

TTC DSL専門委員会 スペクトラム管理SWG（第21回）

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LongReachBoost-VDSL (LRB-VDSL)のスペクトル適合性について

LR2-VDSLの1.104MHz以上の周波数帯域でのPSDを -36.5dBm/Hz に変更したLongReachBoost-VDSL（以降、システム名称を「LRB-VDSL」とする）のスペクトル適合性確認を行った。

LRB-VDSLはG.993.1BandplanAに従い、1.104MHz以下の周波数帯域では、ADSL（G.992.1 AnnexA/FDM）のPSDと互換性を有する。

1. PSD 定義

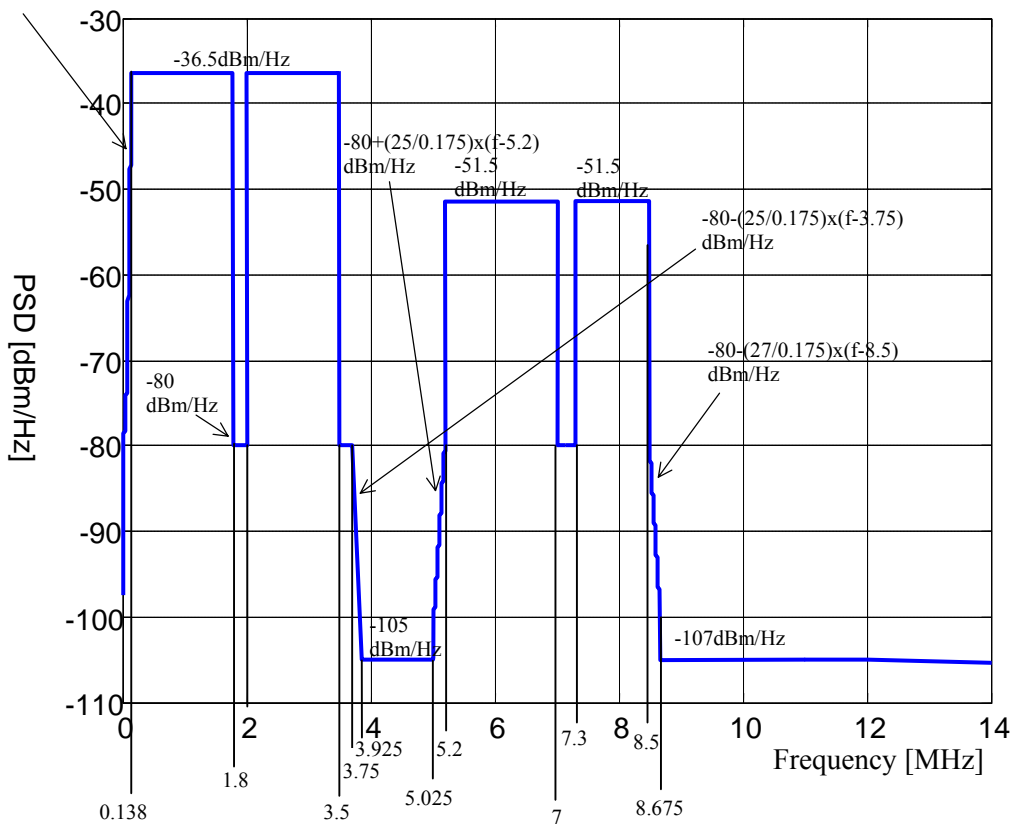
LRB-VDSL 下り PSD mask

| Band attribute | Frequency band f[MHz] | Maximum PSD limitation (PSD mask) [dBm/Hz] |
|----------------|--------------------------|--|
| | $0 < f < 0.004$ | $-97.5 + 15 \text{ dBm}$ |
| | $0.004 \leq f < 0.08$ | $-92.5 + 4.63 \times \log_2(f/0.004)$ |
| | $0.08 \leq f \leq 0.138$ | $-72.5 + 36 \times \log_2(f/0.08)$ |
| DS1 | $0.138 < f < 1.8$ | $-40 + 3.5 (= -36.5)$ |
| | $1.8 \leq f < 2$ | -80 |
| DS1 | $2 \leq f < 3.5$ | $-40 + 3.5 (= -36.5)$ |
| | $3.5 < f \leq 3.75$ | -80 |
| | $3.75 < f \leq 3.925$ | $-80 - (25/0.175) \times (f - 3.75)$ |
| | $3.925 < f < 5.025$ | -105 |
| | $5.025 \leq f \leq 5.2$ | $-80 + (25/0.175) \times (f - 5.2)$ |
| DS2 | $5.2 < f < 7$ | $-55 + 3.5 (= -51.5)$ |
| | $7 \leq f \leq 7.3$ | -80 |
| DS2 | $7.3 < f < 8.5$ | $-55 + 3.5 (= -51.5)$ |
| | $8.5 \leq f \leq 8.675$ | $-80 - (27/0.175) \times (f - 8.5)$ |
| | $8.675 < f \leq 12$ | -107 |
| | $12 < f < 30$ | $-107 - (3/18) \times (f - 12)$ |
| | $30 \leq f < \infty$ | -120 |

NOTE 1 – All PSD and power measurements are in 100 Ω.
 NOTE 2 – The maximum PSD shall be measured with a 10 kHz resolution bandwidth.

$-72.5 + 36 \times \log_2(f/0.08)$
dBm/Hz

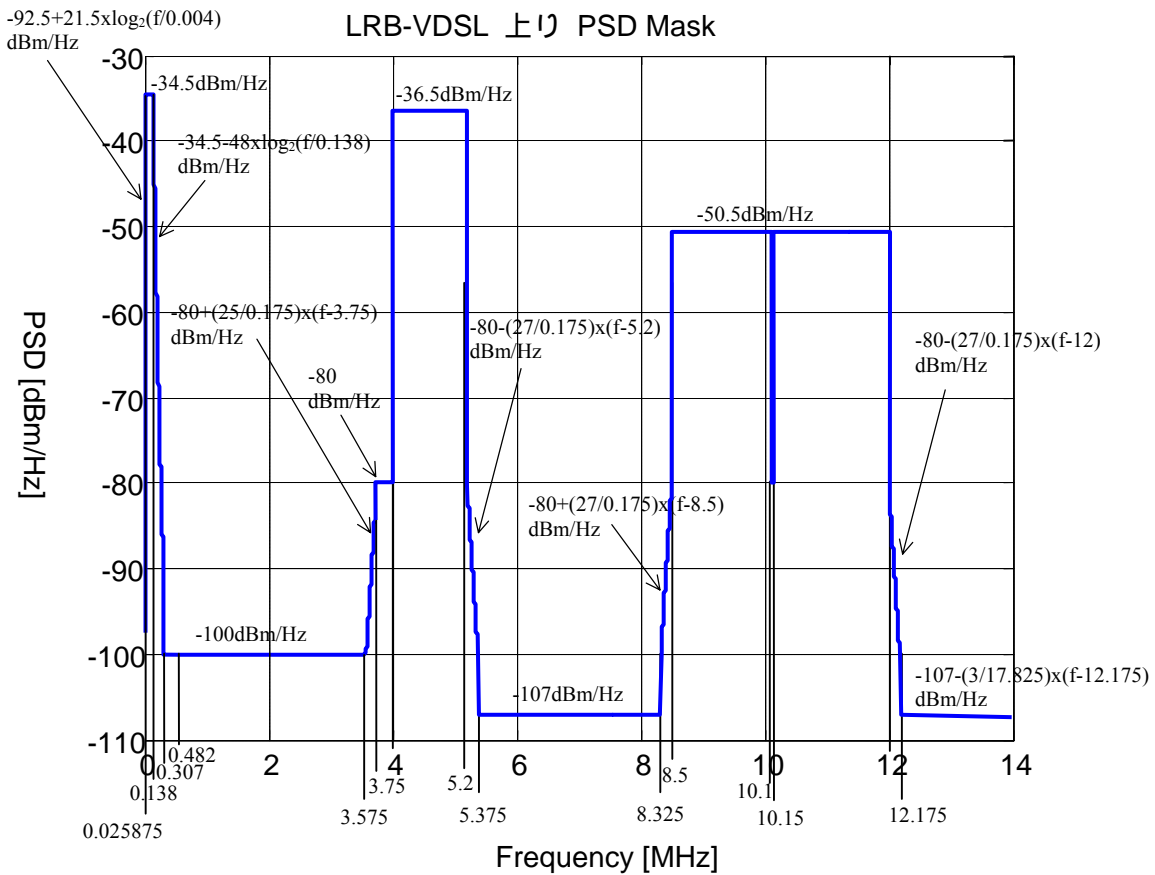
LRB-VDSL 下り PSD Mask



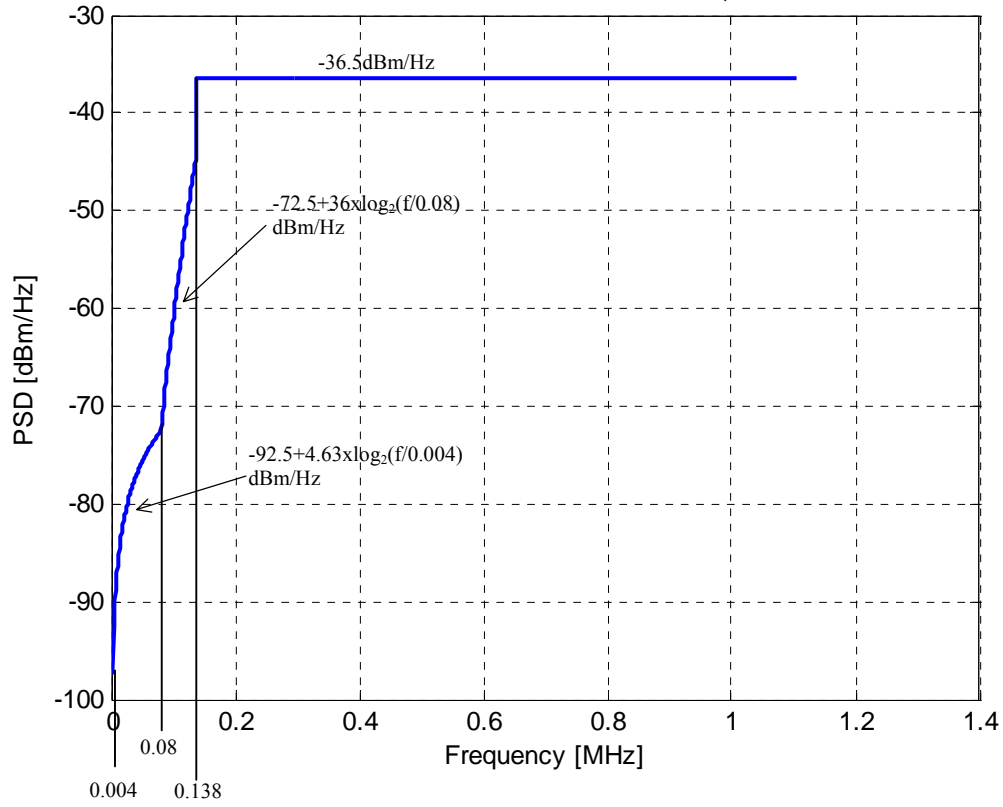
LRB-VDSL 上ノ PSD mask

| Band attribute | Frequency band f [MHz] | Maximum PSD limitation (PSD mask) [dBm/Hz] |
|----------------|---------------------------|--|
| | $0 < f < 0.004$ | $-97.5 + 15 \text{ dBm}$ |
| | $0.004 \leq f < 0.025875$ | $-92.5 + 21.5 \times \log_2(f/0.004)$ |
| US0 | $0.025875 \leq f < 0.138$ | -34.5 |
| | $0.138 \leq f < 0.307$ | $-34.5 - 48 \times \log_2(f/0.138)$ |
| | $0.307 \leq f < 0.482$ | -100 |
| | $0.482 \leq f < 3.575$ | -100 |
| | $3.575 \leq f < 3.75$ | $-80 + (25/0.175) \times (f - 3.75)$ |
| | $3.75 \leq f \leq 4$ | -80 |
| US1 | $4 < f < 5.2$ | $-40 + 3.5 (= -36.5)$ |
| | $5.2 \leq f < 5.375$ | $-80 - (27/0.175) \times (f - 5.2)$ |
| | $5.375 < f < 8.325$ | -107 |
| | $8.325 \leq f \leq 8.5$ | $-80 + (27/0.175) \times (f - 8.5)$ |
| US2 | $8.5 < f < 10.1$ | $-54 + 3.5 (= -50.5)$ |
| | $10.1 \leq f \leq 10.15$ | -80 |
| US2 | $10.15 < f < 12$ | $-54 + 3.5 (= -50.5)$ |
| | $12 \leq f \leq 12.175$ | $-80 - (27/0.175) \times (f - 12)$ |
| | $12.175 < f < 30$ | $-107 - (3/17.825) \times (f - 12.175)$ |
| | $30 \leq f < \infty$ | -120 |

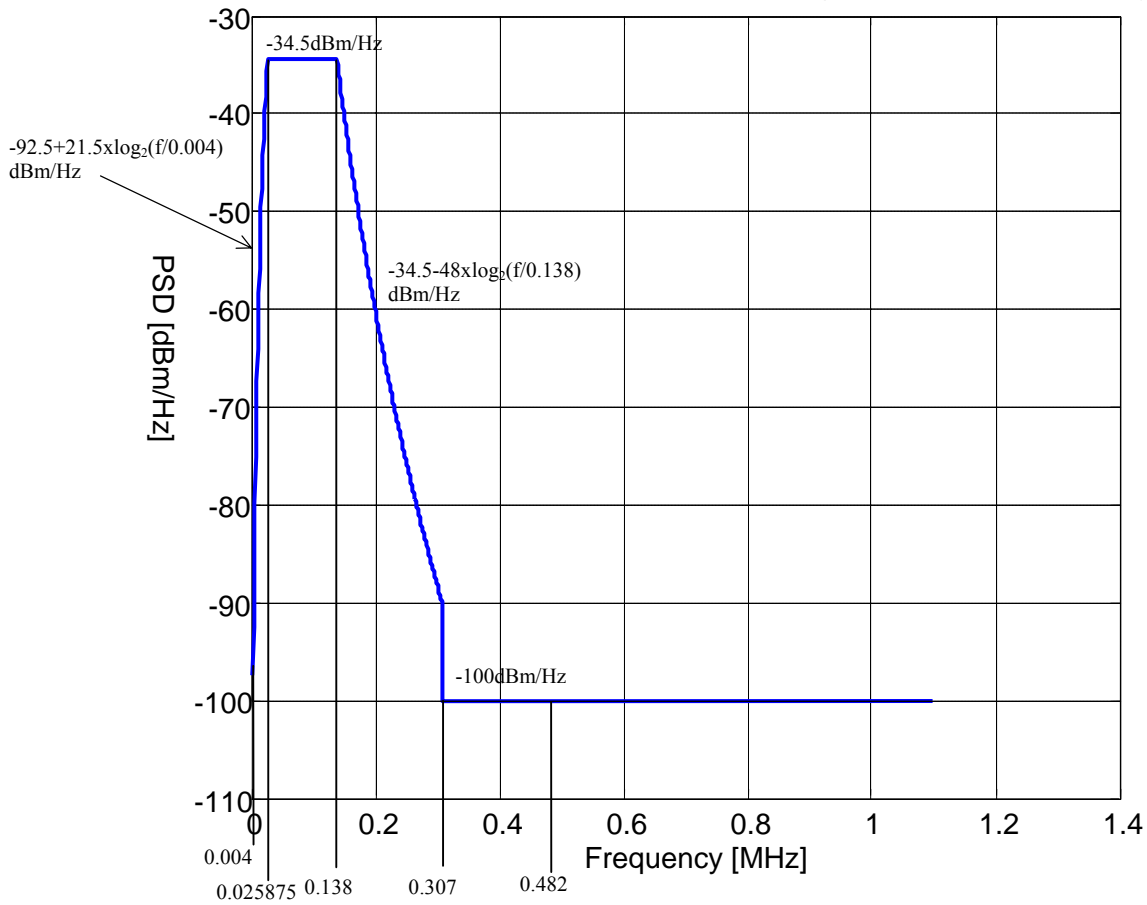
NOTE 1 – All PSD and power measurements are in 100 Ω.
 NOTE 2 – The maximum PSD shall be measured with a 10 kHz resolution bandwidth.



LRB-VDSL 下り PSD Mask 0 - 1.104MHz(= G.992.1 AnnexA)



LRB-VDSL 上り PSD Mask 0 - 1.104MHz(= G.992.1 AnnexA FDM)



2. スペクトル適合性計算結果

| Dist | ISDN | | G.992.1 AnnexA (FDM) | | G.992.2 AnnexA | | G.992.1 AnnexC | | | | G.992.2 AnnexC | | | |
|------|------|-----|----------------------|-----|----------------|-----|----------------|-----|------|-----|----------------|-----|------|-----|
| | | | | | | | DBM | | FBM | | DBM | | FBM | |
| | DS | US | DS | US | DS | US | DS | US | DS | US | DS | US | DS | US |
| 0.5 | 144 | 144 | 7104 | 832 | 3008 | 832 | 7104 | 832 | 2624 | 288 | 3008 | 832 | 1088 | 288 |
| 0.75 | 144 | 144 | 7008 | 832 | 3008 | 832 | 7008 | 832 | 2592 | 288 | 3008 | 832 | 1088 | 288 |
| 1.0 | 144 | 144 | 6880 | 832 | 3008 | 832 | 6880 | 832 | 2528 | 288 | 3008 | 832 | 1088 | 288 |
| 1.25 | 144 | 144 | 6784 | 832 | 3008 | 832 | 6784 | 832 | 2496 | 288 | 3008 | 832 | 1088 | 288 |
| 1.5 | 144 | 144 | 6624 | 832 | 2976 | 832 | 6624 | 832 | 2432 | 288 | 2976 | 832 | 1088 | 288 |
| 1.75 | 144 | 144 | 6496 | 832 | 2976 | 832 | 6496 | 832 | 2400 | 288 | 2976 | 832 | 1088 | 288 |
| 2.0 | 144 | 144 | 6368 | 832 | 2976 | 832 | 6368 | 832 | 2336 | 288 | 2976 | 832 | 1088 | 288 |
| 2.25 | 144 | 144 | 6208 | 832 | 2944 | 832 | 6208 | 832 | 2304 | 288 | 2944 | 832 | 1088 | 288 |
| 2.5 | 144 | 144 | 5984 | 832 | 2912 | 832 | 5984 | 832 | 2208 | 288 | 2912 | 832 | 1056 | 288 |
| 2.75 | 144 | 144 | 5568 | 800 | 2880 | 800 | 5568 | 800 | 2048 | 288 | 2880 | 800 | 1056 | 288 |
| 3.0 | 144 | 144 | 4992 | 800 | 2848 | 800 | 4992 | 800 | 1824 | 288 | 2848 | 800 | 1024 | 288 |
| 3.25 | 144 | 144 | 4128 | 800 | 2752 | 800 | 4128 | 800 | 1536 | 288 | 2752 | 800 | 992 | 288 |
| 3.5 | 144 | 0 | 3424 | 768 | 2624 | 768 | 3424 | 768 | 1248 | 288 | 2624 | 768 | 960 | 288 |
| 3.75 | 0 | 0 | 2752 | 736 | 2432 | 736 | 2752 | 736 | 1024 | 256 | 2432 | 736 | 896 | 256 |
| 4.0 | 0 | 0 | 2176 | 736 | 2176 | 736 | 2176 | 736 | 800 | 256 | 2176 | 736 | 800 | 256 |
| 4.25 | 0 | 0 | 1664 | 704 | 1824 | 704 | 1664 | 704 | 608 | 256 | 1824 | 704 | 672 | 256 |
| 4.5 | 0 | 0 | 1216 | 672 | 1440 | 672 | 1216 | 672 | 448 | 224 | 1440 | 672 | 544 | 224 |
| 4.75 | 0 | 0 | 864 | 640 | 1024 | 640 | 864 | 640 | 320 | 224 | 1024 | 640 | 384 | 224 |
| 5.0 | 0 | 0 | 544 | 608 | 704 | 608 | 544 | 608 | 192 | 224 | 704 | 608 | 256 | 224 |

LRB-VDSL システムはスペクトル適合性を満足することを確認した。