Cabling Transmission Parameters

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Supporters

- Ron Tellas, Panduit
- Paul Kish, Belden
- Sterling Vaden, Vaden Enterprises
- George Zimmerman, CommScope and Aquantia
- Peter Wu, Marvell
- Pete Cibula, Intel
- Andy Jimenez, Anixter
- Dave Hess, Cord Data
- Jeff Poulsen, Leviton

Outline

- Insertion Loss
- Return Loss
- PSANEXT
- PSAACRF (alien FEXT)

Insertion Loss

ISO Class I and II

Table 3 – Equations for insertion loss limits for a channel

	Frequency MHz	Maximum insertion loss dB
Class I	$1 < f \le 250$	$0{,}32\left(1{,}8\sqrt{f}+0{,}005f+0{,}25/\sqrt{f}\right)+0{,}0324\sqrt{f}$ $+2\left(0{,}016835\sqrt{f}-10\lg\left[1-10^{\frac{32-20\lg(f/100)}{-10}}\right]-10\lg\left[1-10^{\frac{51-20\lg(f/100)}{-10}}\right]\right)$
	$250 < f \le 500$	$0{,}32\left(1{,}8\sqrt{f}+0{,}005f+0{,}25/\sqrt{f}\right)+0{,}0324\sqrt{f}$ $+2\left(0{,}016835\sqrt{f}-10\lg\left[1-10^{\frac{32-20\lg(f/100)}{-10}}\right]-10\lg\left[1-10^{\frac{43{,}04-30\lg(f/250)}{-10}}\right]\right)$
	$500 < f \le 1\,000$	$0{,}32\left(1{,}8\sqrt{f}+0{,}005f+0{,}25/\sqrt{f}\right)+0{,}0324\sqrt{f}$ $+2\left(0{,}016835\sqrt{f}-10\lg\left[1-10^{\frac{32-20\lg(f/100)}{-10}}\right]-10\lg\left[1-10^{\frac{34-40\lg(f/500)}{-10}}\right]\right)$
	$1\,000 < f \le 1\,600$ $1\,600 < f \le 2\,000$ ffs	$0{,}32\left(1{,}8\sqrt{f}+0{,}005f+0{,}25/\sqrt{f}\right)+0{,}0324\sqrt{f}$ $+2\left(0{,}016835\sqrt{f}+0{,}283-10\lg\left[1-10^{\frac{34-40\lg(f/500)}{-10}}\right]\right)$
Note: The term $0{,}0324\sqrt{f}$ is ffs		
Class II	$1 < f \le 1\,600$ $1\,600 < f \le 2\,000$ ffs	$0{,}32\left(1{,}8\sqrt{f}+0{,}005f+0{,}25/\sqrt{f}\right)+2\times 0{,}02\sqrt{f}$
For measurements the values below 4,0 dB revert to 4,0 dB (ffs)		

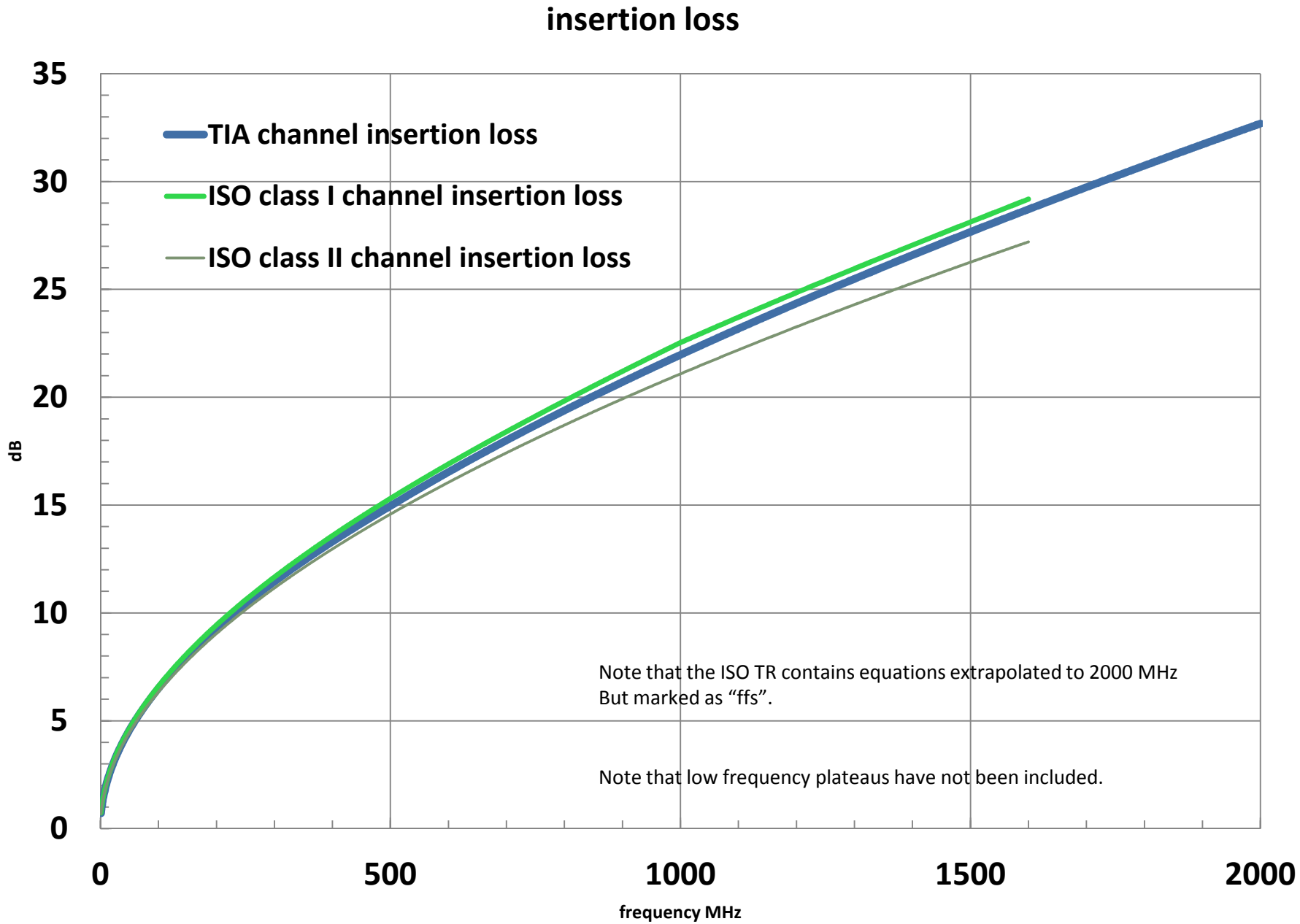
TIA category 8

Table 7 - Channel insertion loss

	Frequency (MHz)	Insertion loss (dB)[1]
Category 8	$1 \le f \le 2000$	$0.312(1.80\sqrt{f}+0.005f+\frac{0.25}{\sqrt{f}})+2IL_{conn}+0.0324\sqrt{f}$

1 Calculations that result in category 8 channel insertion loss values less than 2 dB shall revert to a requirement of 2 dB maximum.

$$InsertionLoss_{conn} \quad \begin{matrix} 1 \le f \le 500 & 0.02\sqrt{f} \\ 500 < f \le 2000 & \left(0.00649\sqrt{f}+0.000605f\right) \end{matrix}$$


insertion loss
TIA channel insertion loss
ISO class I channel insertion loss
ISO class II channel insertion loss
dB
35
30
25
20
15
10
5
0
0
500
1000
1500
2000
frequency MHz
Note that the ISO TR contains equations extrapolated to 2000 MHz
But marked as “ffs”.
Note that low frequency plateaus have not been included.

Insertion Loss Discussion

- The ISO Class I eqn. is much less elegant than the TIA, but we can hope ISO will simplify it before edition 3 is published, as TIA has done.
- To align on the TIA category 8 eqn. would provide a simple solution that would accommodate all classes.

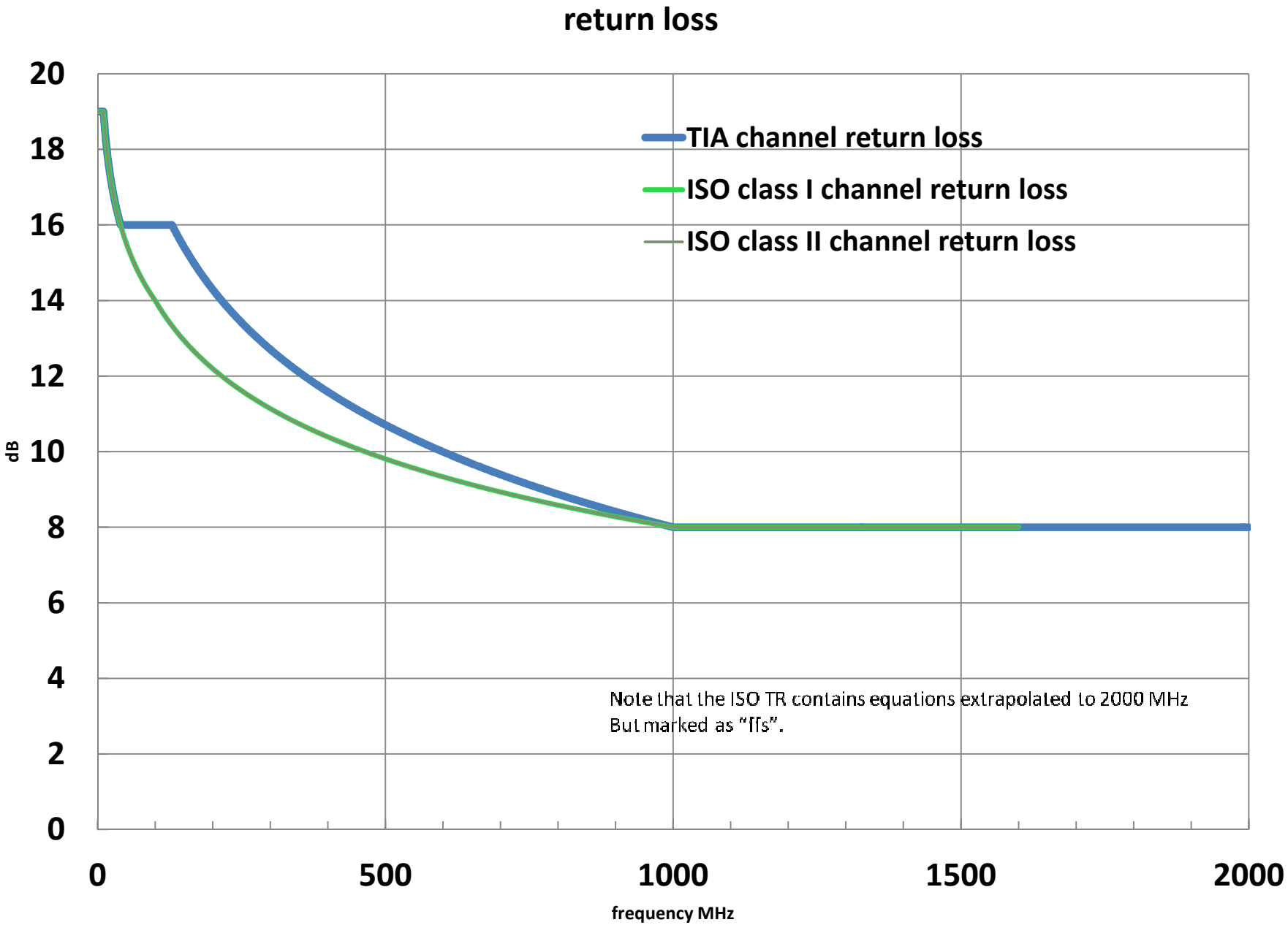
Return Loss

Table 1 – Equations for return loss limits for a channel

Frequency MHz	Minimum return loss Class I and Class II dB
$1 \le f \le 10$	19,0
$10 < f \le 100$	$24 - 5\lg(f)$
$100 < f \le 1\,000$	$26 - 8\lg(f)$
$1\,000 < f \le 1600$	8,0
$1\,600 < f \le 2\,000$	8,0 ffs

Table 5 - Channel return loss

	Frequency (MHz)	Return loss (dB)
Category 8	$1 \le f < 10$ $10 \le f < 40$ $40 \le f < 130$ $130 \le f < 1000$ $1000 \le f \le 2000$	19.0 24-5log(f) 16.0 35-9log(f) 8 dB


return loss
20
18
16
14
12
10
8
6
4
2
0
dB
0
500
1000
1500
2000
frequency MHz
TIA channel return loss
ISO class I channel return loss
ISO class II channel return loss
Note that the ISO TR contains equations extrapolated to 2000 MHz
But marked as "TBs".

Return Loss Discussion

- ISO specifications are the same for Class I and II.
- TIA and ISO specifications are nearly the same, differing slightly from 40-1000 MHz.
- TIA limits are supported by modeling of a 2-connector channel. ISO limits are based on a 4-connector channel. Hoping this will be improved in edition 3.

PSANEXT

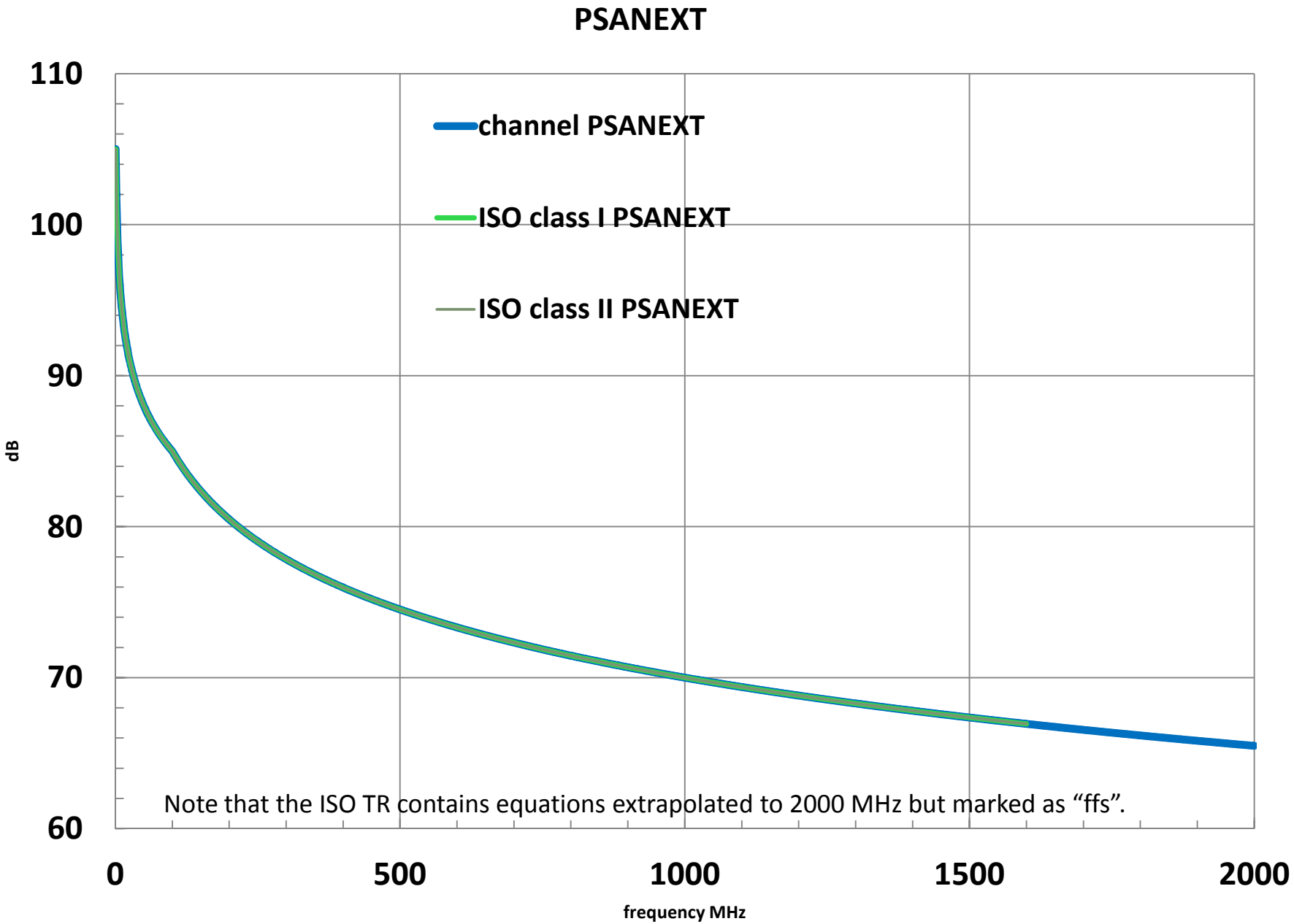
Table 13 – Equations for PS ANEXT limits for a channel

	Frequency MHz	Minimum PS ANEXT dB
Class I Class II	$1 \le f < 100$	$105 - 10\lg(f/f')$ For measurements 67,0 ffs max
	$100 \le f \le 1\,600$ $1\,600 < f \le 2\,000$ ffs	$115 - 15\lg(f/f')$ For measurements 67,0 ffs max

Table 25 - Channel PSANEXT loss

	Frequency (MHz)	Channel PSANEXT loss (dB)[1]
Category 8	$1 \le f < 100$	85-10log(f/100)
	$100 \le f \le 2000$	85-15log(f/100)
1 Calculations that result in category 8 channel PSANEXT loss values greater than 75 dB shall revert to a requirement of 75 dB minimum.		

These limits are exactly the same, only the log expressions are anchored at a different frequency.


PSANEXT
channel PSANEXT
ISO class I PSANEXT
ISO class II PSANEXT
dB
110
100
90
80
70
60
0
500
1000
1500
2000
frequency MHz
Note that the ISO TR contains equations extrapolated to 2000 MHz but marked as “ffs”.

PSAACRF

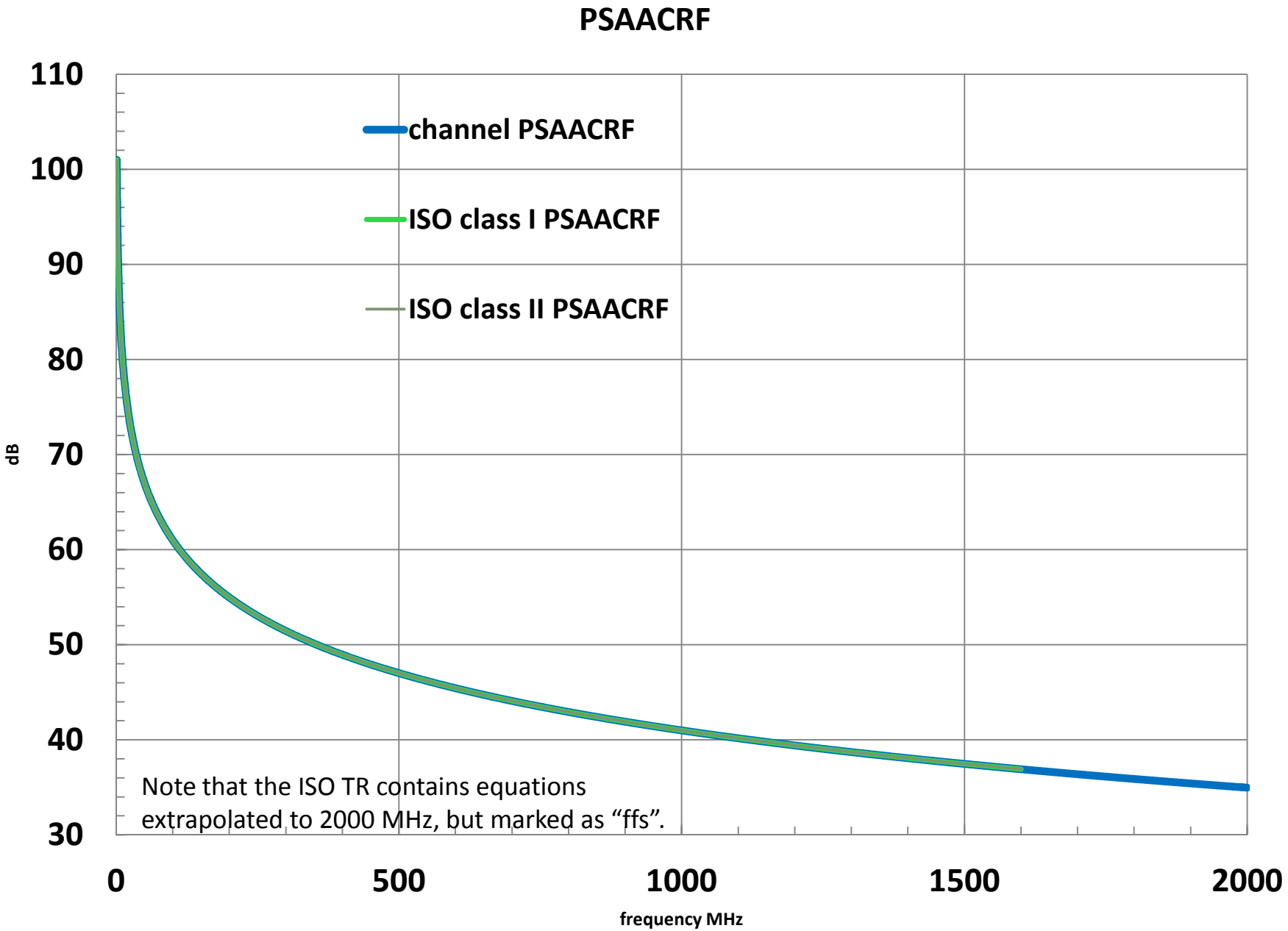
Table 15 – Equations for PS AACR-F limits for a channel

	Frequency MHz	Minimum PS AACR-F dB
Class I Class II	$1 \le f \le 1\,600$ $1\,600 < f \le 2\,000$ ffs	$101 - 20\lg(f)$ For measurements 67,0 ffs max
PS AACR-F limit at frequencies that correspond to calculated values of PS AFEXT greater than 67,0 dB ffs or $102-15\lg(f)$ ffs shall be for information only.		

Table 27 - Channel PSAACRF

	Frequency (MHz)	Channel PSAACRF (dB)[1]
Category 8	$1 \le f \le 2000$	$61-20\log(f/100)$
1 Calculations that result in category 8 channel PSAACRF values greater than 75 dB shall revert to a requirement of 75 dB minimum.		

These limits are exactly the same, only the log expressions are anchored at a different frequency.


PSAACRF
channel PSAACRF
ISO class I PSAACRF
ISO class II PSAACRF
dB
110
100
90
80
70
60
50
40
30
0
500
1000
1500
2000
frequency MHz
Note that the ISO TR contains equations extrapolated to 2000 MHz, but marked as “ffs”.

Thank You.