

RTPGE

Channel Performance Formulation Proposal

CommScope

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Richard Mei

Trent Hayes

Wayne Larsen

Todd Herman

Supporters:

- Insertion Loss Calculations with Variables
 - Temperature
 - Connector Count
 - Frequency
 - Conduction size (AWG & Area)
 - Length
- Return Loss
- PSANEXT
- PSAACRF
 - Connector Count
 - Frequency
 - Length

equations for insertion loss of 1-pair ethernet channel

For 20 degrees C and AWG 23

$$IL := \left(1.2 \cdot \frac{L}{100} \right) \cdot \left(1.82 \cdot \sqrt{f} + .0091 \cdot f + \frac{.25}{\sqrt{f}} \right) + B \cdot .02 \cdot \sqrt{f}$$

where

B := number of connectors

f := frequency_MHz

L.. length_m

For any temperature above 20 degrees C and for any conductor size

$$IL := [1 + .004 \cdot (T - 20)] \cdot \left(1.2 \cdot \frac{L}{100} \right) \cdot \left[\frac{1.82}{(23-n)} \cdot \sqrt{f} + .0091 \cdot f + \frac{.25}{\sqrt{f}} \right] + B \cdot .02 \cdot \sqrt{f}$$

where

T := **Temperature in degrees_C**

n := **conductor_size_in_AWG**

For conductor size in cross-sectional area, mm²

$$IL := [1 + .004 \cdot (T - 20)] \cdot \left(1.2 \cdot \frac{L}{100}\right) \cdot \left[1.82 \cdot \left(\frac{.508}{\sqrt{A}}\right) \cdot \sqrt{f} + .0091 \cdot f + \frac{.25}{\sqrt{f}}\right] + B \cdot .02 \cdot \sqrt{f}$$

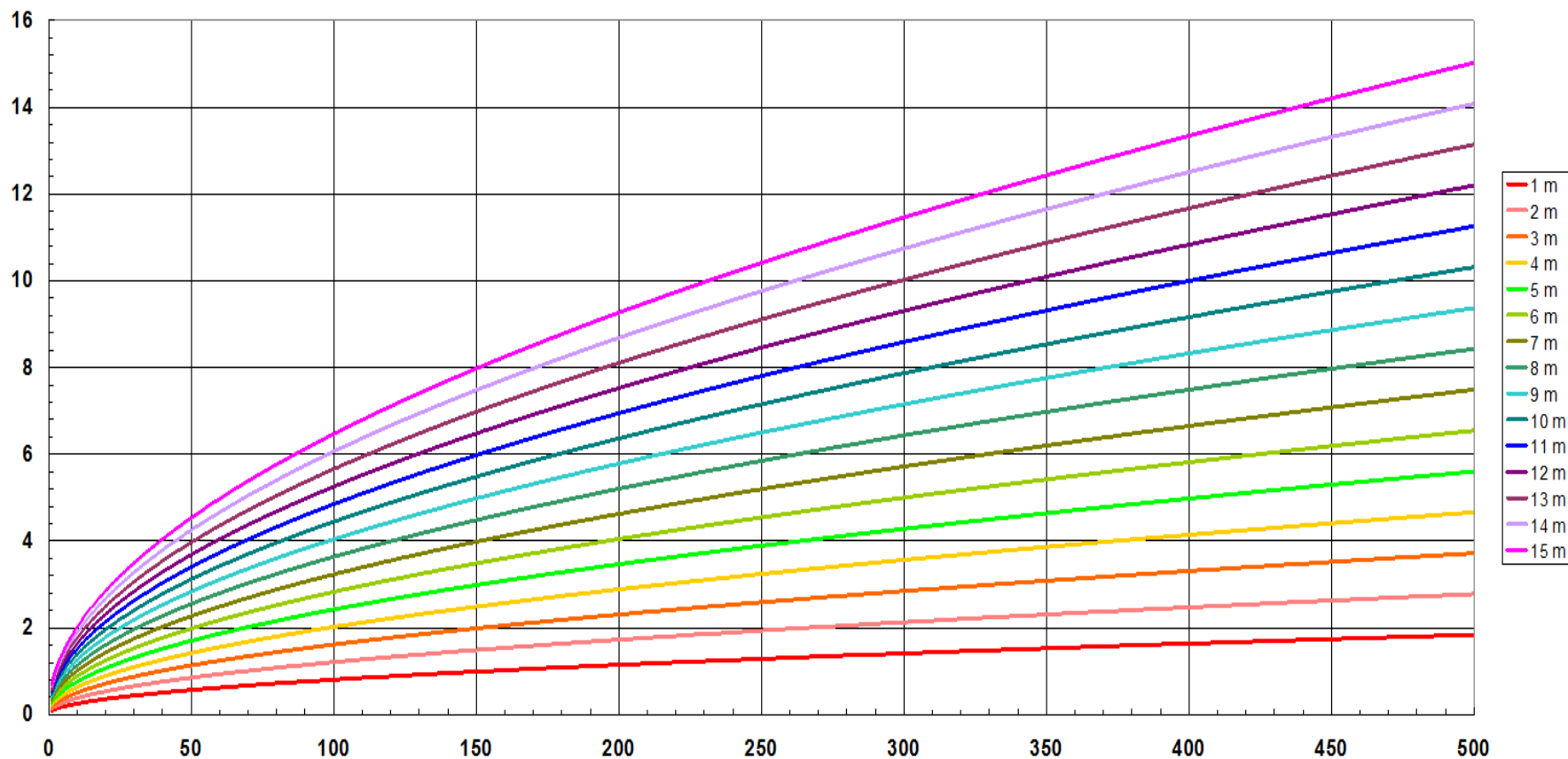
where

$$A := \text{conductor_cross_sectional_area_mm}^2$$

Example calculation for AWG 26 at 125 degrees C

AWG	26														
temperature (degrees C)	125														
number of connectors	2														
	Length														
	1 m	2 m	3 m	4 m	5 m	6 m	7 m	8 m	9 m	10 m	11 m	12 m	13 m	14 m	15 m
frequency MHz															
1	0.08	0.13	0.17	0.21	0.25	0.30	0.34	0.38	0.43	0.47	0.51	0.56	0.60	0.64	0.68
50	0.57	0.85	1.13	1.42	1.70	1.98	2.27	2.55	2.83	3.12	3.40	3.68	3.97	4.25	4.54
100	0.80	1.21	1.61	2.02	2.42	2.83	3.23	3.64	4.04	4.45	4.85	5.26	5.66	6.06	6.47
150	0.99	1.49	1.99	2.49	2.99	3.48	3.98	4.48	4.98	5.48	5.98	6.48	6.98	7.48	7.98
200	1.15	1.73	2.31	2.89	3.47	4.05	4.63	5.21	5.79	6.37	6.95	7.53	8.11	8.69	9.27
250	1.28	1.94	2.59	3.24	3.89	4.54	5.20	5.85	6.50	7.15	7.80	8.46	9.11	9.76	10.41
300	1.41	2.13	2.85	3.56	4.28	5.00	5.72	6.44	7.15	7.87	8.59	9.31	10.02	10.74	11.46
350	1.53	2.31	3.08	3.86	4.64	5.42	6.20	6.98	7.76	8.54	9.32	10.09	10.87	11.65	12.43
400	1.64	2.47	3.31	4.14	4.98	5.82	6.65	7.49	8.33	9.16	10.00	10.83	11.67	12.51	13.34
450	1.74	2.63	3.52	4.41	5.30	6.19	7.08	7.97	8.86	9.75	10.64	11.53	12.42	13.31	14.21
500	1.84	2.78	3.72	4.66	5.61	6.55	7.49	8.43	9.37	10.32	11.26	12.20	13.14	14.08	15.03

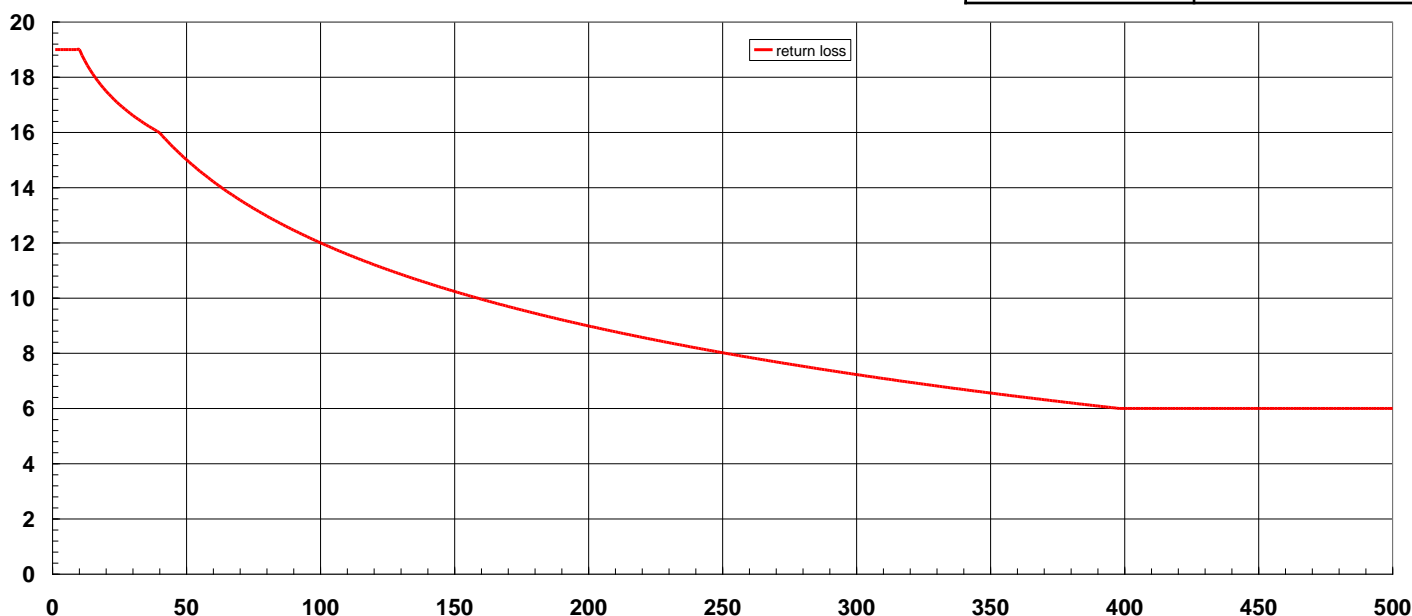
IL versus length and frequency



Return Loss

Frequency MHz	Requirement (dB)
1-10	19
10-40	$24 - 5 * \log(f)$
40-398.1	$32 - 10 * \log(f)$
398.1-500	6

return loss	
frequency MHz	return loss requirement
1	19.00
50	15.01
100	12.00
150	10.24
200	8.99
250	8.02
300	7.23
350	6.56
400	6.00
450	6.00
500	6.00



PSANEXT

from 1 to 100 MHz

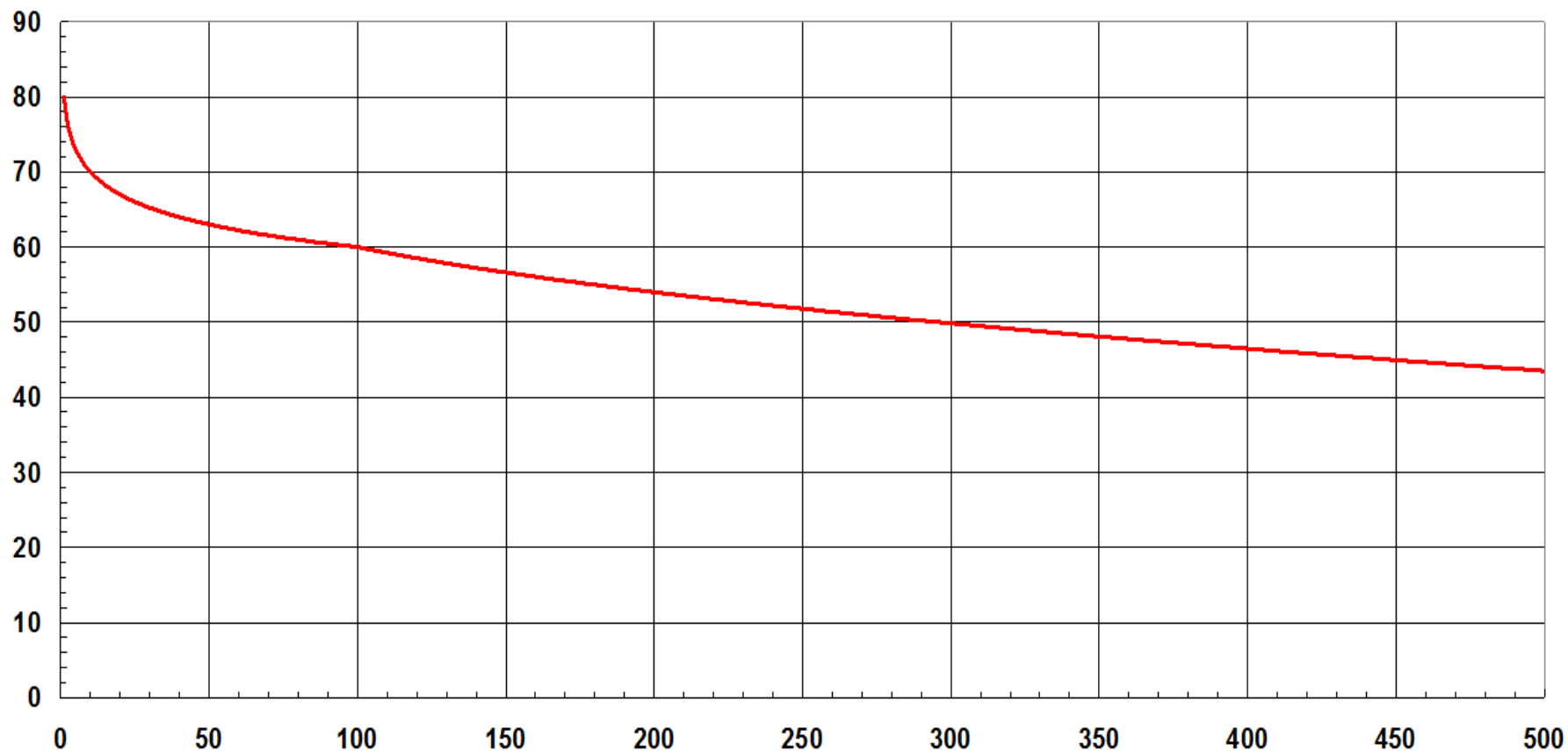
$$\text{PSANEXT} := 60 - 10 \cdot \log\left(\frac{f}{100}\right)$$

from 100 to 500 MHz

$$\text{PSANEXT} := 60 - 15 \cdot \log\left(\frac{f}{100}\right) + 6 \cdot \frac{(f - 100)}{400}$$

PSANEXT loss	
frequency MHz	PSNEXT requirement
1	80.00
50	63.01
100	60.00
150	56.61
200	53.98
250	51.78
300	49.84
350	48.09
400	46.47
450	44.95
500	43.52

PSANEXT specs



Power Sum Alien Attenuation to Crosstalk Ratio, Far End Model

PSAACRF

$$\text{PSAACRF} := -20 \cdot \log_{10} \left[10^{-\frac{\left(-10 \cdot \log\left(\frac{L}{100}\right) + 38.2 - 20 \cdot \log\left(\frac{f}{100}\right) \right)}{-20}} \right] + B \cdot 10^{-\frac{\left(67 - 20 \cdot \log\left(\frac{f}{100}\right) \right)}{-20}}$$

where

$L :=$ length_in_meters

$f :=$ frequency_in_MHz

$B :=$ number_of_connectors

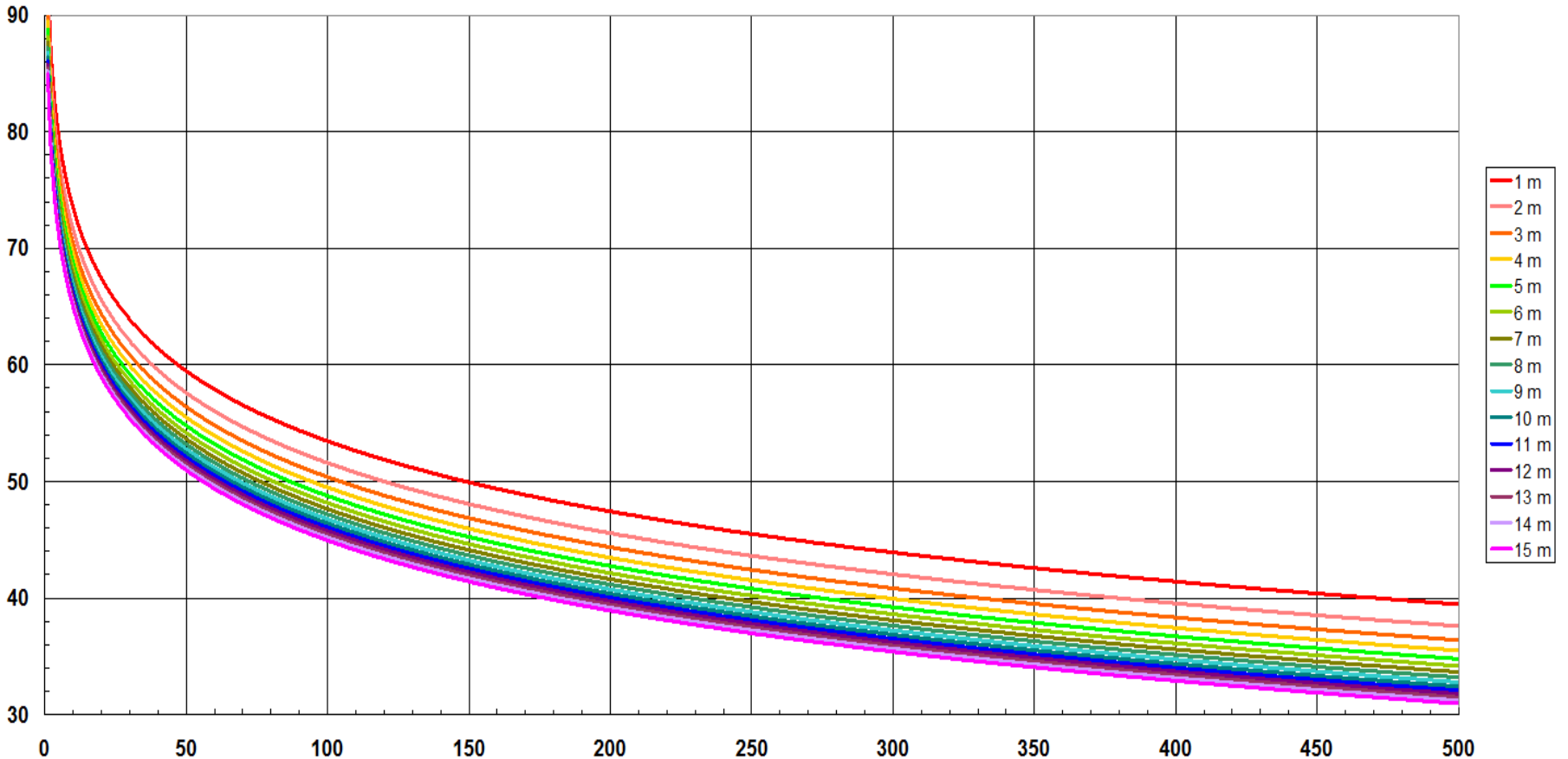
Power Sum Alien Attenuation to Crosstalk Ratio, Far End Model

Example calculation for a 2-connector channel:

Frequency MHz	Length														
	1 m	2 m	3 m	4 m	5 m	6 m	7 m	8 m	9 m	10m	11m	12m	13m	14m	15m
1	93.5	91.6	90.4	89.5	88.8	88.2	87.6	87.2	86.8	86.4	86.1	85.8	85.5	85.2	84.9
50	59.5	57.6	56.4	55.5	54.8	54.2	53.7	53.2	52.8	52.4	52.1	51.8	51.5	51.2	51.0
100	53.5	51.6	50.4	49.5	48.8	48.2	47.6	47.2	46.8	46.4	46.1	45.8	45.5	45.2	44.9
150	49.9	48.1	46.9	46.0	45.2	44.6	44.1	43.7	43.3	42.9	42.5	42.2	41.9	41.7	41.4
200	47.4	45.6	44.4	43.5	42.7	42.1	41.6	41.2	40.8	40.4	40.0	39.7	39.4	39.2	38.9
250	45.5	43.6	42.4	41.5	40.8	40.2	39.7	39.2	38.8	38.4	38.1	37.8	37.5	37.2	37.0
300	43.9	42.0	40.8	39.9	39.2	38.6	38.1	37.6	37.2	36.9	36.5	36.2	35.9	35.7	35.4
350	42.6	40.7	39.5	38.6	37.9	37.3	36.8	36.3	35.9	35.5	35.2	34.9	34.6	34.3	34.1
400	41.4	39.5	38.3	37.4	36.7	36.1	35.6	35.1	34.7	34.4	34.0	33.7	33.4	33.2	32.9
450	40.4	38.5	37.3	36.4	35.7	35.1	34.6	34.1	33.7	33.3	33.0	32.7	32.4	32.1	31.9
500	39.5	37.6	36.4	35.5	34.8	34.2	33.7	33.2	32.8	32.4	32.1	31.8	31.5	31.2	31.0

Power Sum Alien Attenuation to Crosstalk Ratio, Far End Model

PSAACRF versus length and frequency



- This was a follow-up to the recommendation to adopt ISO Class EA specification made in the March Plenary.
- Provided equations provision for all the variable parameters.
- Derivation from combined test data and extrapolation from the standard
- These equations should be reviewed by the Task Force to be used as the foundation for the RTPGE standard.
- LCL, LCTL, TCL, TCTL should be specified based on EMC modeling study

Thank You

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