Comment 317

Stephan Schreiner
Rosenberger Hochfrequenztechnik GmbH & Co. KG
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Purpose

- Support of Comment 317 regarding Mixing Segment Return Loss

Return Loss TCI and Channel

Current proposal

- **Return loss TCI:**
  - Equation was proposed in diminico_SPMD_01_0524.pdf and incoperated into Draft 1.3
 - Measurement Points at „TC1" and „TC2"

$$RL(f) \geq \begin{cases} -0.3 + 13f & 0.3 \leq f < 1.7 \\ -38.55 - 50.28 \log_{10} f - \dfrac{3.16}{f} + 69.31\sqrt{f} - 10.19f + 0.0636f^2 & 1.7 \leq f \leq 40 \end{cases} dB$$

- **Return loss channel**
  - Equation was proposed in diminico_SPMD_01a_0724.pdf and incoperated into Draft 1.4
  - Measurement Points at „End Termination"

$$RL(f) \geq \begin{cases} 0.8 & 0.3 \leq f < 1.6 \\ 7.34f - 10.21 & 1.6 \leq f < 2.8 \\ -42.5 - 20 \log_{10}(f) - \dfrac{0.024}{f} + 47.5\sqrt{f} - 6.39f + 0.0259f^2 & 2.8 \leq f \leq 40 \end{cases} dB$$

- **Crossing between TCI return loss and channel return loss indicates an issue at the construction of the channel return loss**
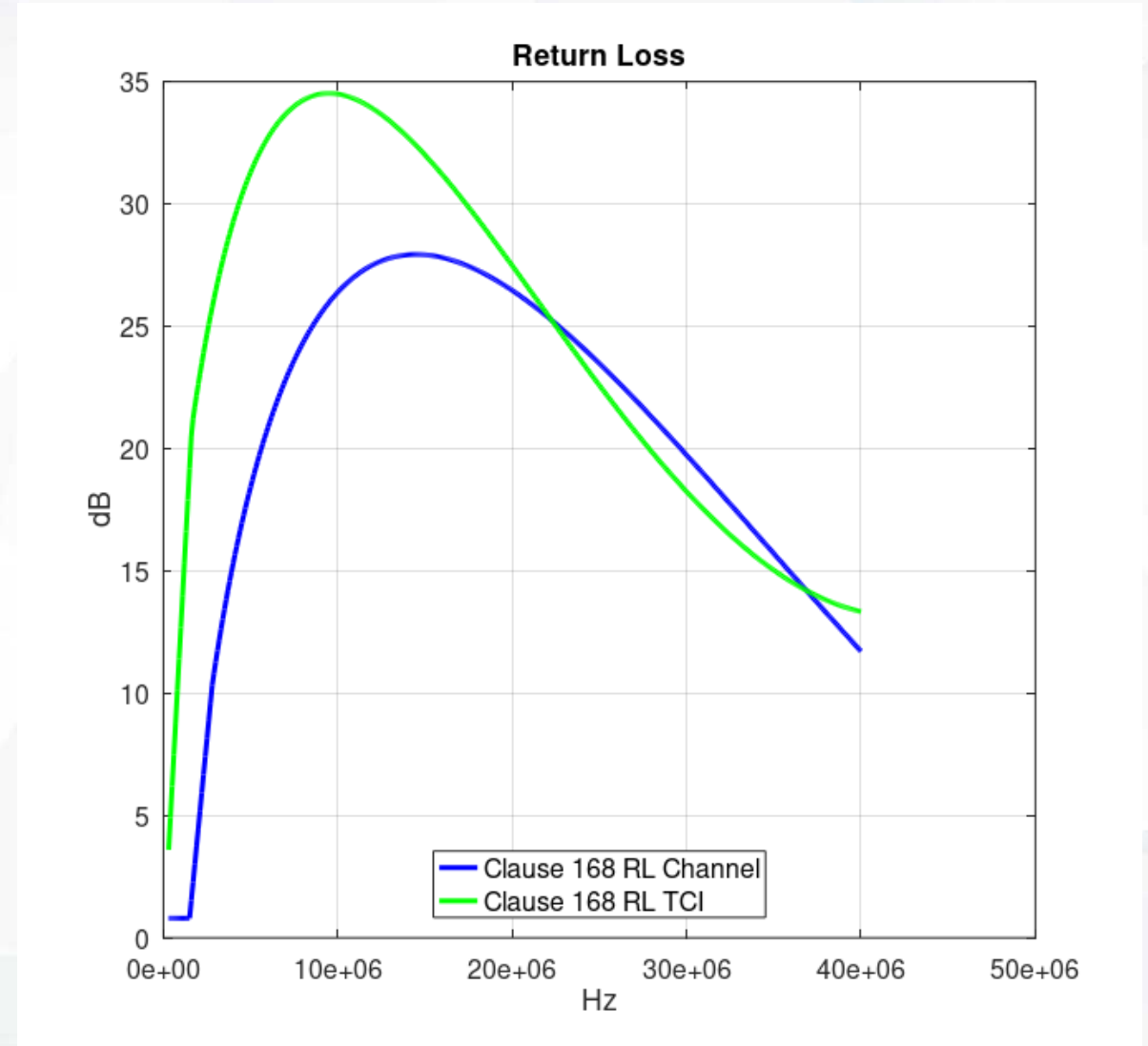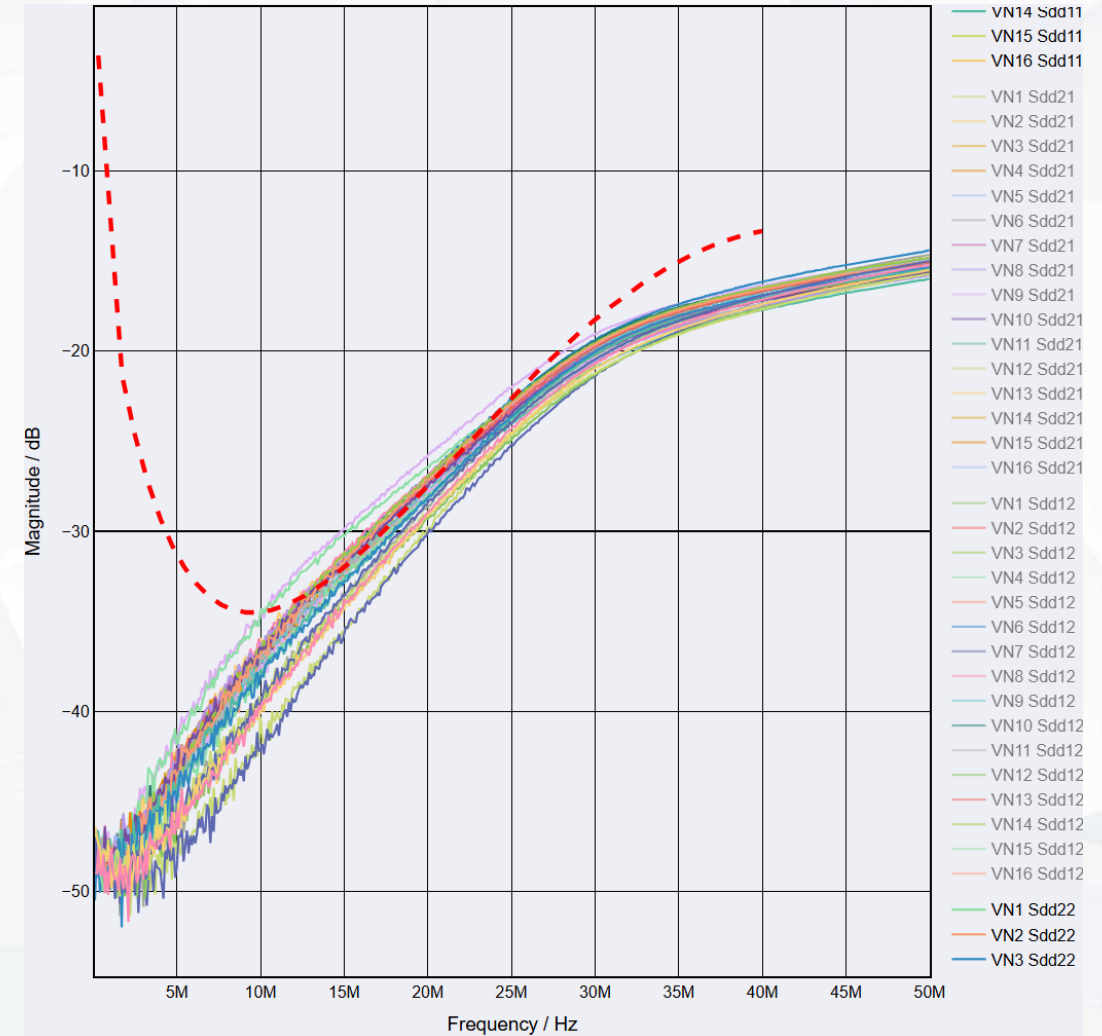
Measurement Arbitrary Channels

16 close to limit Node / TCI combination

- Created 16 Node / TCI combinations which are close to limit
  - 16 Nodes are assembled to be close to the limit
  - All Nodes are without inductor, because introducing an inductor makes it very hard to get a curve close to limit
- Nodes
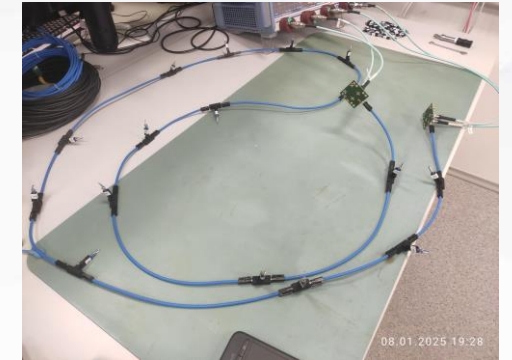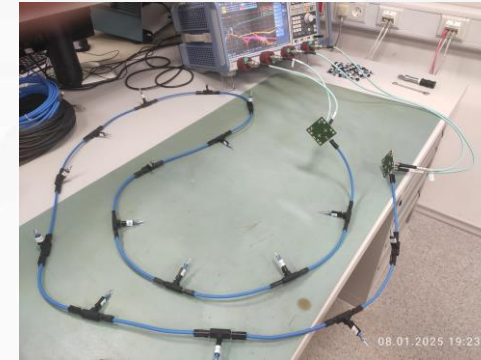

S_{DD11} and S_{DD22} of TCIs

Measurement Arbitrary Channels

Different Channels constructed from Node / TCI combinations

- **Create 16 Node / TCI combinations which are close to limit**
  - 16 Nodes are assembled to be close to the limit
  - All Nodes are without inductor, because introducing an inductor makes it very hard to get a curve close to limit
- **Multliple channel configurations are created**

Distance between Nodes [m]:

VN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2	**0.5**	**0.5**	0.2	0.2	**0.5**	0.2	0.2	0.2	0.2	**0.5**	0.2	0.2	**0.5**	0.2	0.2
3	0.5	0.5	0.2	**34.5**	0.5	0.2	0.2	0.2	0.2	0.5	0.2	0.2	0.5	0.2	0.2
4	0.5	0.5	0.2	34.5	0.5	0.2	0.2	0.2	0.2	0.5	0.2	0.2	0.5	**4**	0.2
5	0.5	0.5	0.2	34.5	0.5	**4**	0.2	0.2	0.2	0.5	0.2	0.2	0.5	4	0.2
6	**34.5**	0.5	0.2	**0.5**	0.5	4	0.2	0.2	0.2	0.5	0.2	0.2	0.5	4	0.2
7	34.5	0.5	0.2	0.5	0.5	4	0.2	0.2	**1.5**	0.5	0.2	0.2	0.5	4	0.2

Measurement Arbitrary Channels
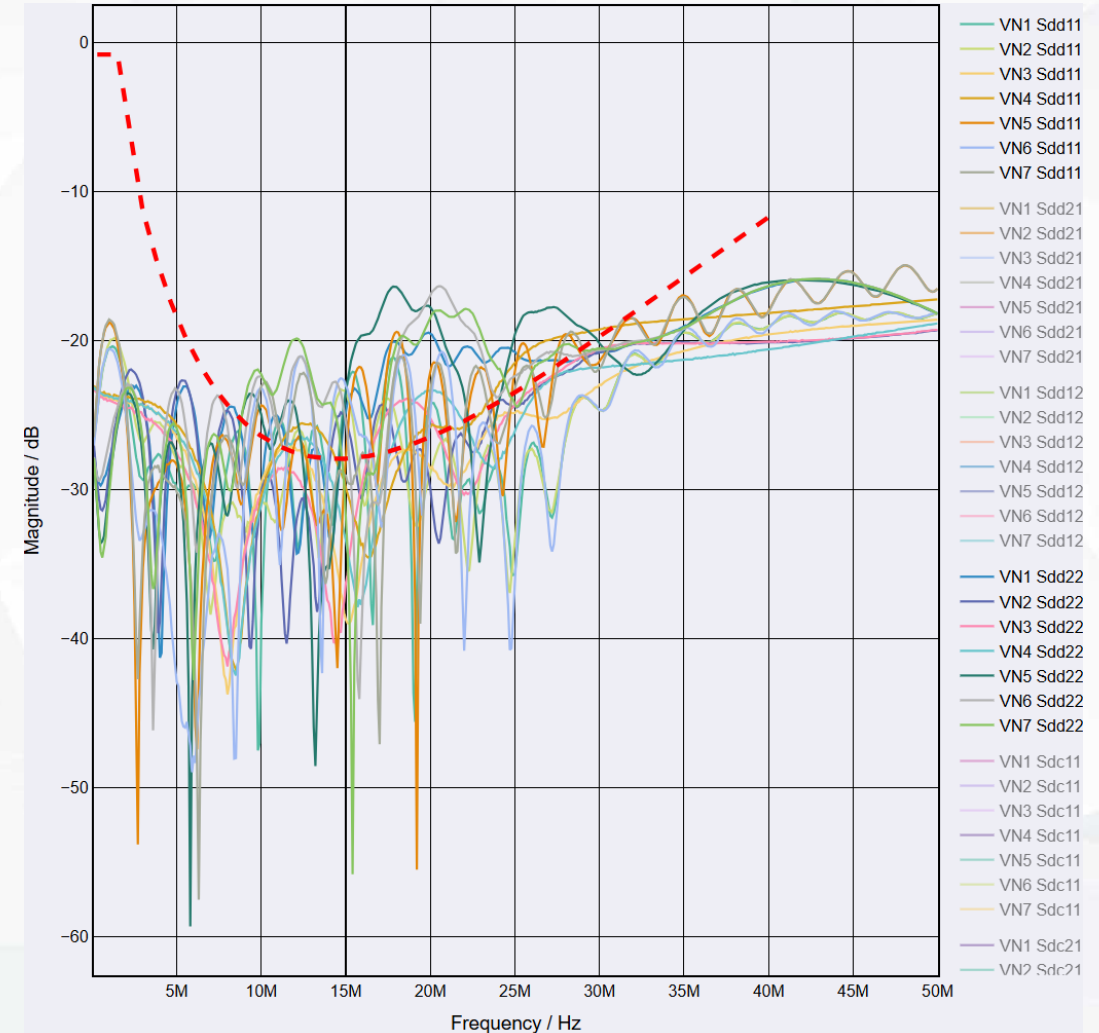## Different Channels constructed from Node / TCI combinations

- Create 16 Node / TCI combinations which are close to limit
  - 16 Nodes are assembled to be close to the limit
  - All Nodes are without inductor, because introducing an inductor makes it very hard to get a curve close to limit
- Multliple channel configurations are measured

Distance between Nodes [m]:

VN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2	**0.5**	**0.5**	0.2	0.2	**0.5**	0.2	0.2	0.2	0.2	**0.5**	0.2	0.2	**0.5**	0.2	0.2
3	0.5	0.5	0.2	**34.5**	0.5	0.2	0.2	0.2	0.2	0.5	0.2	0.2	0.5	0.2	0.2
4	0.5	0.5	0.2	34.5	0.5	0.2	0.2	0.2	0.2	0.5	0.2	0.2	0.5	**4**	0.2
5	0.5	0.5	0.2	34.5	0.5	**4**	0.2	0.2	0.2	0.5	0.2	0.2	0.5	4	0.2
6	**34.5**	0.5	0.2	**0.5**	0.5	4	0.2	0.2	0.2	0.5	0.2	0.2	0.5	4	0.2
7	34.5	0.5	0.2	0.5	0.5	4	0.2	0.2	**1.5**	0.5	0.2	0.2	0.5	4	0.2

- **Channel return loss is significant above limit**

S_{DD11} and S_{DD22} of Channels
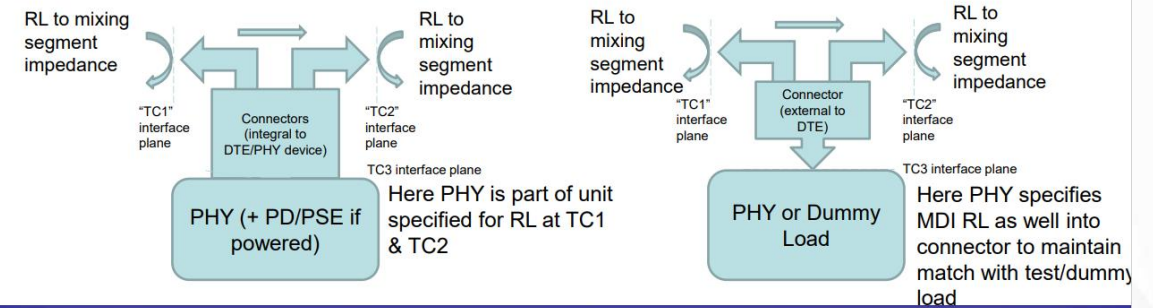
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Channel Limits

- **TCI return loss**
  - https://www.ieee802.org/3/da/public/0324/zimmerman_3da_01_031224.pdf
  - ➢ P. 10 „Reflected energy at TC1 and TC2 determines ISI"
  - ➢ P. 25 „13dB SINR required, 27 dB RL minimum, recommended 34 dB RL, not more than 42dB"

  - https://www.ieee802.org/3/da/public/0524/zimmerman_3da_01a_052024.pdf
  - ➢ P. 4 „Combined Reflections must be within noise budget"
  - ➢ P. 7 „Impact of noise sources falls off below 3 MHz, above 16 MHz"
  - ➢ Assumption: ISI Noise is adding up as mixture of power and voltages
  - ➢ The resulting ISI Noise, based on 16 Nodes, have to be below the required 13dB of SINR

Source: https://www.ieee802.org/3/da/public/0324/zimmerman_3da_01_031224.pdf

Channel Limits

- TCI return loss
  - https://www.ieee802.org/3/da/public/0324/zimmerman_3da_01_031224.pdf
  - P. 10 „Reflected energy at TC1 and TC2 determines ISI"
  - P. 25 „13dB SINR required, 27 dB RL minimum, recommended 34 dB RL, not more than 42dB"

  - https://www.ieee802.org/3/da/public/0524/zimmerman_3da_01a_052024.pdf
  - P. 4 „Combined Reflections must be within noise budget"
  - P. 7 „Impact of noise sources falls off below 3 MHz, above 16 MHz"
  - Assumption: ISI Noise is adding up as mixture of power and voltages
  - The resulting ISI Noise, based on 16 Nodes, have to be below the required 13dB of SINR

- Channel return loss
  - Each TCIs RL contributes to the channel RL
  - Under the Assumption: The reflection of each TCI adds up as power during measurement, reflected power is missing at input of next TCI
    (This assumption is typically not used for S-Parameters)

$$RL_{CH}(f) = -10 \cdot \log_{10}\left(\sum_{n=0}^{N-1}\left(\left(1 - 10^{\frac{-RL_{TCI}}{10}}\right)^n \cdot \left(10^{\frac{-RL_{TCI}}{10}}\right)\right)\right)$$

  - $N = 15$: *All nodes power sum (optimistic)*
  - $N = 23$: *Additional small margin*
  - $N = 31$: *Additional increased margin*

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S_{DD11} and S_{DD22} of Channels
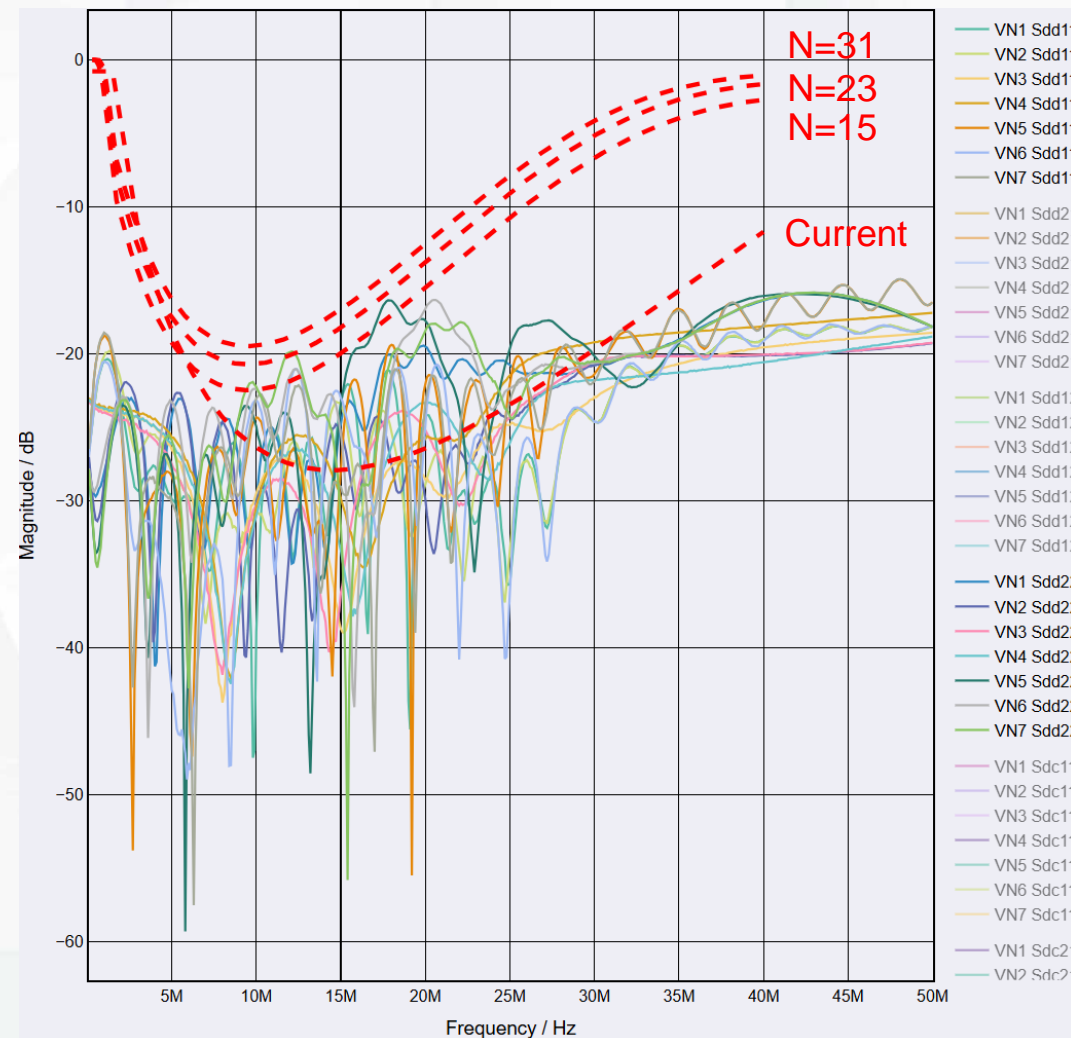
Apply Curve Fitting

Current:

$$RL(f) \geq \begin{cases} 0.8 & 0.3 \leq f < 1.6 \\ 7.34f - 10.21 & 1.6 \leq f < 2.8 \\ -42.5 - 20\log_{10}(f) - \dfrac{0.024}{f} + 47.5\sqrt{f} - 6.39f + 0.0259f^2 & 2.8 \leq f \leq 40 \end{cases} \; dB$$

Equation for Fit:

$$RL(f) = -10 \cdot \log_{10}\left(\sum_{n=0}^{N-1} \left(\left(1 - 10^{\frac{-RL_{TCI}}{10}}\right)^n \cdot \left(10^{\frac{-RL_{TCI}}{10}}\right) \right) \right) \; with \; N = 31$$
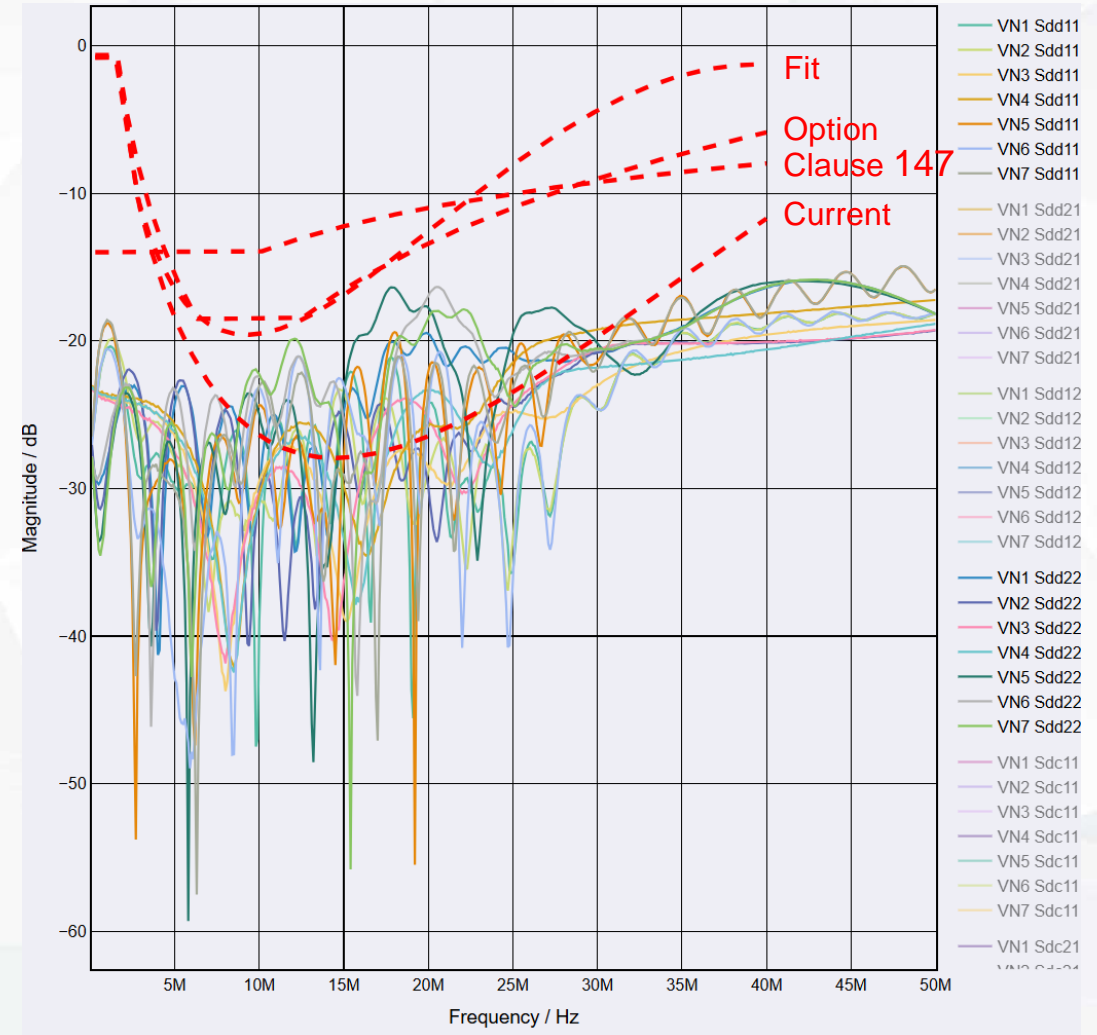
Fit:

$$RL(f) \geq \begin{cases} 0.8 & 0.3 \leq f < 1.6 \\ 7.91f - 11.85 & 1.6 \leq f < 2.8 \\ -43.3 - 20\log_{10}(f) - \dfrac{0.97}{f} + 51.9\sqrt{f} - 8.73f + 0.061f^2 & 2.8 \leq f \leq 40 \end{cases} \; dB$$

Option:

$$RL(f) \geq \begin{cases} 0.65 & 0.3 \leq f < 1.6 \\ 0.65 + 30\log_{10}\left(\dfrac{f}{1.6}\right) & 1.6 \leq f < 6.4 \\ 18.5 & 6.4 \leq f \leq 12.5 \\ 18.5 - 25\log_{10}\left(\dfrac{f}{12.5}\right) & 12.5 \leq f \leq 40 \end{cases} \; dB$$

S_{DD11} and S_{DD22} of Channels

Summary

- ## Comment 317
  - Current channel return loss value can't be fulfilled
  - A proposal for a more feasible channel return loss is given
  - I would highly appreciate some help to improve the return loss equation

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