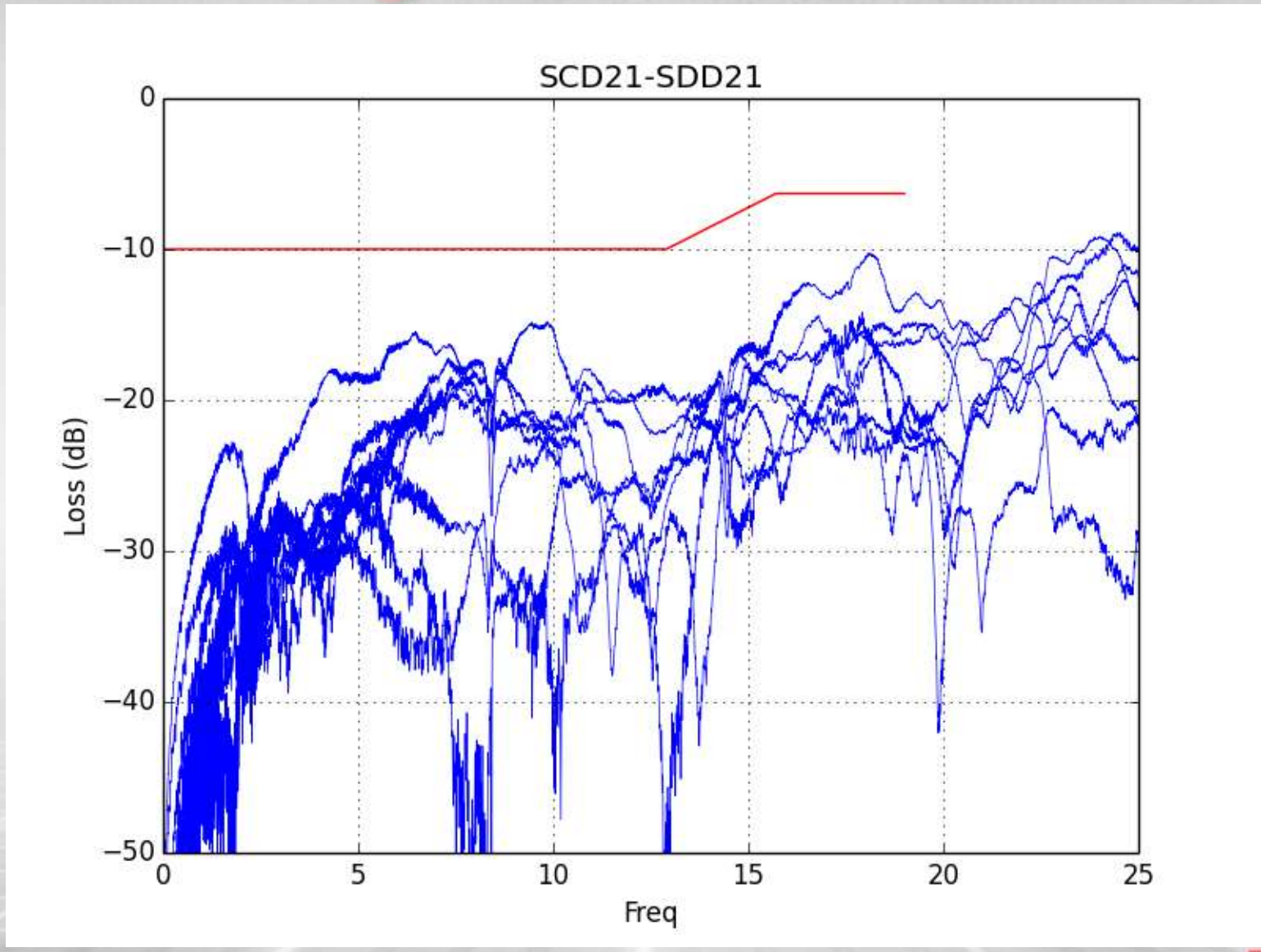
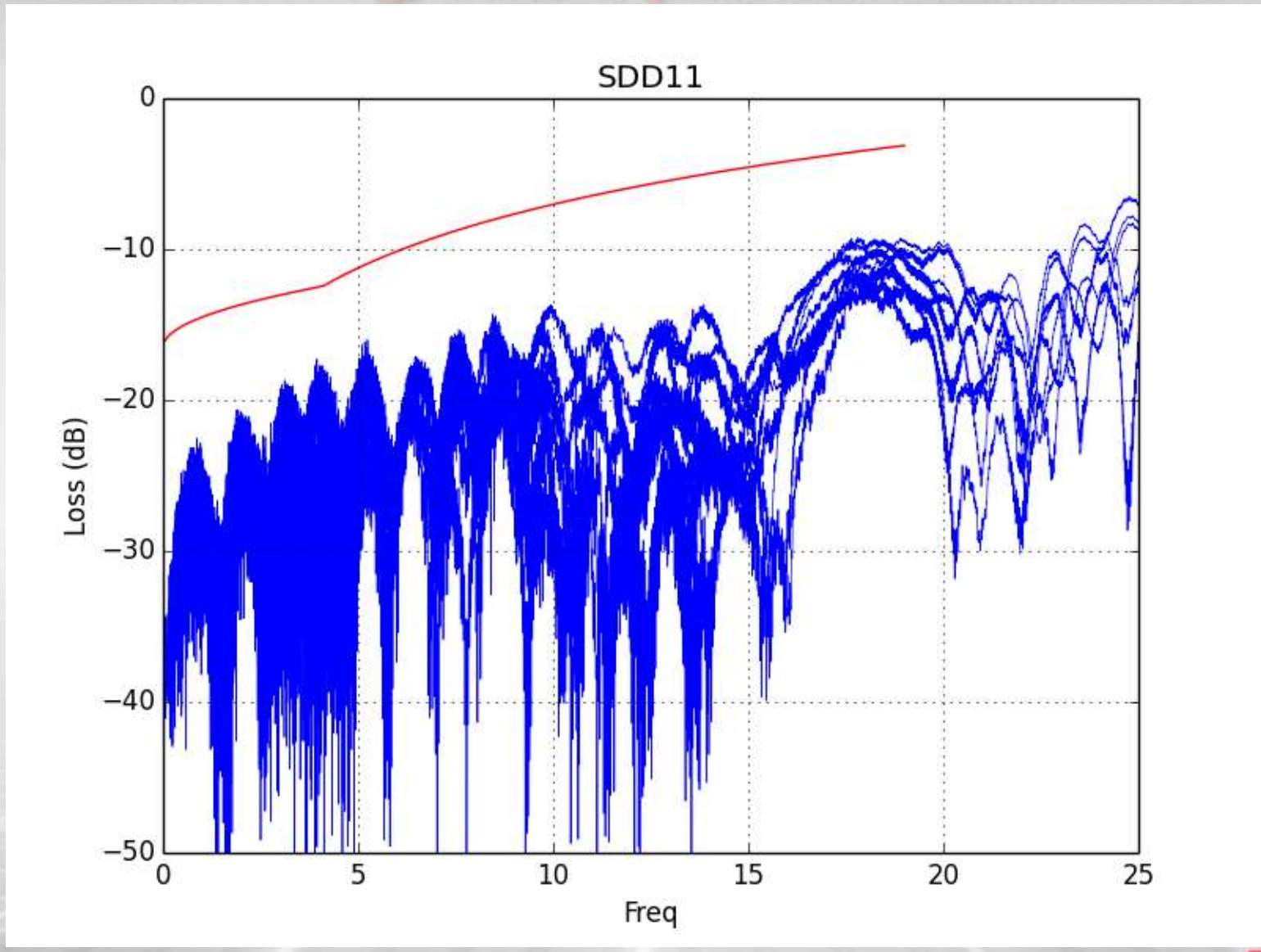
3m 26 awg – Conversion Loss



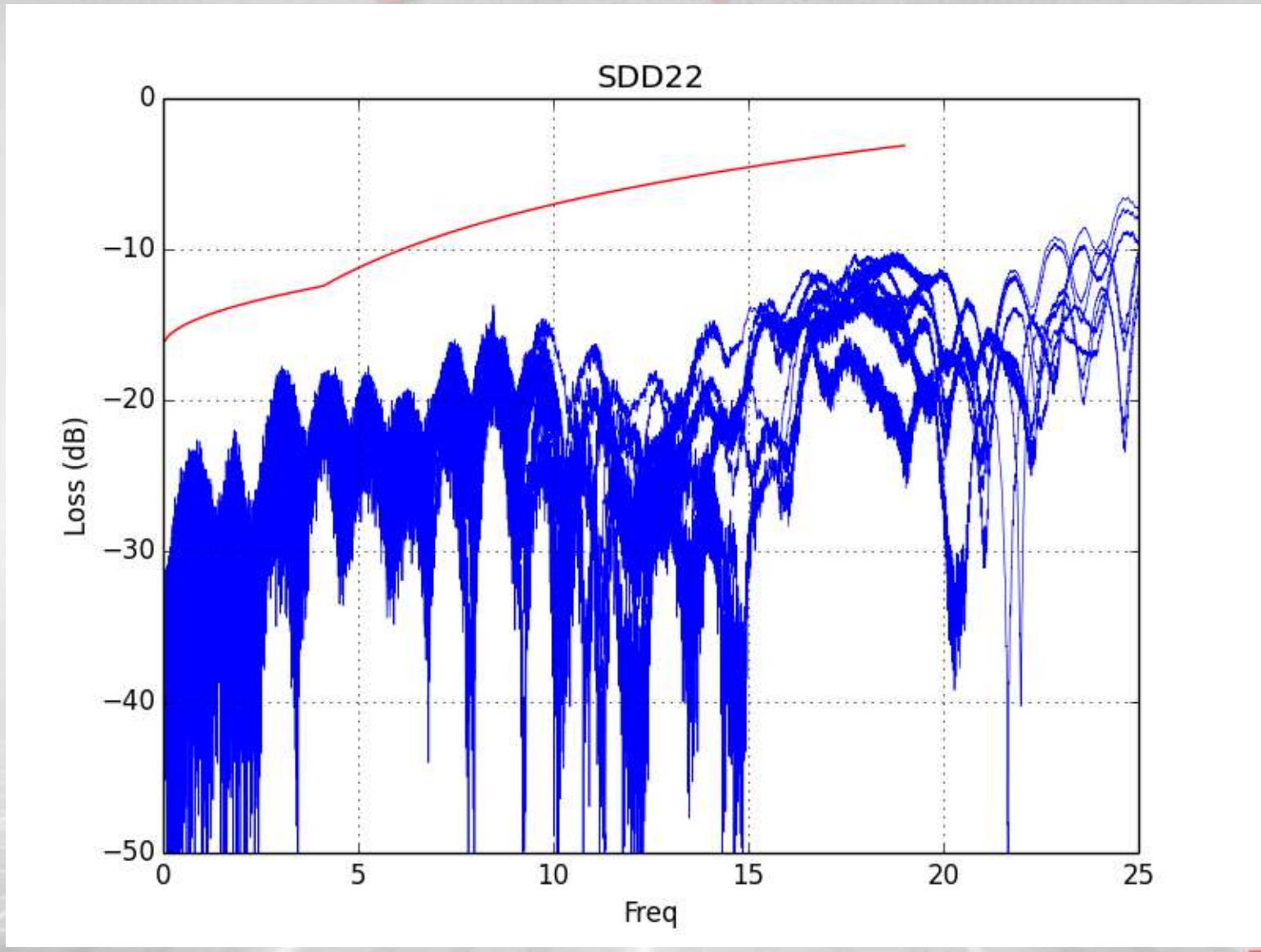
molex

3m 26 awg – Input RL

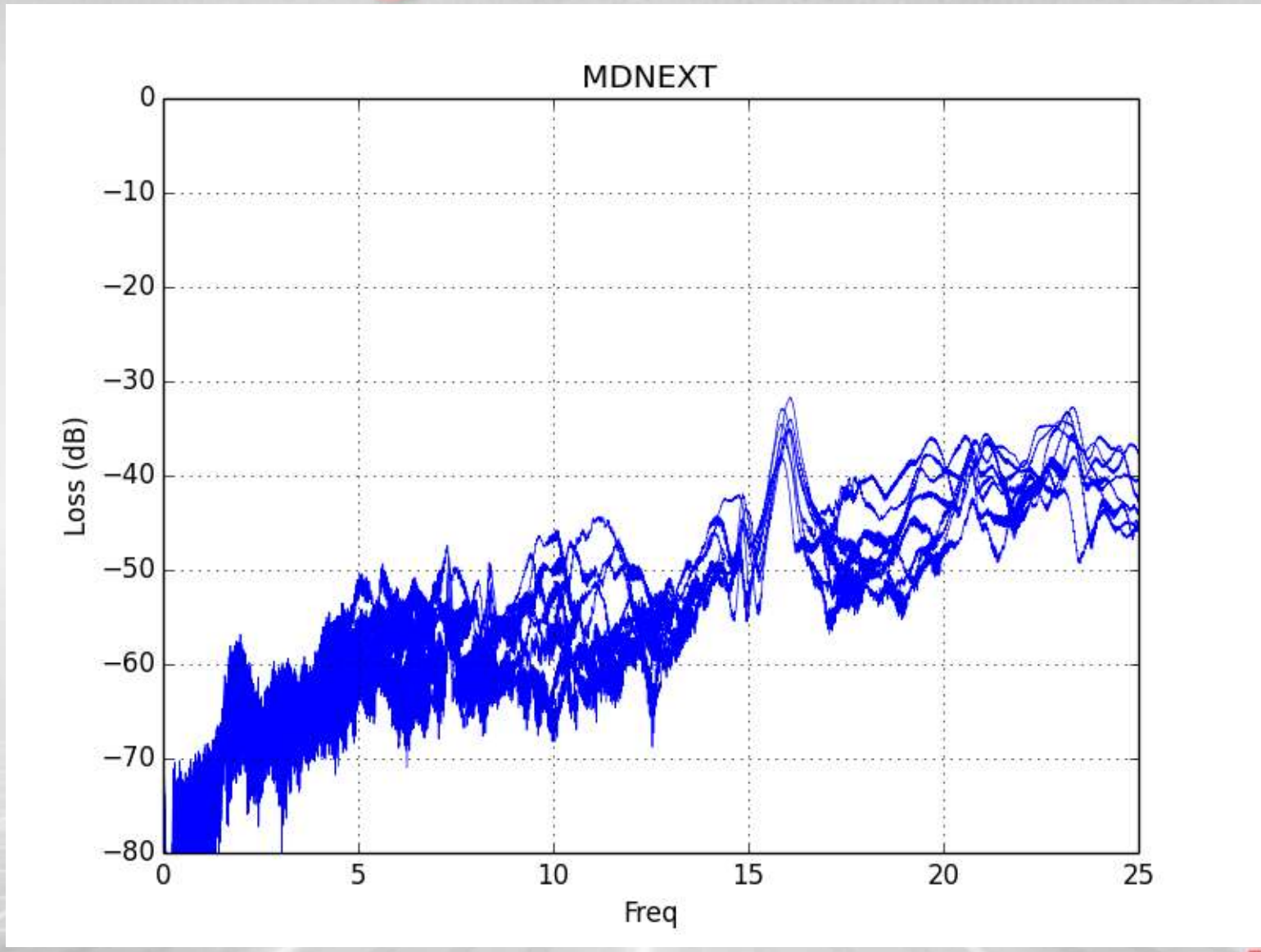


molex

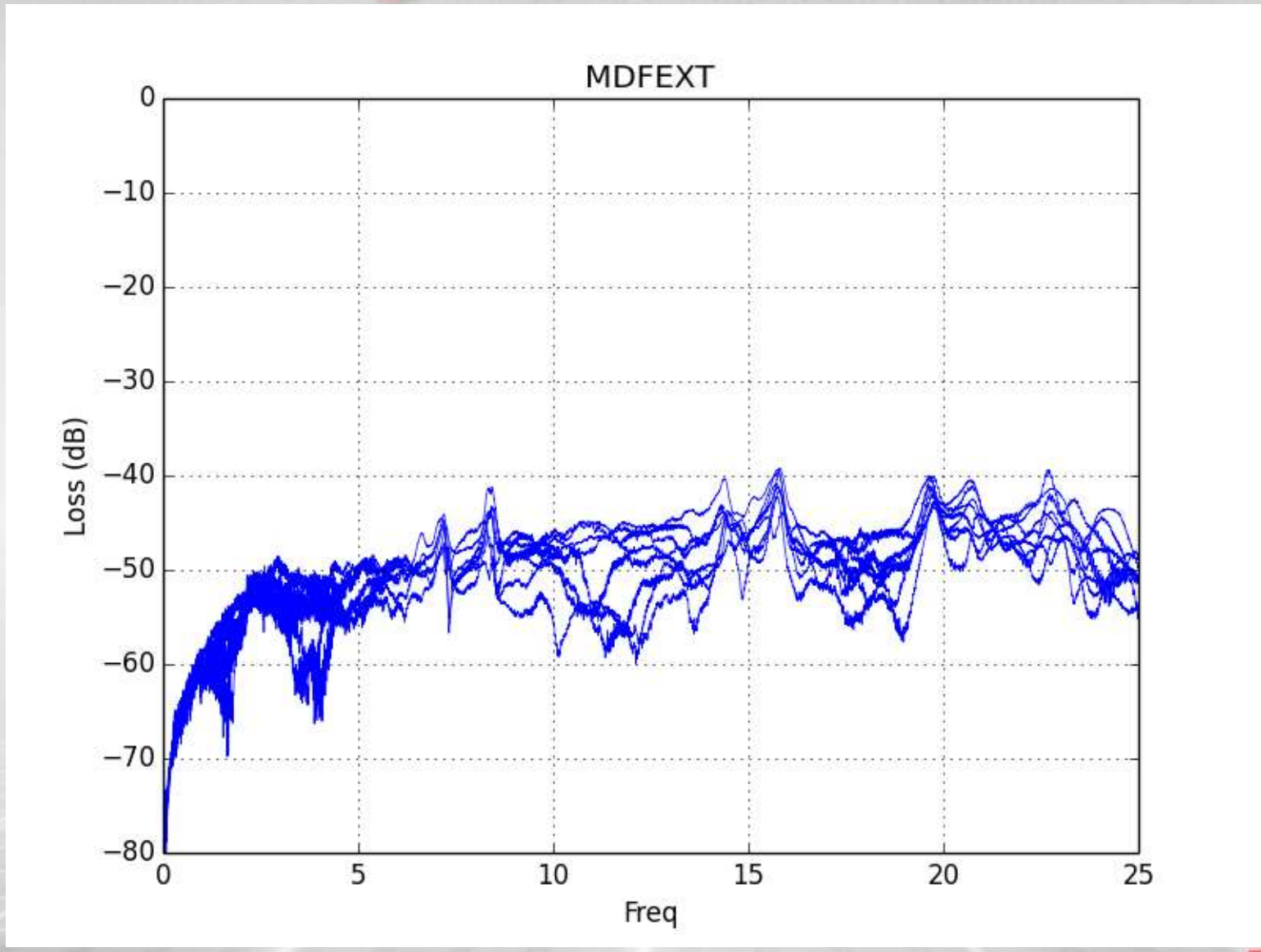
3m 26 awg – Output RL



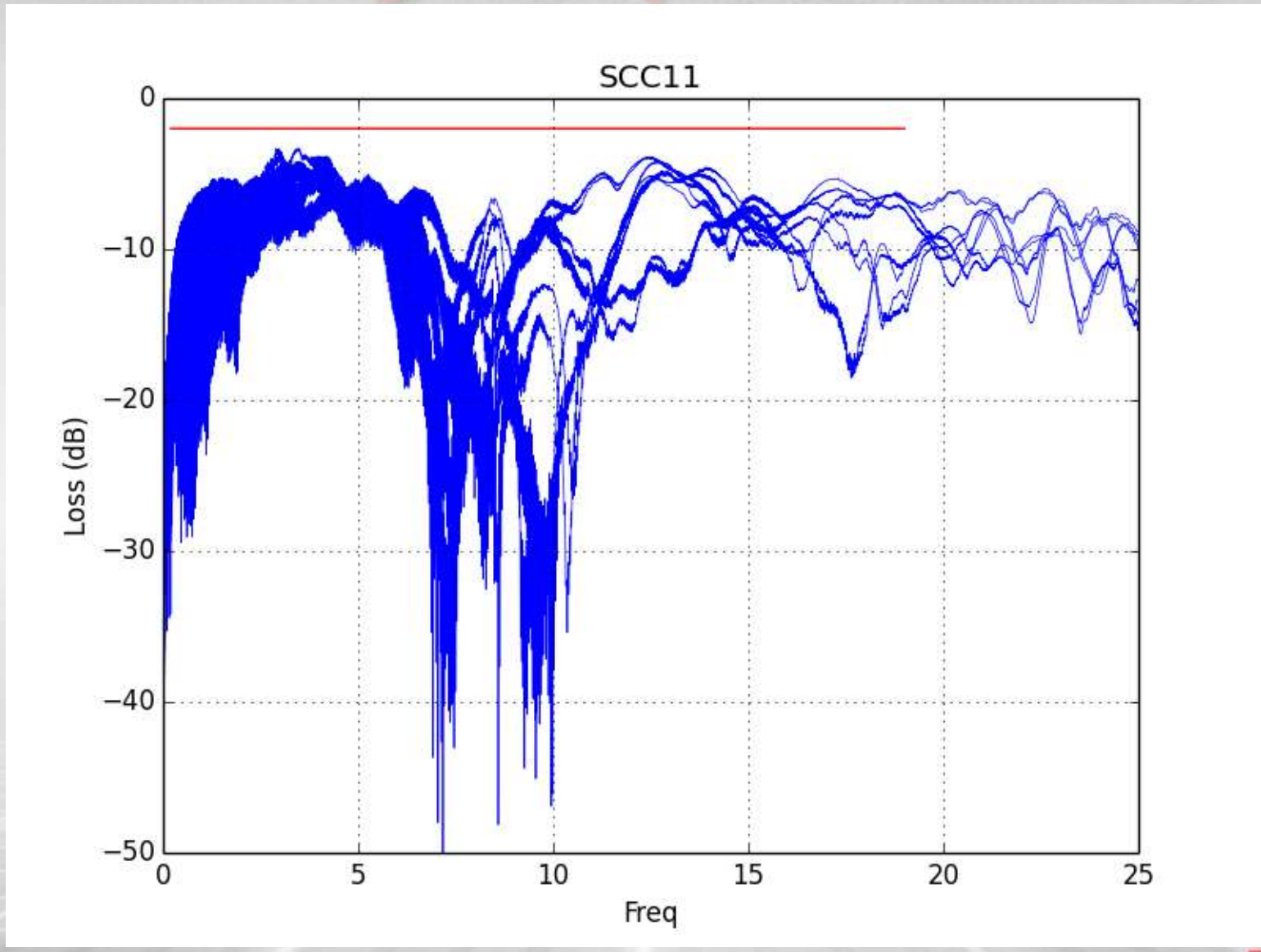
3m 26 awg – MDNEXT



3m 26 awg – MDFEXT

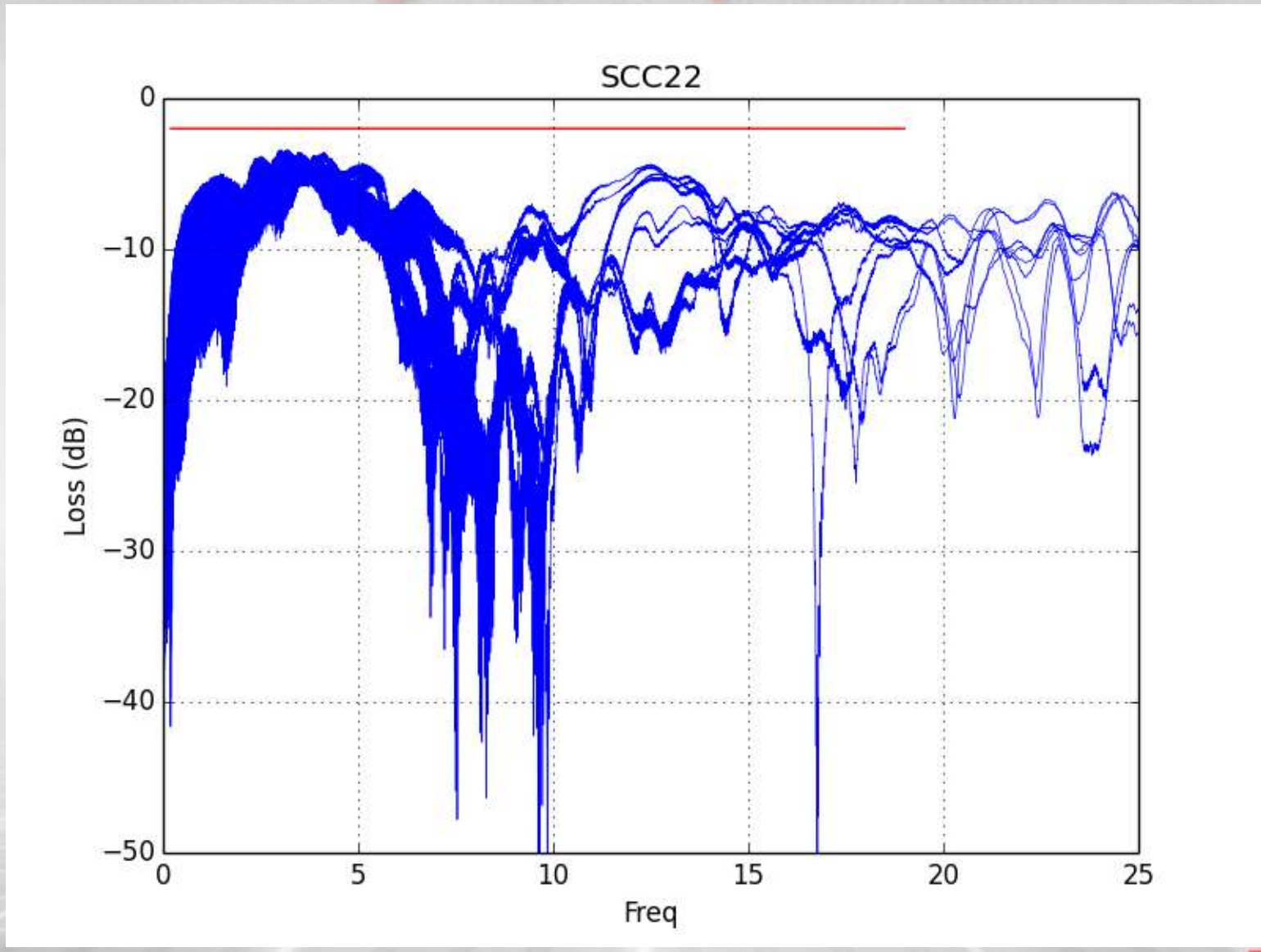


3m 26 awg – Input CM RL



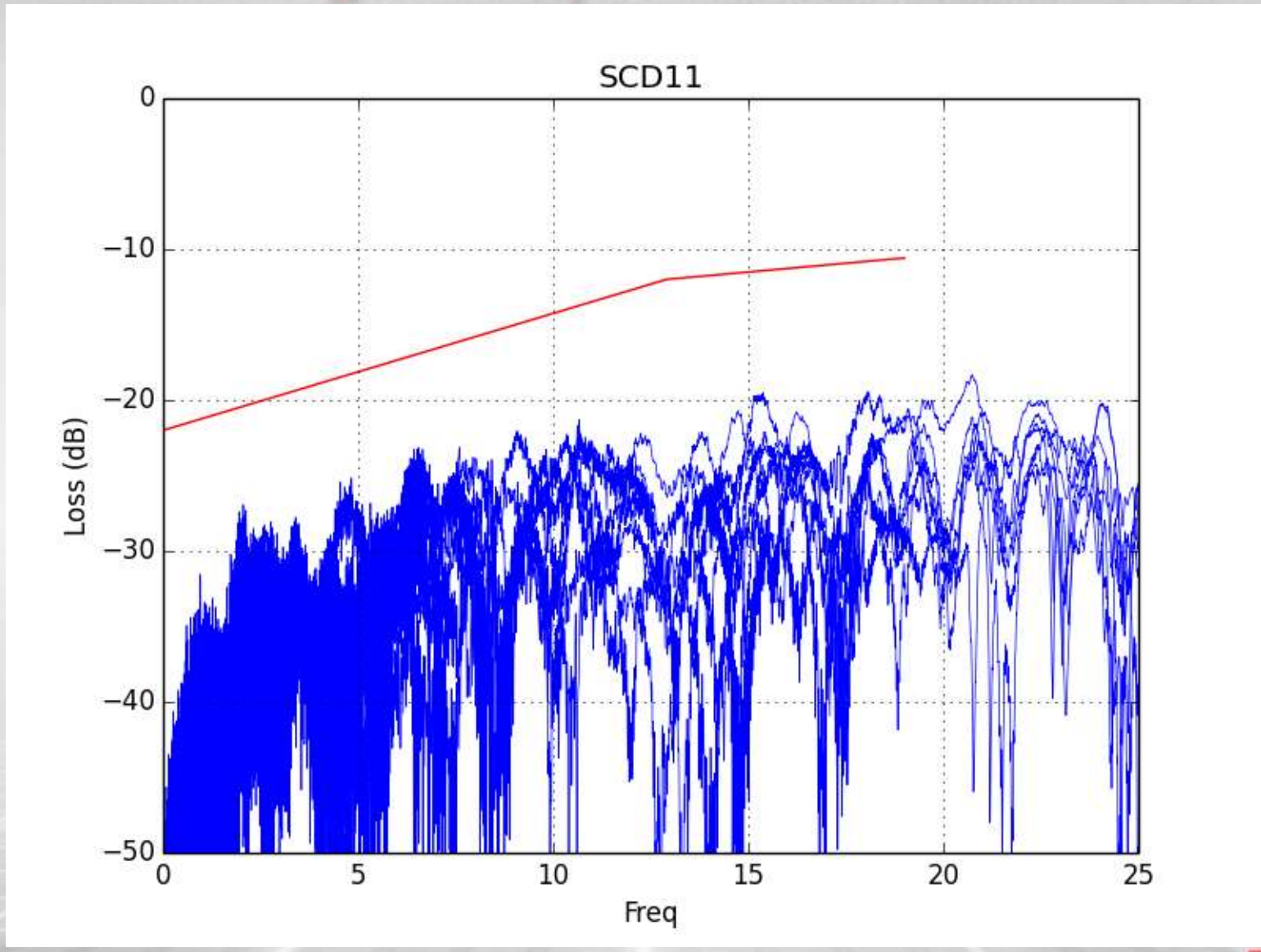
molex

3m 26 awg – Output CM RL



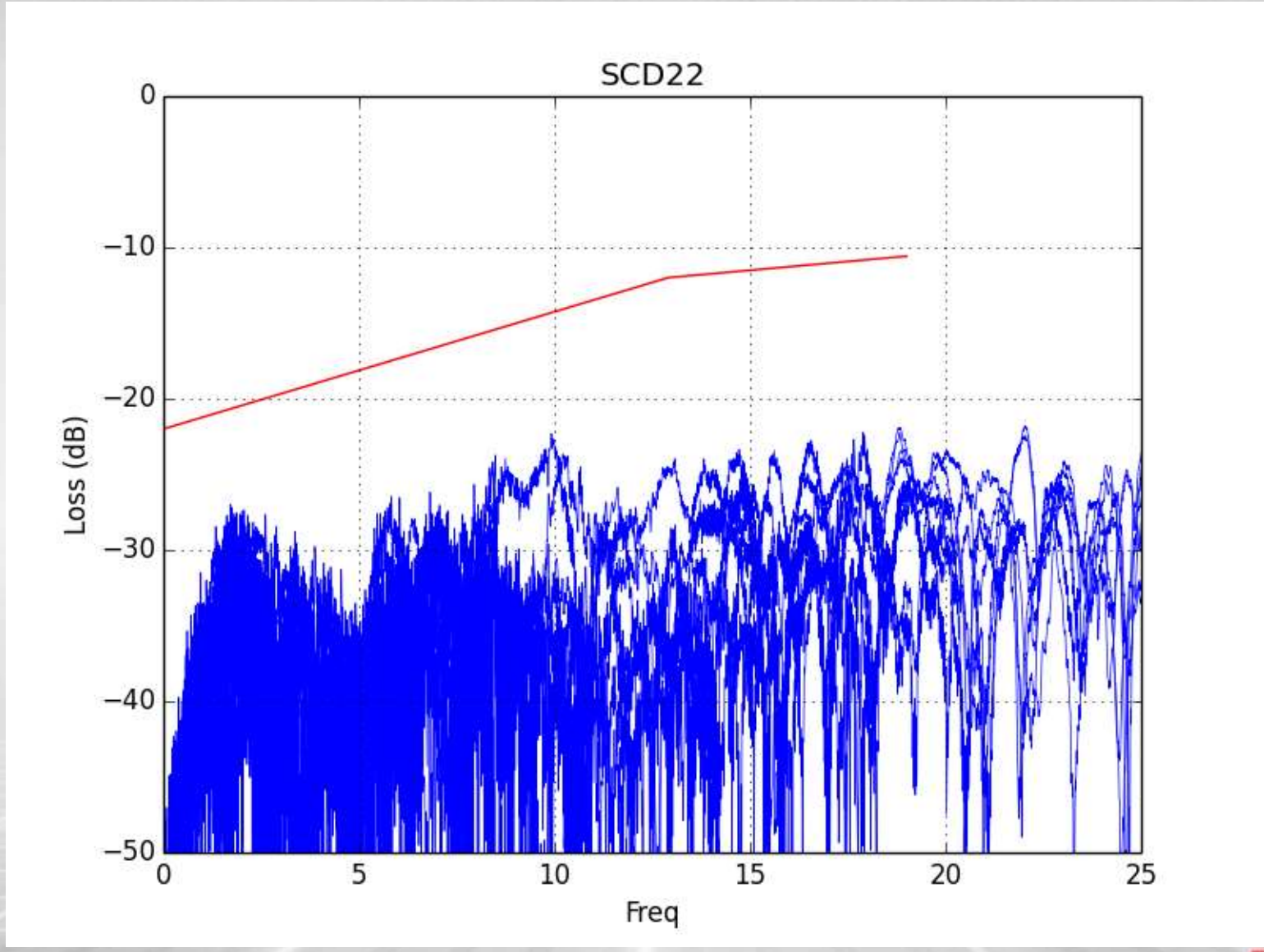
molex

3m 26 awg – Input CM to DIFF RL



molex

3m 26 awg – Output CM to DIFF RL



COM – CR4 (25G NRZ)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	7.40	6.53
P1Tx2 P2Rx2	7.23	6.30
P1Tx3 P2Rx3	7.34	6.54
P1Tx4 P2Rx4	7.37	6.51
P2Tx1 P1Rx1	7.22	6.38
P2Tx2 P1Rx2	7.40	6.55
P2Tx3 P1Rx3	7.36	6.50
P2Tx4 P1Rx4	7.44	6.60

COM – CDAUI-8 (50G PAM-4)

COM		
Pair	Case 1	Case 2
P1Tx1 P2Rx1	2.83	0.40
P1Tx2 P2Rx2	2.70	0.35
P1Tx3 P2Rx3	2.09	-0.26
P1Tx4 P2Rx4	2.00	-0.34
P2Tx1 P1Rx1	2.67	0.35
P2Tx2 P1Rx2	2.90	0.51
P2Tx3 P1Rx3	2.48	0.15
P2Tx4 P1Rx4	3.01	0.63

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Next Steps

- Upload Channel Data if requested
- Repeat COM calculations as configurations and available implementations change

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Thank You

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