Proposed frequency mask equations and figures for electrical PMDs, AUIs, and test fixtures

Associated comments: 374, 527, 378, 379, 380, 387, 388, 393, 445

Adee Ran, Cisco

Supporter’s corner

- Howard Heck, Intel

Goal and disclaimers

- Provide proposed equations and figures for frequency-mask parameters, replacing TBDs
  - Some of the proposed equations are based on existing ones in 802.3ck, with frequency scaling
  - Others are based on mated test fixtures S-parameters contributed by Steve Sekel and Ray Schmelzer (sekel_3dj_02_2407)
  - DUT specs should be relaxed relative to test fixture specs
- Frequency masks extend up to 60 GHz
  - Based on value adopted for 178.9.2.3, following comment #242 against D1.0
  - Note that the recommendation for channel measurements may be to a higher frequency, e.g. 67 GHz. These are not necessarily related
- No analysis was done on the combined effect of different specs
- This presentation does not address the importance of specific masks, feasibility of meeting them, or completeness of the specifications.

Comment #374: 178.9.3.6, KR Receiver RLcd

Proposed Equation (178–4):

$$RL_{cd}(f) \geq \begin{cases} 25 - 20(f/106.25) & 0.05 \leq f \leq 53.125 \\ 15 & 53.125 \leq f \leq 60 \end{cases}$$

Comment # 527 suggests the same equation with upper frequency limit of 106.25 GHz

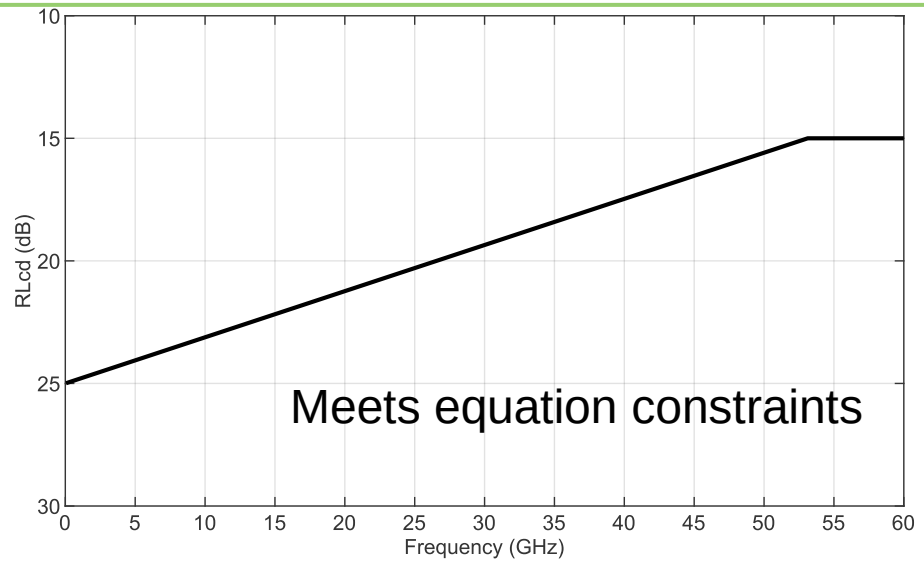


Figure 178–5

Frequency scaling

Corresponding equation and figure in clause 163:

$$RLcd(f) \geq \begin{cases} 25 - 20(f/53.125) & 0.05 \leq f \leq 26.5625 \\ 15 & 26.5625 < f \leq 53.125 \end{cases} \quad (163\text{–}2)$$

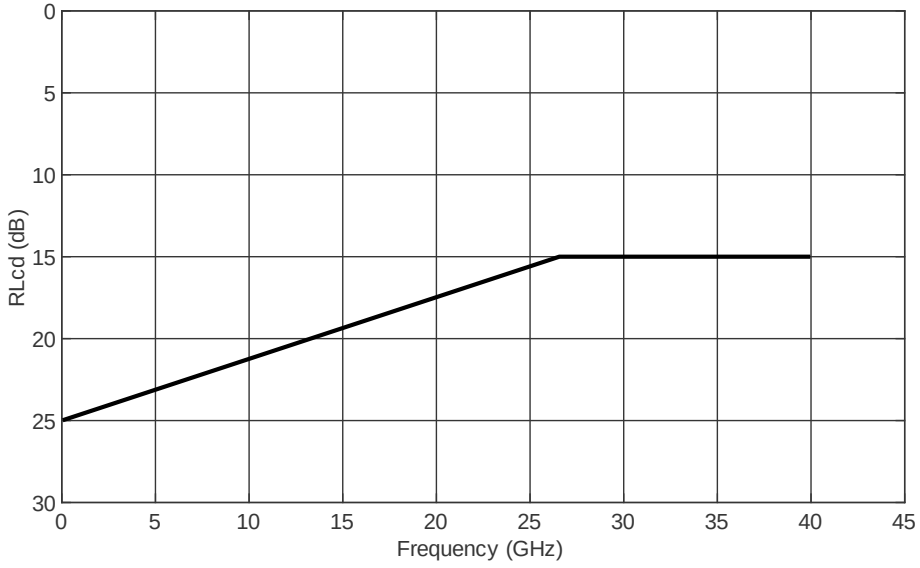


Figure 163–5

Comment #378: 178.10.4, KR channel RLcd

Proposed Equation (178–6):

$$RL_{cd}(f) \geq \begin{cases} 22 - 10(f/53.125) & 0.05 \leq f \leq 53.125 \\ 15 - 3(f/53.125) & 53.125 \leq f \leq 60 \end{cases}$$

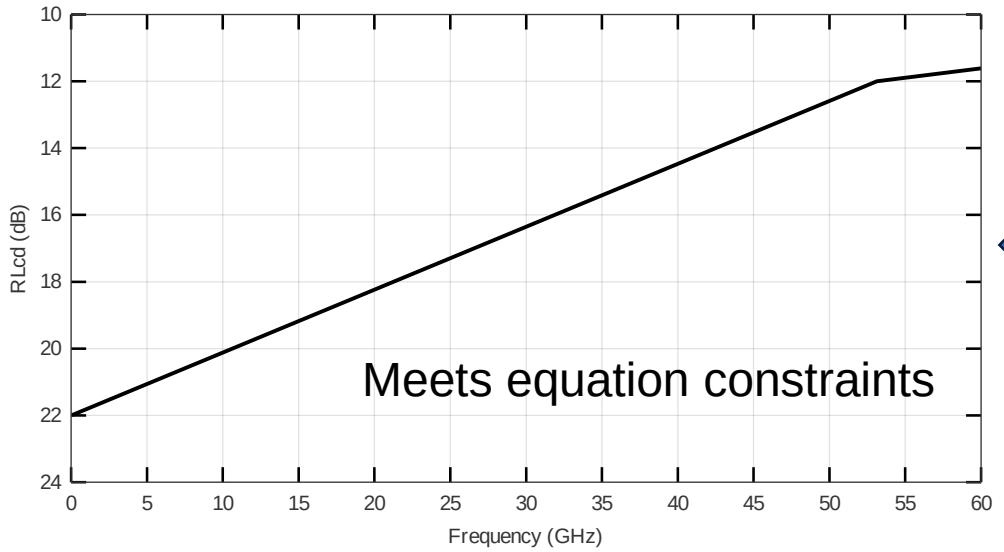


Figure 178–7

Frequency scaling

Corresponding equation and figure in clause 163:

$$RLcd(f) \geq \begin{cases} 22 - 10(f/26.56) & 0.05 \leq f < 26.56 \\ 15 - 3(f/26.56) & 26.56 \leq f \leq 40 \end{cases} \quad (163\text{–}6)$$

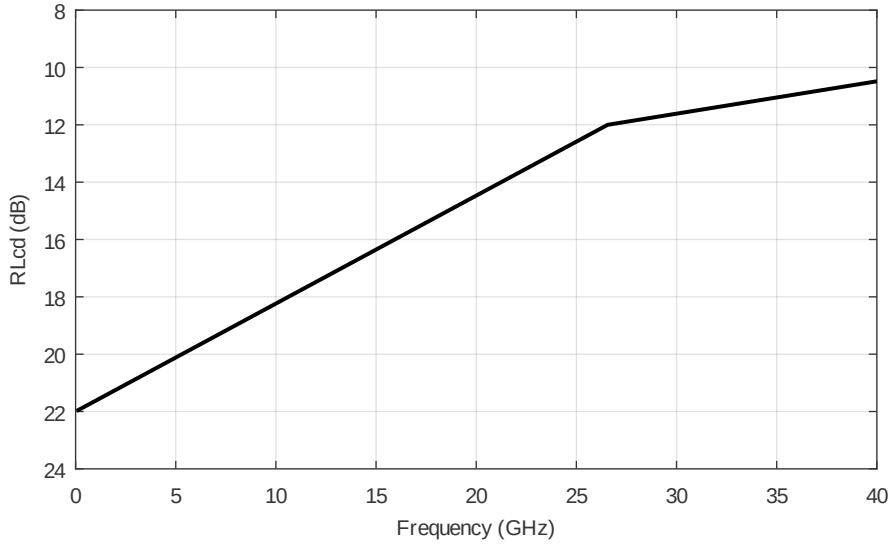


Figure 163–5

Comment #379: 178.10.5, KR channel IL_{cd}-IL_{dd}

Proposed Equation (178–7):

$$IL_{cd}(f) - IL_{dd}(f) \geq \Delta IL(f)$$

$$\Delta IL(f) = \begin{cases} 10 & 0.05 \leq f \leq 26.5625 \\ 10 - 8\,(f - 26.5625) / 53.125 & 26.5625 \leq f \leq 60 \end{cases}$$

Equation modified from the suggested remedy

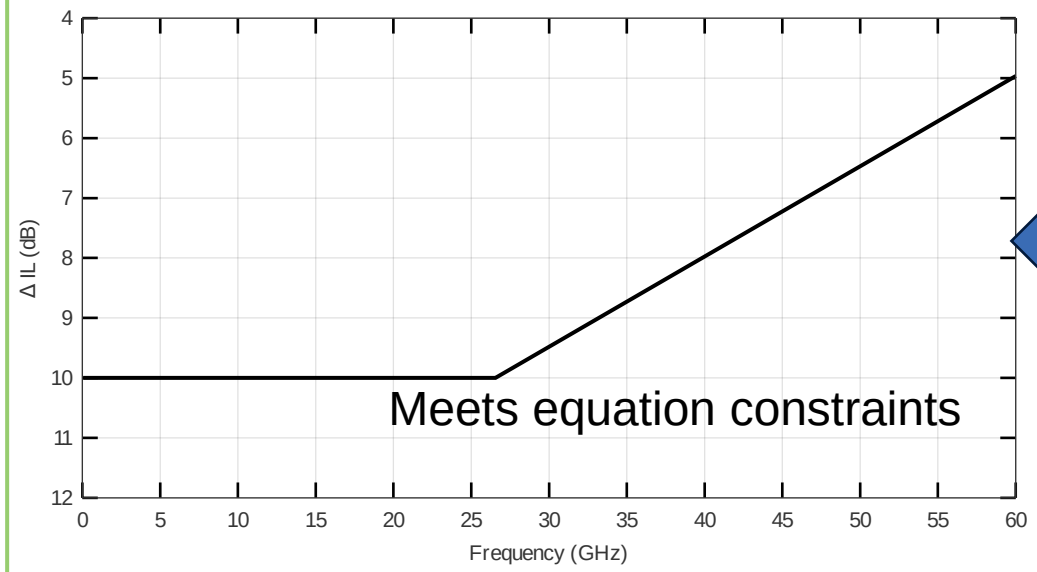


Figure 178–8

Frequency scaling

Corresponding equation and figure in clause 163:

$$ILcd(f) - ILdd(f) \geq \begin{cases} 10 & 0.05 \leq f < 12.89 \\ 14 - 0.3108f & 12.89 \leq f \leq 40 \end{cases} \quad (163\text{–}7)$$

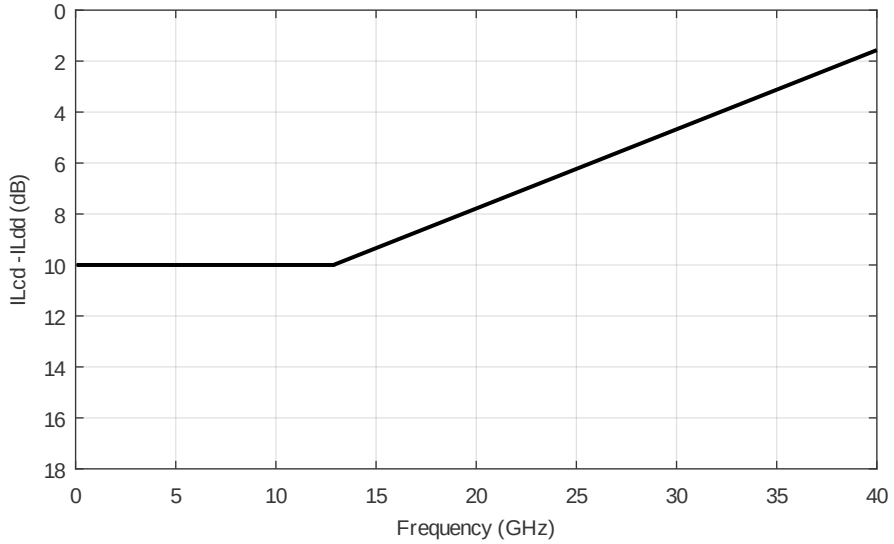


Figure 163–8

Comment #380: 178.10.6, KR channel IL_{dc}-IL_{dd}

Proposed:

Re-use the $\Delta IL(f)$ equation and figure from ILcd-Ildd

Merge 178.10.5 and 178.10.6 into one subclause

Corresponding equation and figure in clause 163:

$$ILdc(f) - ILdd(f) \geq \begin{cases} 10 & 0.05 \leq f < 12.89 \\ 14 - 0.3108f & 12.89 \leq f \leq 40 \end{cases} \quad (163\text{–}8)$$

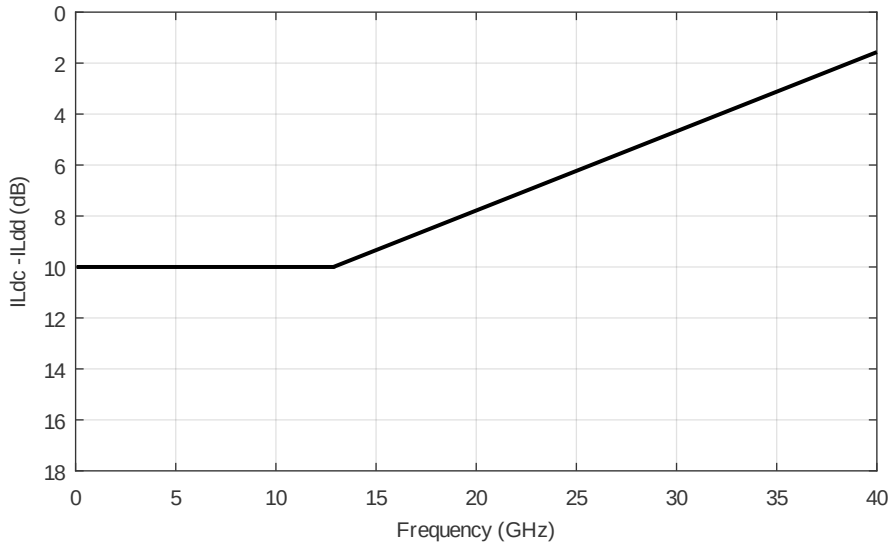
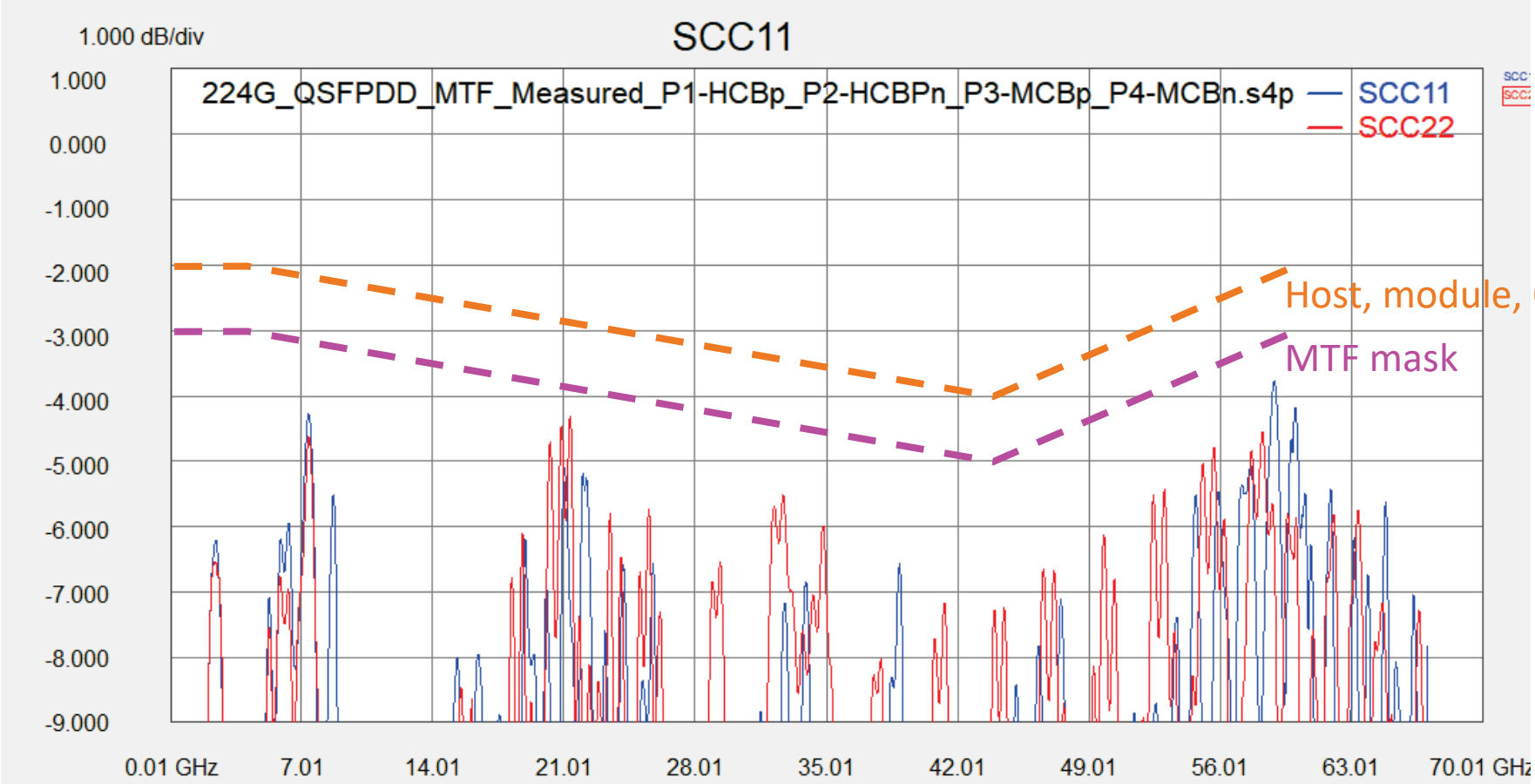


Figure 163–9

Comment #387: CR and C2M RLcc

- The comment notes that in clause 162, the PMD Tx RLcc mask is piecewise-linear, with limits ranging from 2 to 4.5 dB, based on reasoning provided in dawe_3ck_01_0422 , including measurements of mated test fixtures.
- MTF RLcc was not addressed by the comment.
  - Recently provided measurements of mated test fixture (sekel_3dj_02_2407) show RLcc with somewhat different characteristics from the ones contributed to 802.3ck. HCB (SCC11) and MCB (SCC22) show quite similar RLcc.
  - The proposed MTF mask is a modified version of that of Annex 162B. It has a minimum distance of 0.45 dB from RLcc of the MCB (at a single frequency point); the distance is larger for the HCB.
- It is suggested to use one RLcc mask for both sides of the MTF, and another mask for host, module, and cable assembly, relaxed by 1 dB.
  - Adjustments of the masks for specific interfaces can be made later if needed.

Proposed RLcc masks in comparison to measured MTF (sekel_3dj_02_2407)



Comment #387: 179B.4.4, MTF RLcc

Proposed Equation (179B–7):

$$RL_{cc}(f) \geq \begin{cases} 3 & 0.05 \leq f \leq 4 \\ 3 + 2/40(f-4) & 4 \leq f \leq 44 \\ 5 + 2/16(44-f) & 44 \leq f \leq 60 \end{cases}$$

Not included in the original suggested remedy

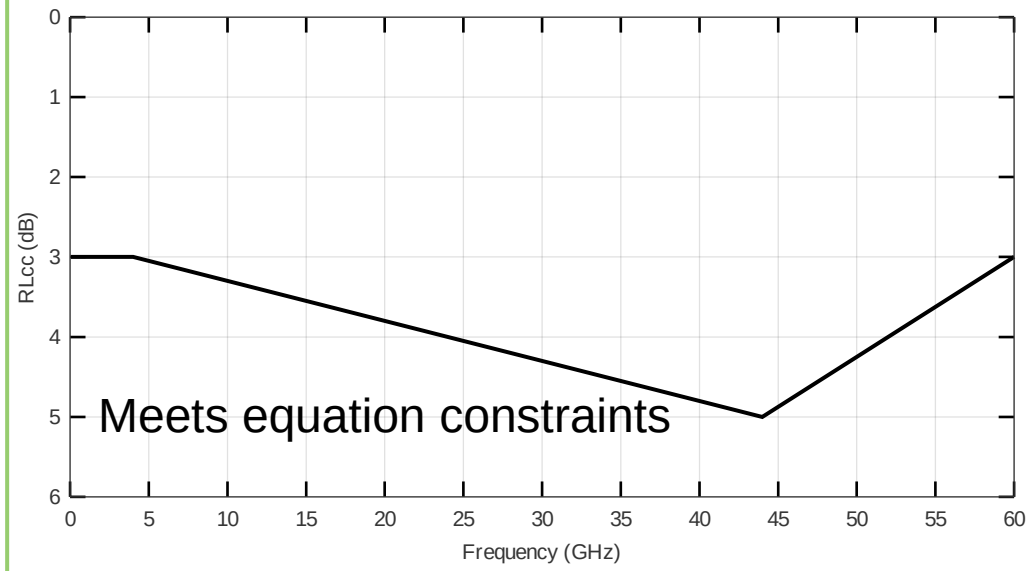


Figure 179B–4

Corresponding equation and figure in Annex 162B:

$$RLcc(f) \geq \begin{cases} 12 - 9f & 0.01 \leq f < 1 \\ 3 & 1 \leq f < 4 \\ 2.6 + 0.1f & 4 \leq f < 30 \\ 9.5 - 0.13f & 30 \leq f \leq 50 \end{cases} \quad \text{(162B–7)}$$

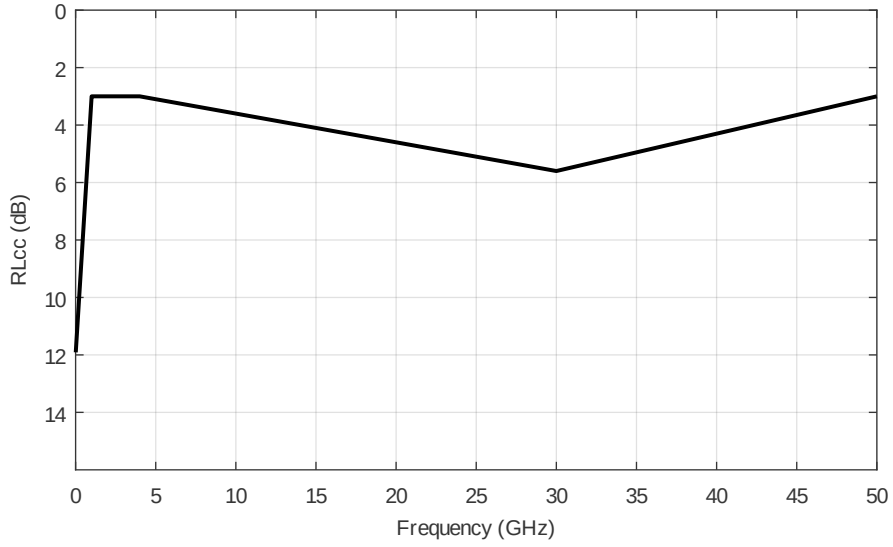


Figure 162B–4

Comment #387: 179.9.4.9, CR+C2M RLcc (Host/module)

Proposed Equation (179–9):

$$RL_{cc}(f) \geq \begin{cases} 2 & 0.05 \leq f \leq 4 \\ 2 + 2/40(f-4) & 4 \leq f \leq 40 \\ 4 + 2/16(44-f) & 40 \leq f \leq 60 \end{cases}$$

Equation modified from the suggested remedy

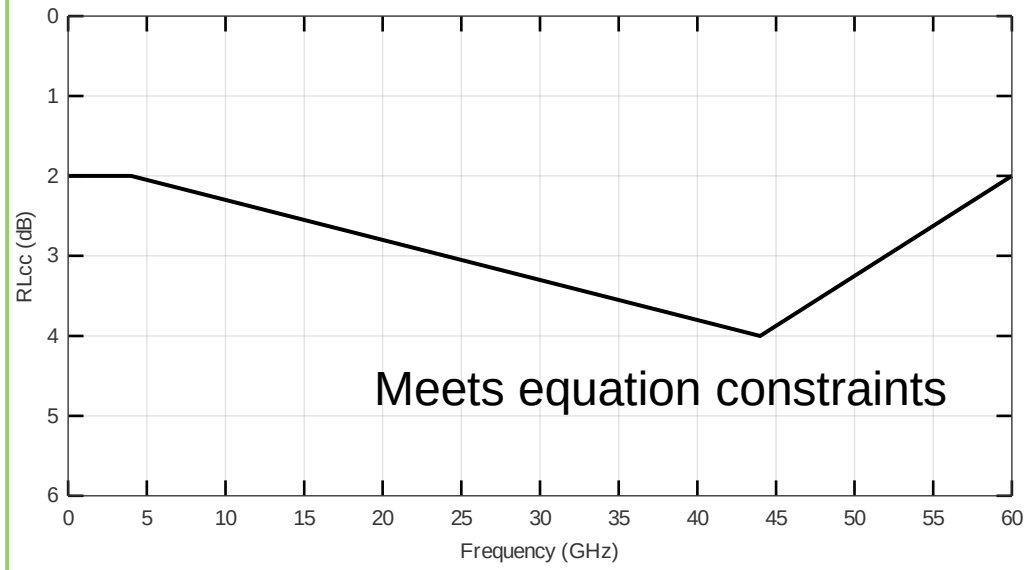


Figure 179–4

Corresponding equation and figure in clause 162:

$$RLcc(f) \geq \begin{cases} 2 & 0.2 \leq f < 4 \\ 1.6 + 0.1f & 4 \leq f \leq 30 \\ 8.5 - 0.13f & 30 < f \leq 40 \end{cases} \quad (162\text{–}6)$$

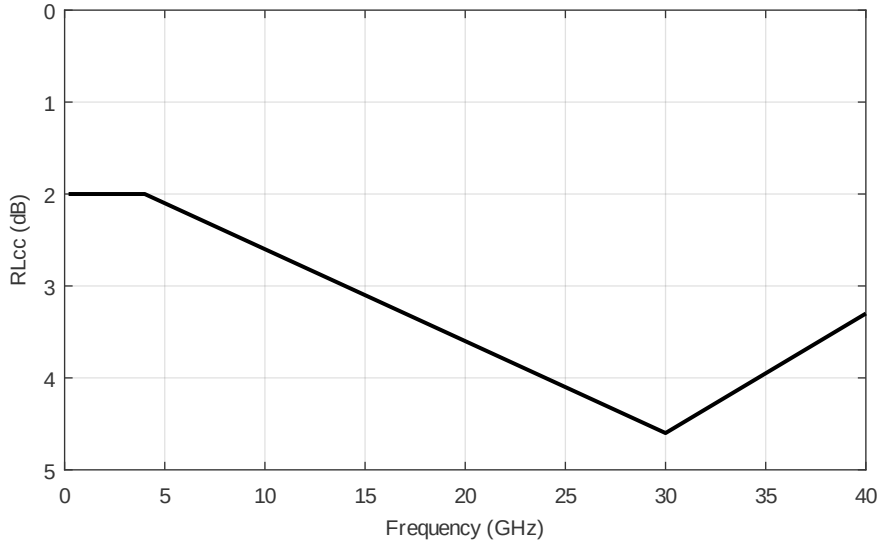


Figure 162–4

Comment #387: 179.9.4.9, CR+C2M RLcc (Cable assembly)

Proposed Equation (179–9):

$$RL_{cc}(f) \geq \begin{cases} 2 & 0.05 \leq f \leq 4 \\ 2 + 2/40(f-4) & 4 \leq f \leq 40 \\ 4 + 2/16(44-f) & 40 \leq f \leq 60 \end{cases}$$

Equation modified from the suggested remedy

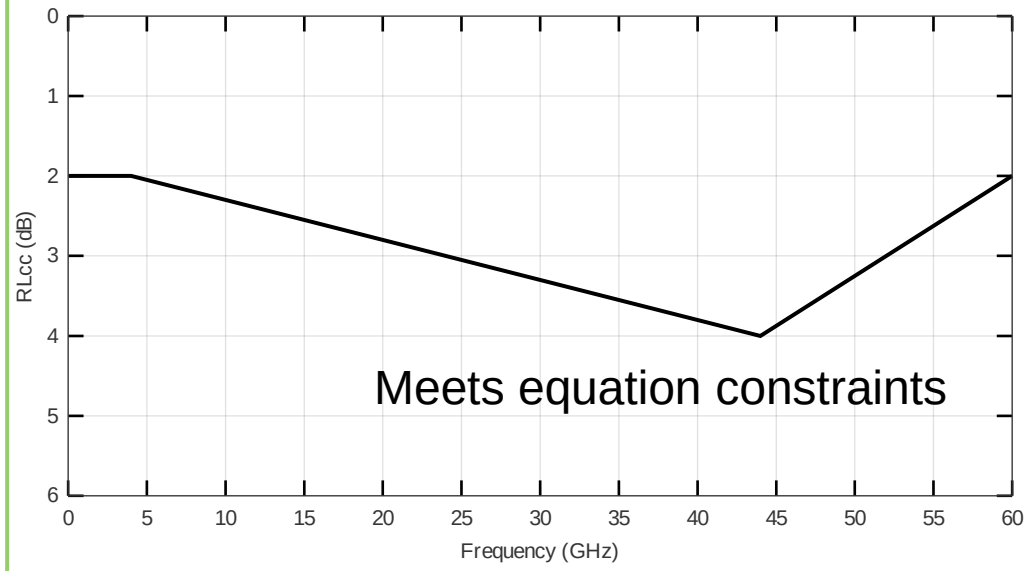


Figure 179–4

Corresponding equation and figure in clause 162:

$$RLcc(f) \geq \begin{cases} 1.4 & 0.05 \leq f \leq 6 \\ 0.68 + 0.12f & 6 < f \leq 30 \\ 10.28 - 0.2f & 30 < f \leq 40 \end{cases} \quad (162\text{–}22)$$

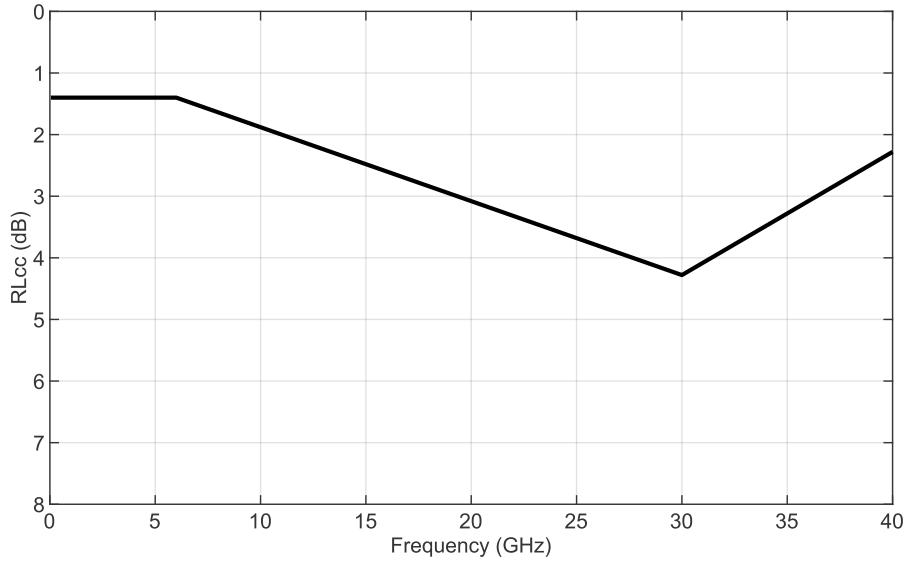
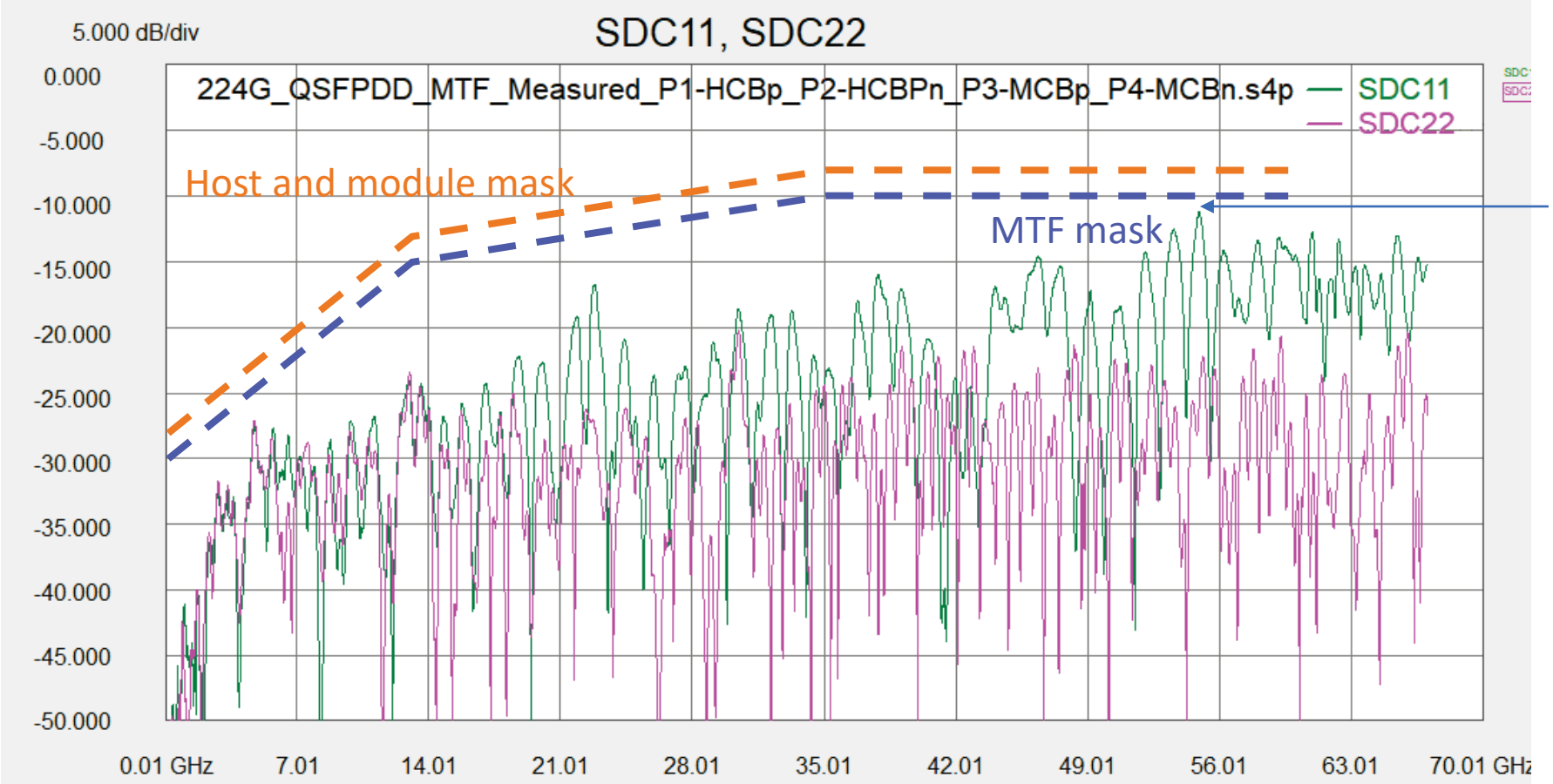


Figure 162–13

Comments #388, #393: RLdc and RLcd

- The comments note that in Clause 162, the PMD Tx **RLdc** mask is the same as the cable assembly **RLcd**, which is based on reasoning provided in diminico_3ck_01_1020 including measured cable assemblies (see also comment resolution slide 4 in brown_3ck_03_0121).
- MTF RLcd/RLdc were not addressed by these comments.
  - Recently provided measurements of mated test fixture (sekel_3dj_02_2407) show similar characteristics to the RLcd mask used in Annex 162B, with MCB-side (SDC22/SCD22) somewhat better than HCB-side (SDC11/SCD11).
  - On each interface, the RLdc and RLcd are identical.
  - The proposed MTF mask is identical to that of Annex 162B extended to 60 GHz. It has minimum distance of ~1.4 dB from RLdc/RLcd of the HCB; the distance is larger for the MCB.
- It is suggested to use one RLdc mask for both sides of the MTF, and another mask for host (CR and C2M) and module, relaxed by 2 dB.
  - As in clause 162, Tx has an RLdc mask and Rx has an RLcd mask.
  - Adjustments of the masks for specific interfaces can be made later.

Proposed RLdc masks in comparison to measured MTF (sekel_3dj_02_2407)



Comments #445: 179B.4.4, MTF RLdc

Proposed Equation (179B–8):

$$RL_{dc}(f) \geq \begin{cases} 30 - 15(f/12.89) & 0.01 \leq f \leq 12.89 \\ 15 - (f - 12.89)/(35 - 12.89) & 12.89 \leq f \leq 35 \\ 10 & 35 \leq f \leq 60 \end{cases}$$

Equation modified from the suggested remedy

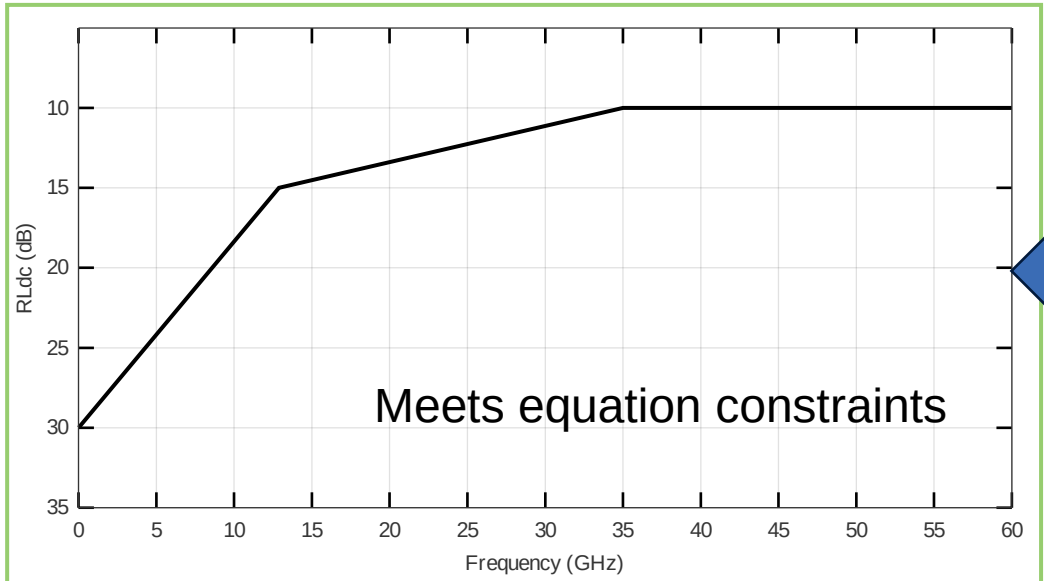


Figure 179B–4

Range extended

Corresponding equation and figure in Annex 162B:

$$RLdc(f) \geq \begin{cases} 30 - (30/25.78)f & 0.01 \leq f < 12.89 \\ 17.85 - 0.225f & 12.89 \leq f < 35 \\ 10 & 35 \leq f \leq 50 \end{cases} \quad (162B–8)$$

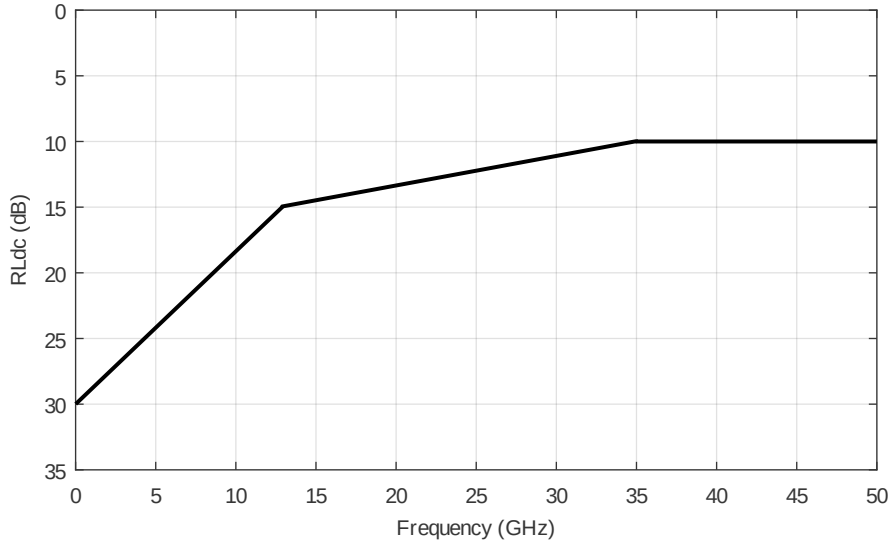


Figure 162B–5

Comment #388: 179.9.4.10, Tx RLdc

Proposed Equation (179–10):

$$RL_{dc}(f) \geq \begin{cases} 28 - 15(f/12.89) & 0.01 \leq f \leq 12.89 \\ 13 - 6\,(f - 12.89)/(35 - 12.89) & 12.89 \leq f \leq 35 \\ 8 & 35 \leq f \leq 60 \end{cases}$$

Equation modified from the suggested remedy

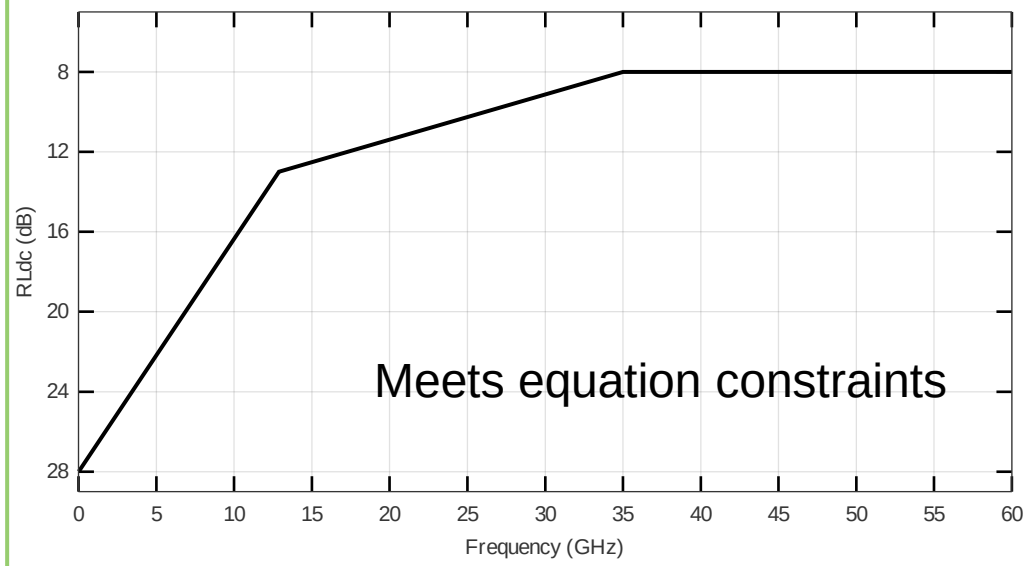


Figure 179–5

Corresponding equation and figure in Clause 162:

$$RLdc(f) \geq \begin{cases} 22 - 10(f/26.56) & 0.05 \leq f < 26.56 \\ 15 - 3(f/26.56) & 26.56 \leq f \leq 40 \end{cases} \qquad (162\text{–}7)$$

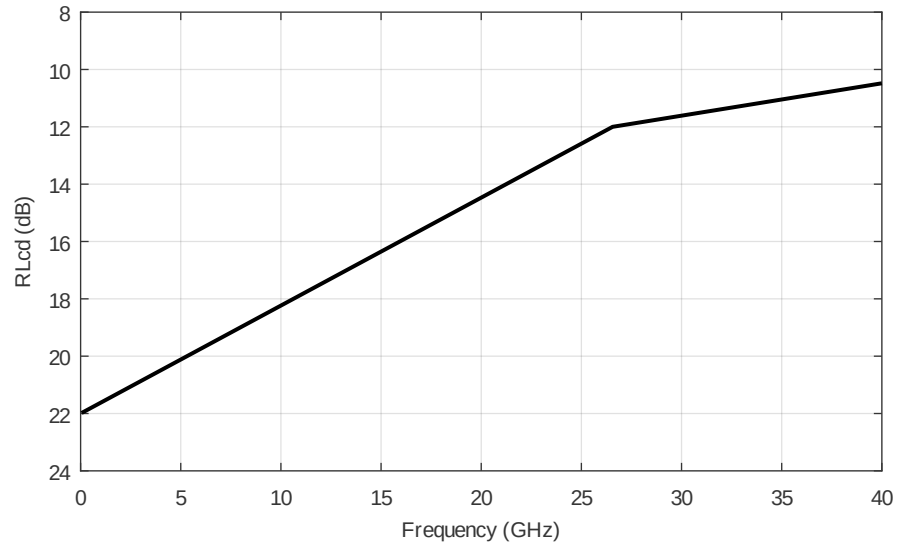


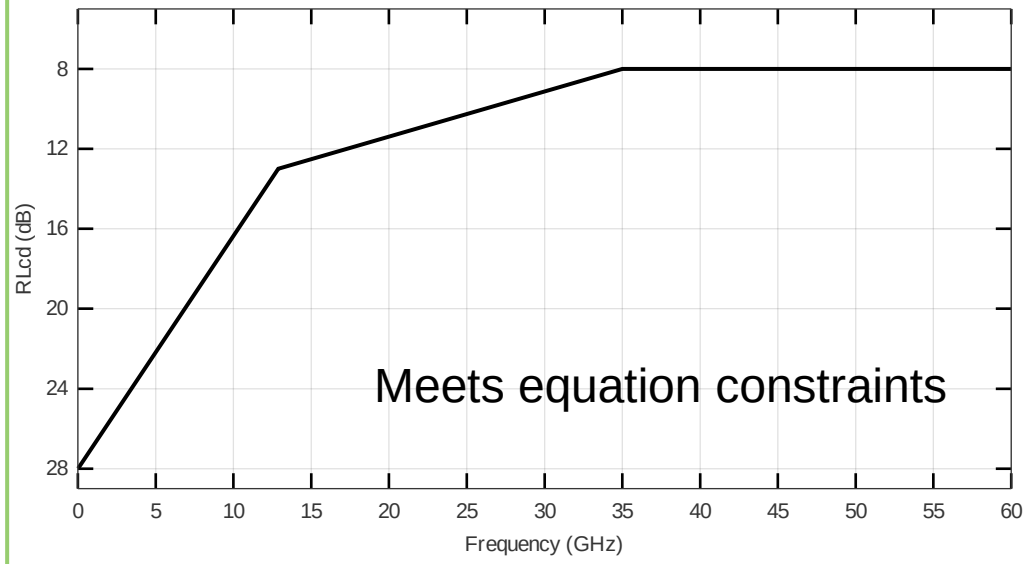
Figure 162–5

Comment #393: 179.9.5.6 and 176E.6.3, Rx RLcd

Proposed Equations (179–21) and (176E–2):

$$RL_{cd}(f) \geq \begin{cases} 28 - 15(f/12.89) & 0.01 \leq f \leq 12.89 \\ 13 - 6\,(f - 12.89)/(35 - 12.89) & 12.89 \leq f \leq 35 \\ 8 & 35 \leq f \leq 60 \end{cases}$$

Equation modified from the suggested remedy



Figures 179–5 and 176E–6

Corresponding equation and figure in Clause 162:

$$RLcd(f) \geq \begin{cases} 22 - 10(f/26.56) & 0.05 \leq f < 26.56 \\ 15 - 3(f/26.56) & 26.56 \leq f \leq 40 \end{cases} \qquad (162\text{–}18)$$

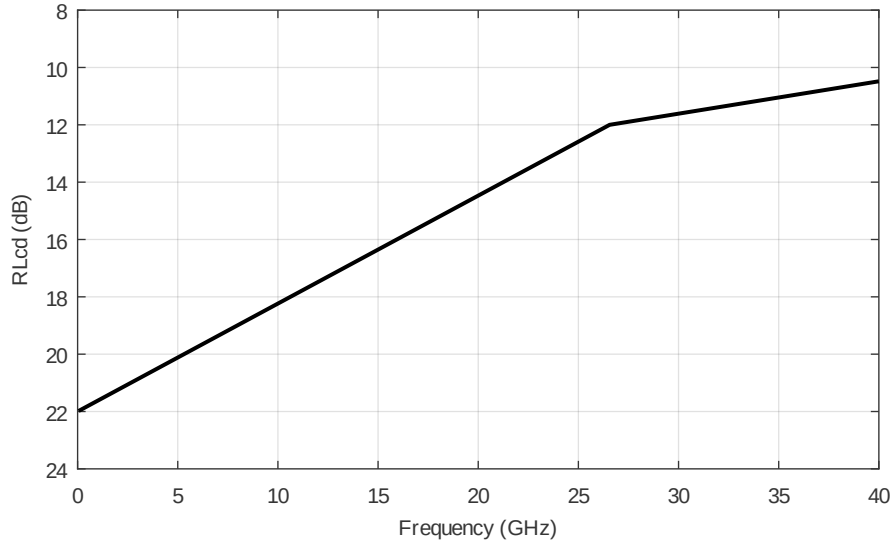
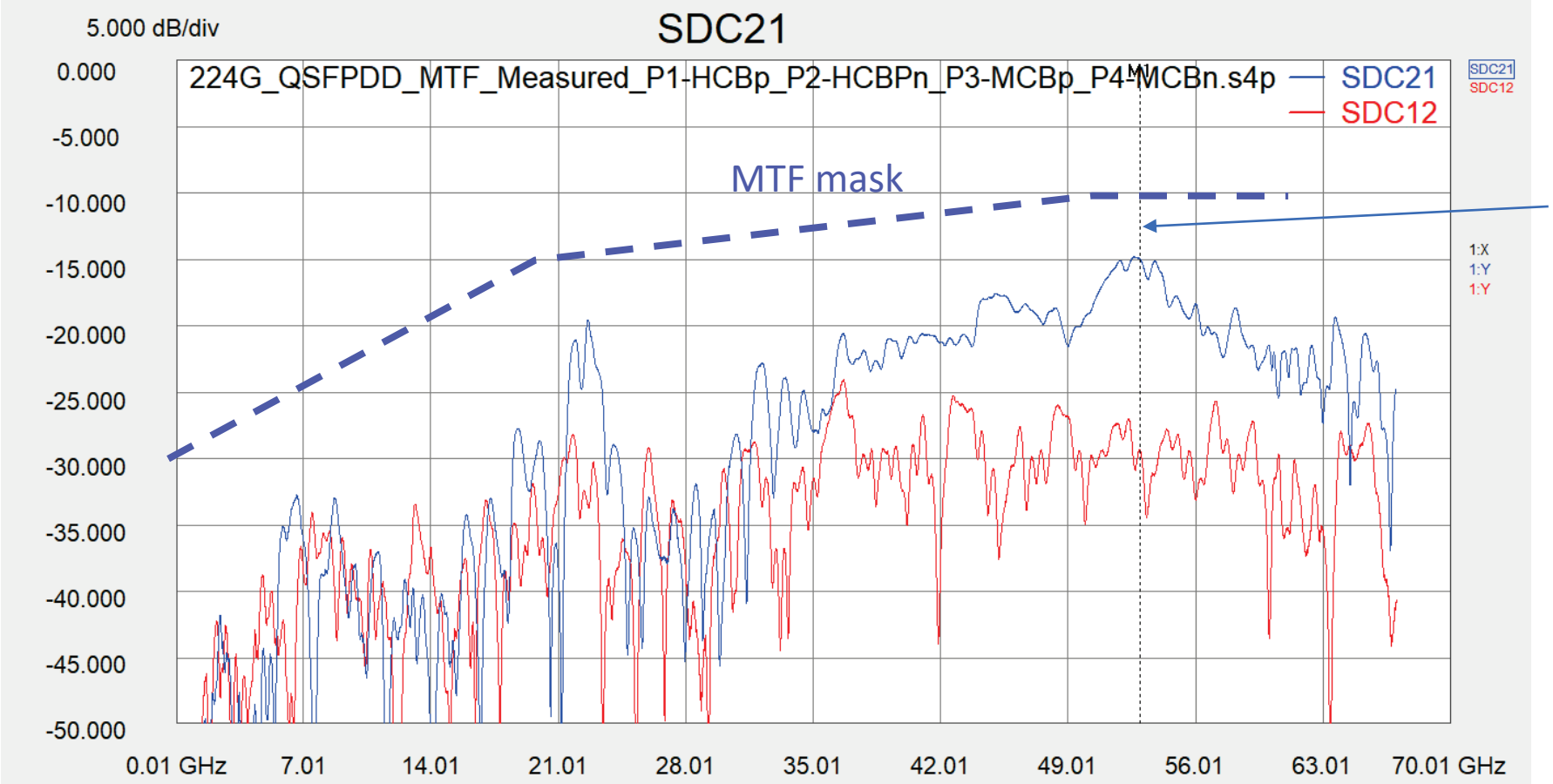


Figure 162–7

Proposed ILdc mask in comparison to measured MTF (sekel_3dj_02_2407)



Comment #445: 179B.4.3, MTF ILdc

TBC

Proposed Equations (179B–6) :

$$IL_{dc}(f) \geq \begin{cases} 30 - 15(f/20) & 0.01 \leq f \leq 20 \\ 15 - 5(f-20)/30 & 20 \leq f \leq 50 \\ 10 & 50 \leq f \leq 60 \end{cases}$$

Equation modified from the suggested remedy

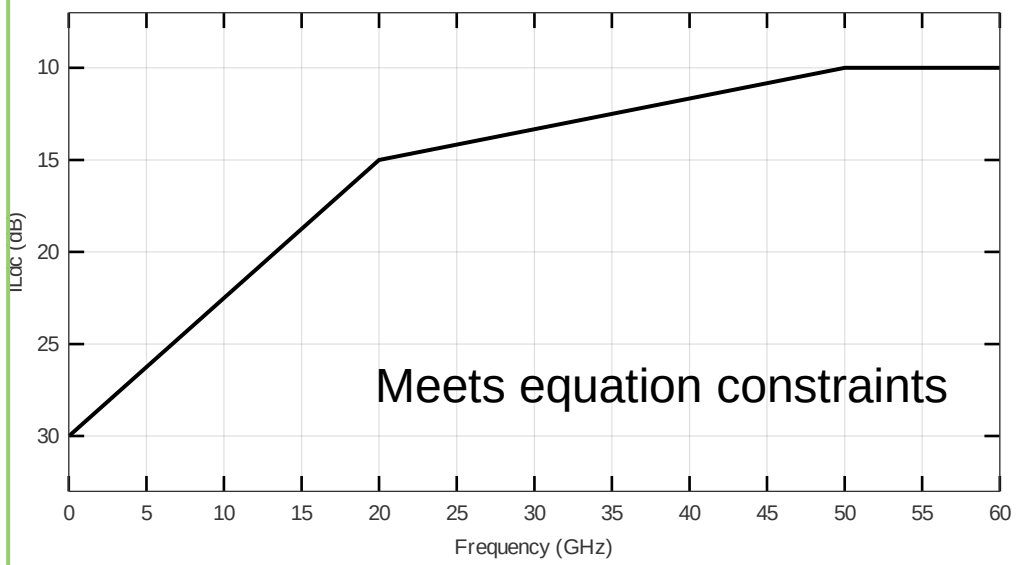


Figure 179B–3

Corresponding equation and figure in Clause 162:

$$ILdc(f) \geq \begin{cases} 30-(21/28)f & 0.01 \leq f < 20 \\ 15 & 20 \leq f \leq 50 \end{cases} \qquad (162B\text{–}6)$$

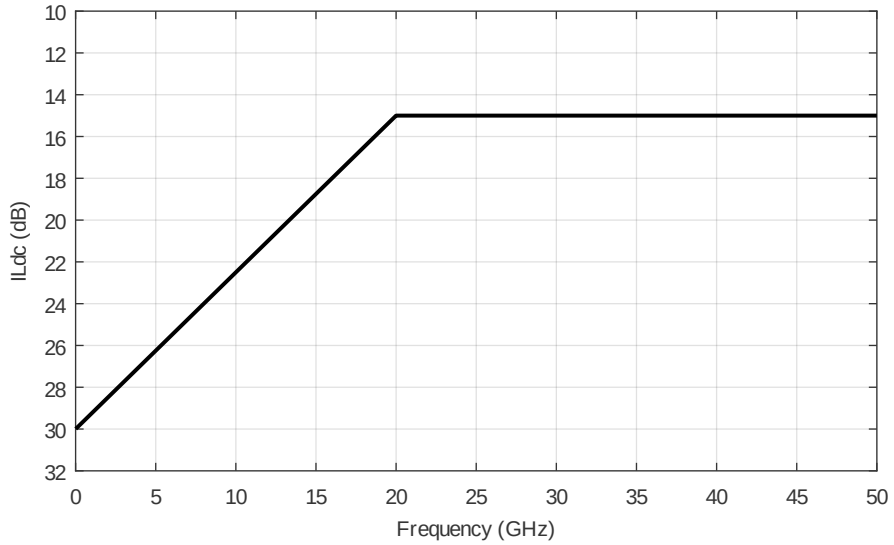


Figure 162–7

Summary

- Equations and figures provided for replacing several TBDs.
  - Content enclosed in green boxes on slides 4-6, 10-12, 15-17, and 19 is proposed to be adopted.
  - These slides can be used for resolution of comments 374, 527, 378, 379, 380, 387, 388, 393, and 445.
- The proposed equations and figures may not be the final word, but replacing TBDs with values moves us forward.
  - Everything is open for future comments.
  - Having specific limits will enable work on providing improved ones.

That’s all

Questions?