Return Loss Modeling

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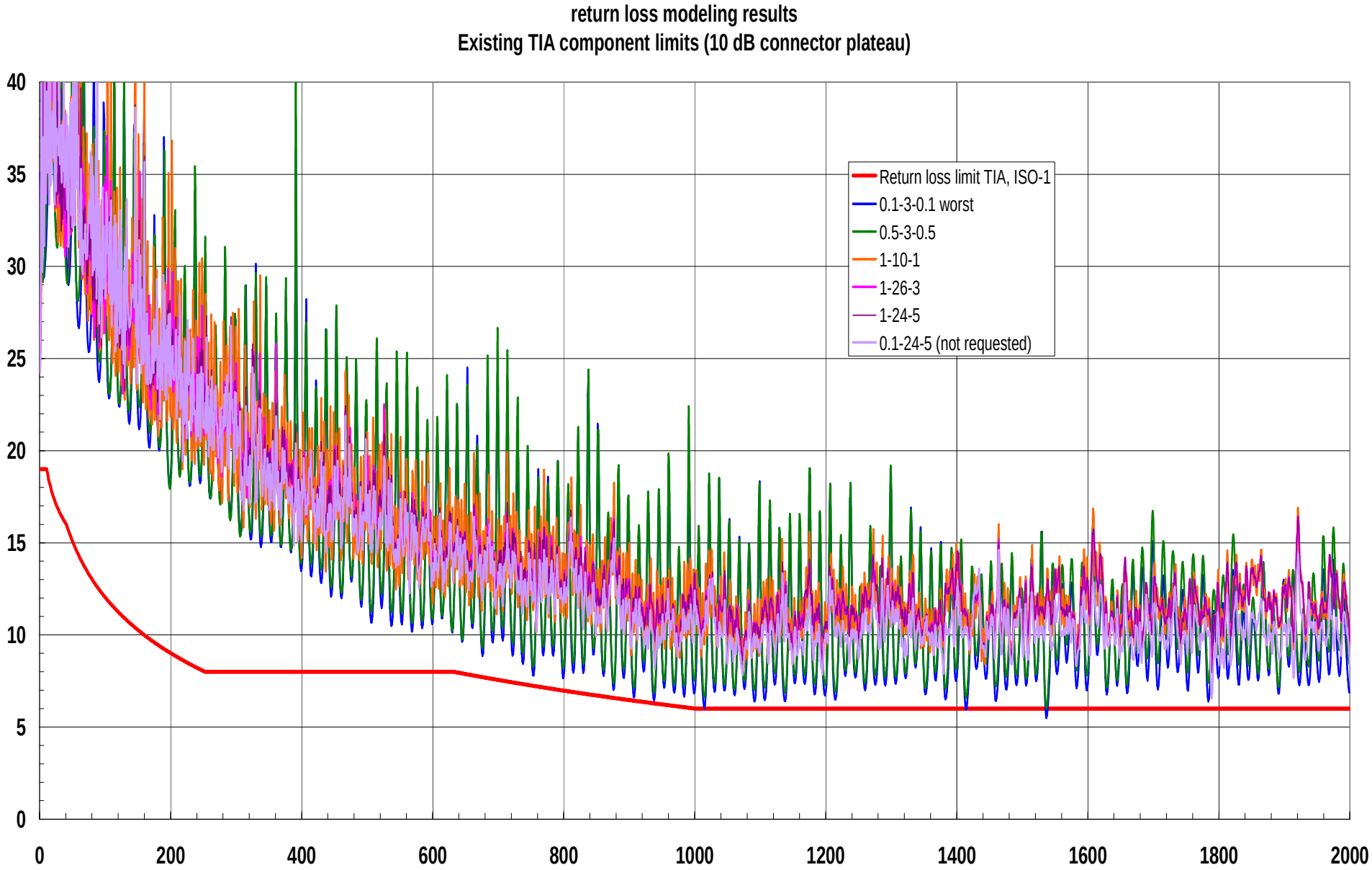
Outline of modeling procedure

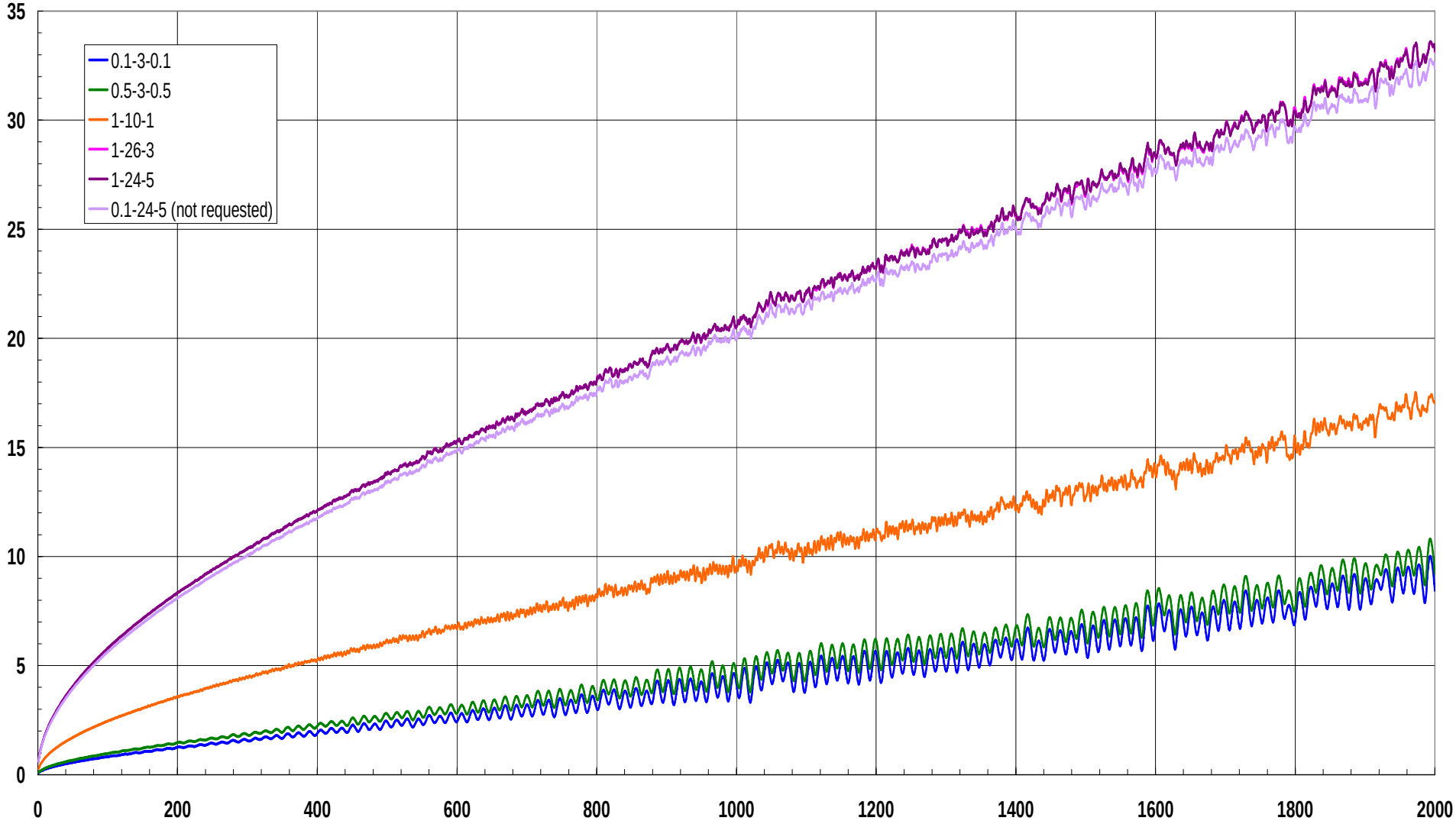
- Cable is modeled to be realistic, with random impedance and coupling variations along length, in 1 cm discrete segments.
- Connectors are modeled as worst case magnitude and physically sensible, deterministic phase.
- Channel model is made by cascading s-parameters in sequence, cable-connector-cable-connector-cable.
- Lengths of cables can be varied in certain discrete amounts.


return loss modeling results
Existing TIA component limits (10 dB connector plateau)
40
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Return loss limit TIA, ISO-1
0.1-3-0.1 worst
0.5-3-0.5
1-10-1
1-26-3
1-24-5
0.1-24-5 (not requested)

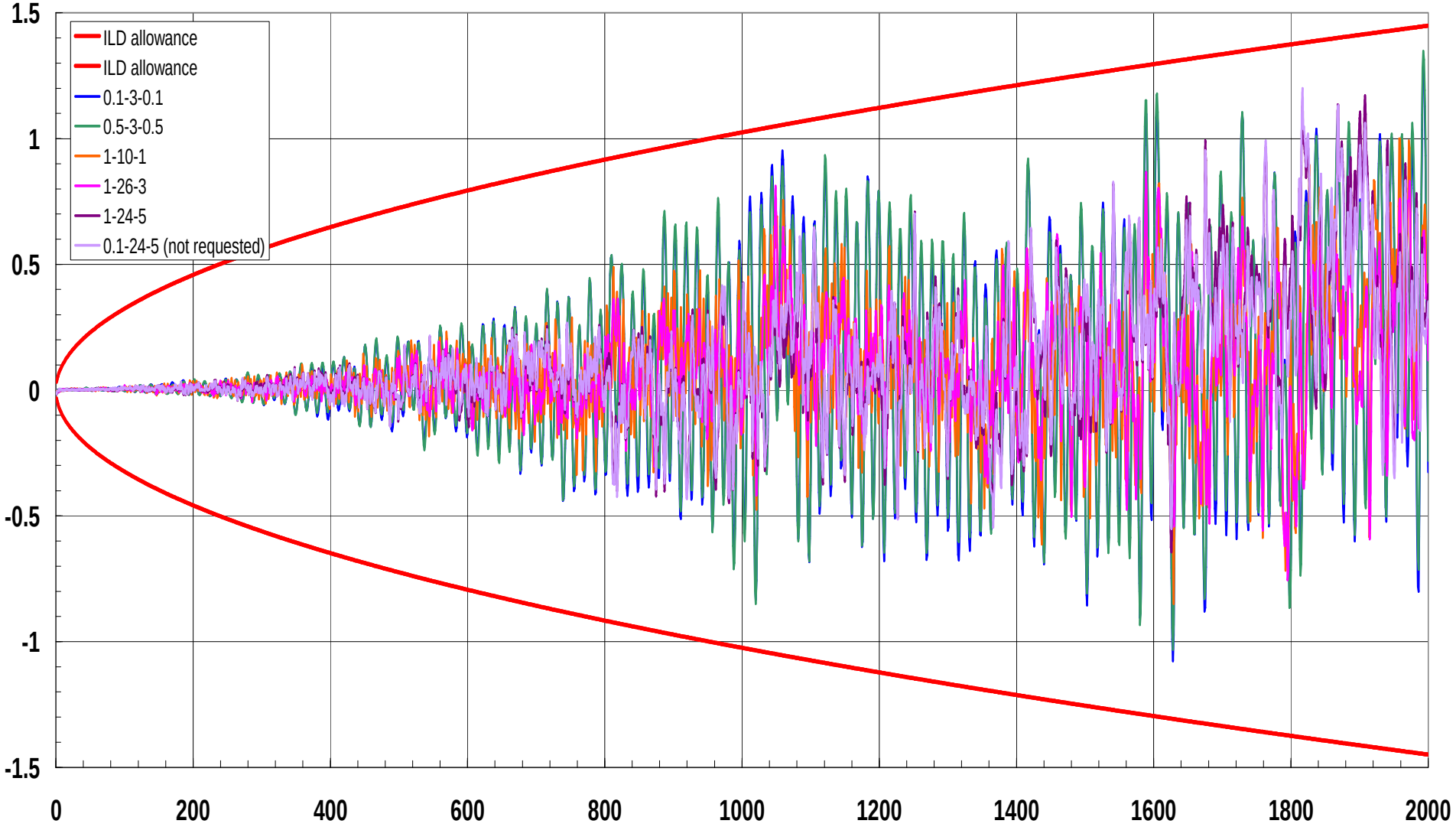
Return loss channel outcome with existing TIA component limits

- All five configurations passed except for 0.1-3-0.1
- 0.1-3-0.1 fails on some pairs, the worst pair is shown.
- 0.1-24-5 configuration was not requested, but was shown, since it is possible short patch cords may be used in long channels. It passes, but with little margin.
- Patch cord length of 0.1 instead of 0.15 was used because of a present limitation in the program and the schedule limit. This can be done again with the 0.15 length if needed.
- ILD is studied below:

Insertion loss modeling results
Existing TIA component limits (10 dB connector plateau)

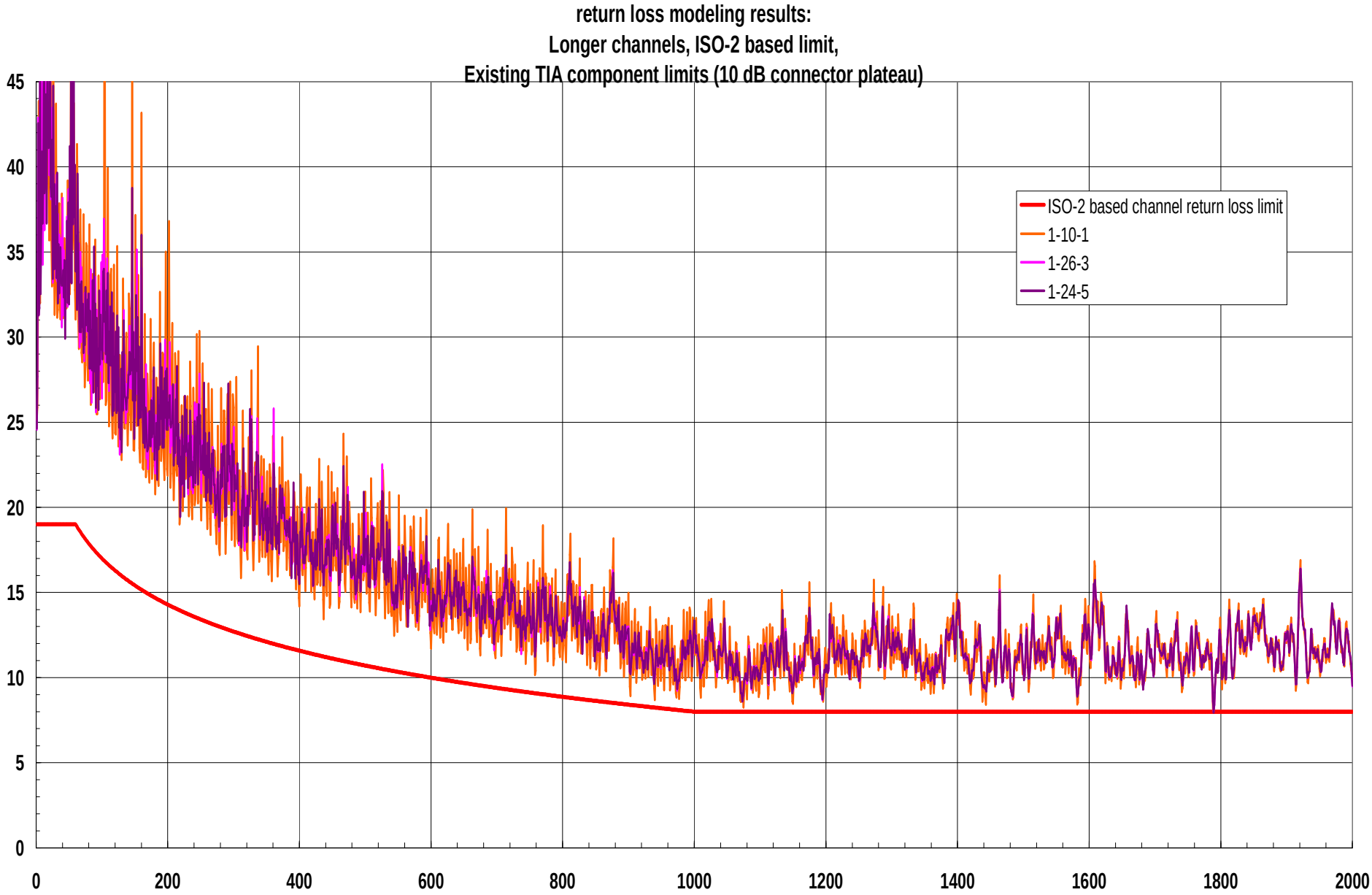


Insertion loss deviation modeling results
Existing TIA component limits (10 dB connector plateau)



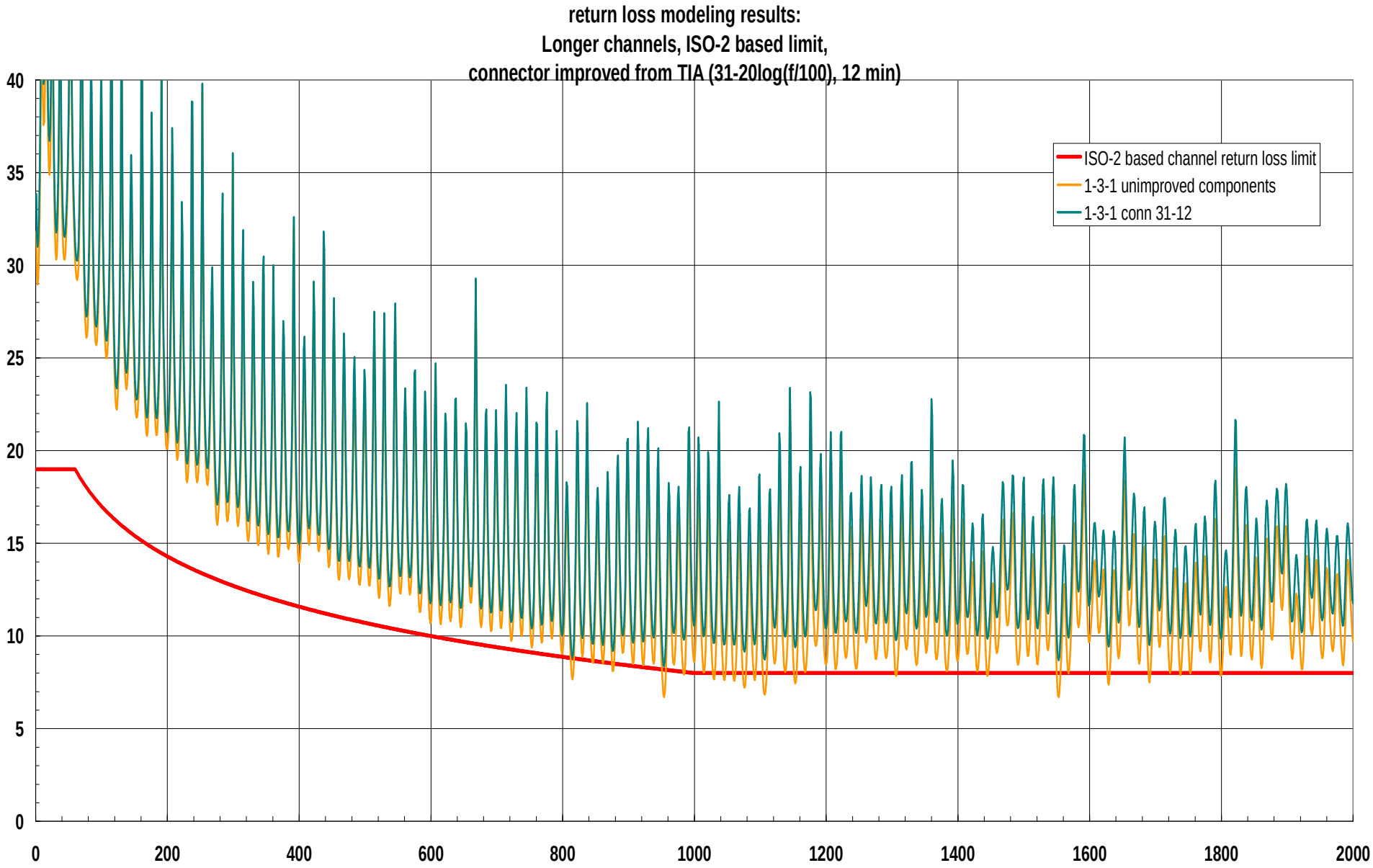
Insertion loss results

- There is a significant ILD, relatively independent of length. This is similar to ILD observed for 10GBASE-T, and hopefully will be acceptable to the PHY.
- Below the ISO-2 limit is considered. The longer channels are met with the TIA limits for the components.


return loss modeling results:
Longer channels, ISO-2 based limit,
Existing TIA component limits (10 dB connector plateau)
ISO-2 based channel return loss limit
1-10-1
1-26-3
1-24-5
45
40
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000

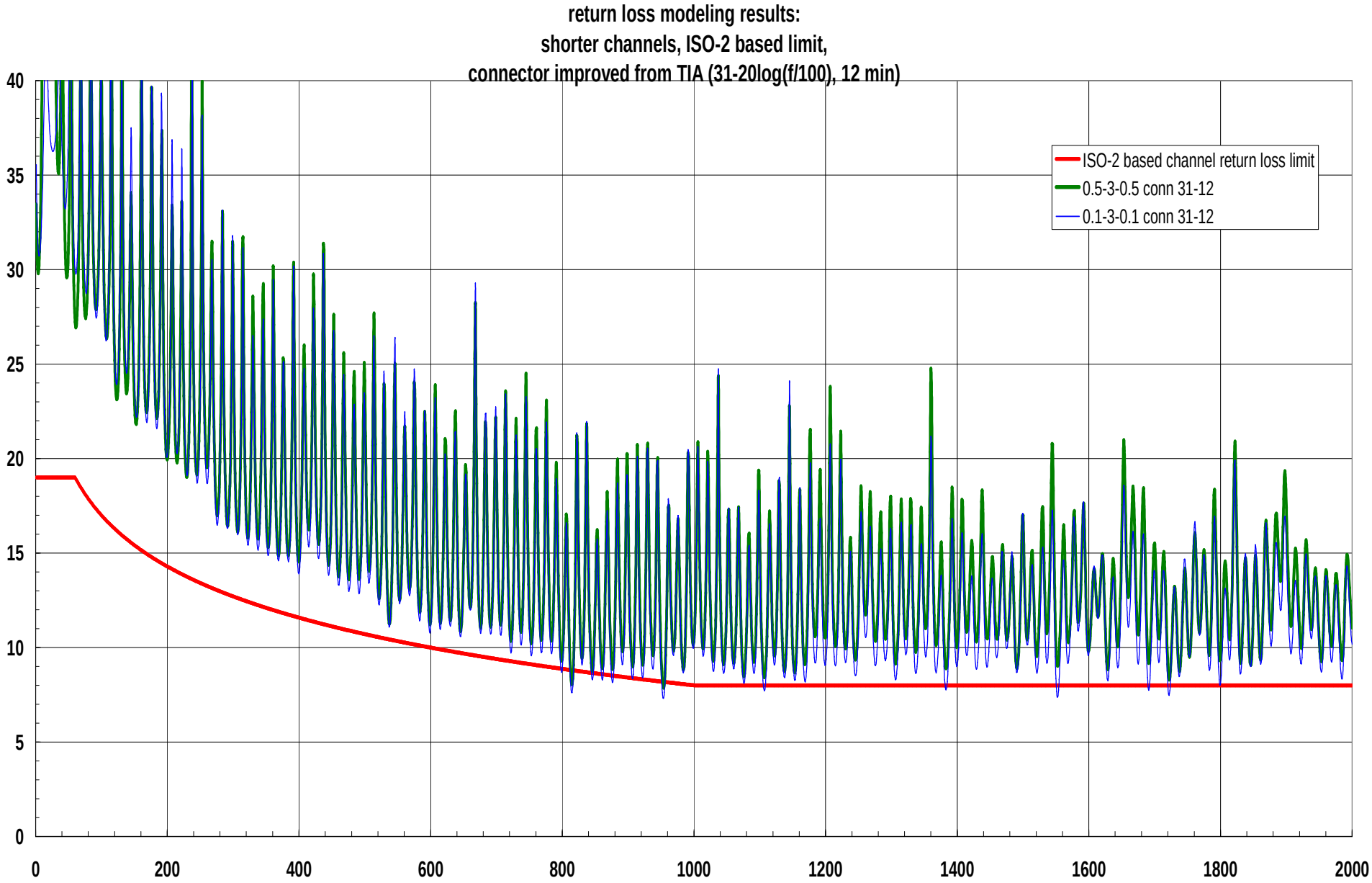
Return loss modeling results v ISO-2 based limit

- These three longer channels all pass based on the TIA component requirements and the ISO class II limits.
- Note that the limit was enhanced from the ISO-2 limit in the middle frequencies and this has no bearing on passing or failing.
- Now consider a shorter, 1-3-1 channel:


return loss modeling results:
Longer channels, ISO-2 based limit,
connector improved from TIA (31-20log(f/100), 12 min)
ISO-2 based channel return loss limit
1-3-1 unimproved components
1-3-1 conn 31-12
40
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000

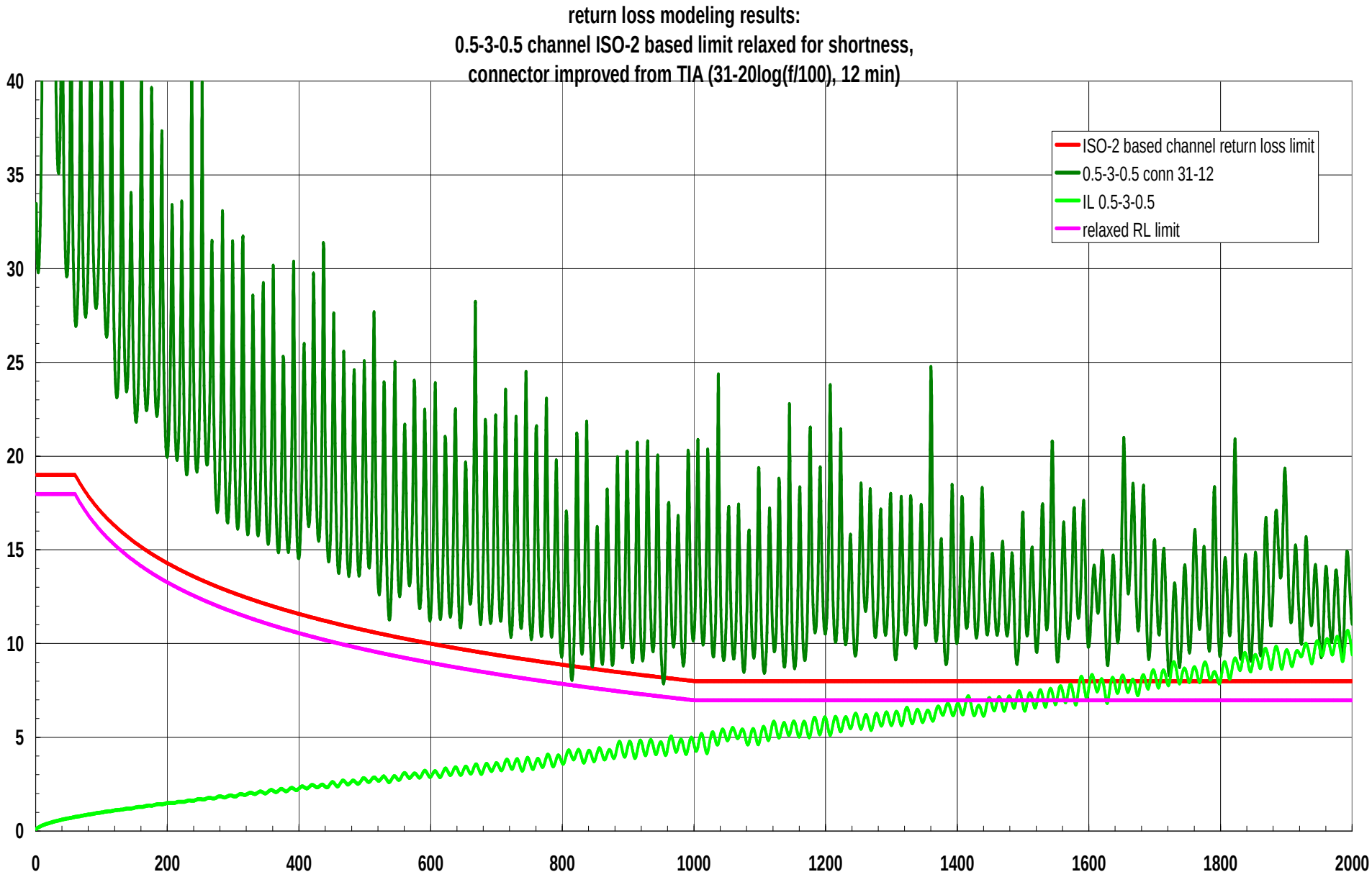
Return loss modeling results continued

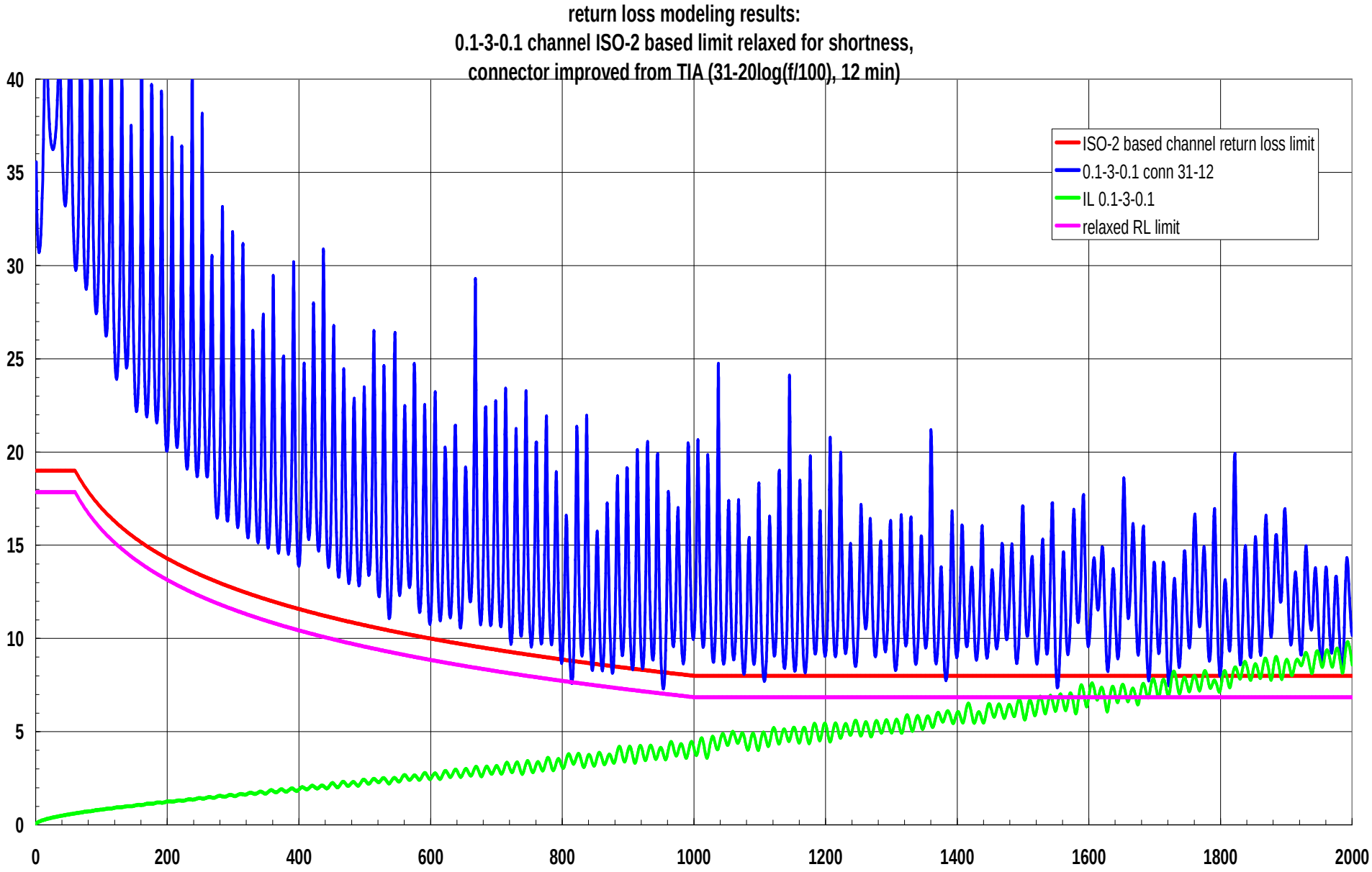
- The 1-3-1 channel was not mentioned in IEEE, but was the basis for the TIA modeling.
- To make the channel pass the ISO-2 limits, and improvement in the connector return loss requirement would be needed, as shown.
- Now consider the other short channels:


return loss modeling results:
shorter channels, ISO-2 based limit,
connector improved from TIA (31-20log(f/100), 12 min)
ISO-2 based channel return loss limit
0.5-3-0.5 conn 31-12
0.1-3-0.1 conn 31-12
40
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000

What to do about short channels?

- Consider a limit which is relaxed when the channel is short
  - Considerably less IL than long channels will assure PHY margin
  - A length dependant term would provide a gradual change
  - Consider subtracting 0.312(6.081-IL(500 MHz)) whenever IL at 500 MHz is less than 6.081
  - This corresponds to a length of 12 m.


return loss modeling results:
0.5-3-0.5 channel ISO-2 based limit relaxed for shortness,
connector improved from TIA (31-20log(f/100), 12 min)
ISO-2 based channel return loss limit
0.5-3-0.5 conn 31-12
IL 0.5-3-0.5
relaxed RL limit
40
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000


return loss modeling results:
0.1-3-0.1 channel ISO-2 based limit relaxed for shortness,
connector improved from TIA (31-20log(f/100), 12 min)
ISO-2 based channel return loss limit
0.1-3-0.1 conn 31-12
IL 0.1-3-0.1
relaxed RL limit
40
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000