PSANEXT and PSAACRF Requirements for 10BASE-T1S

IEEE 802.3cg Task Force

February 2019 interim
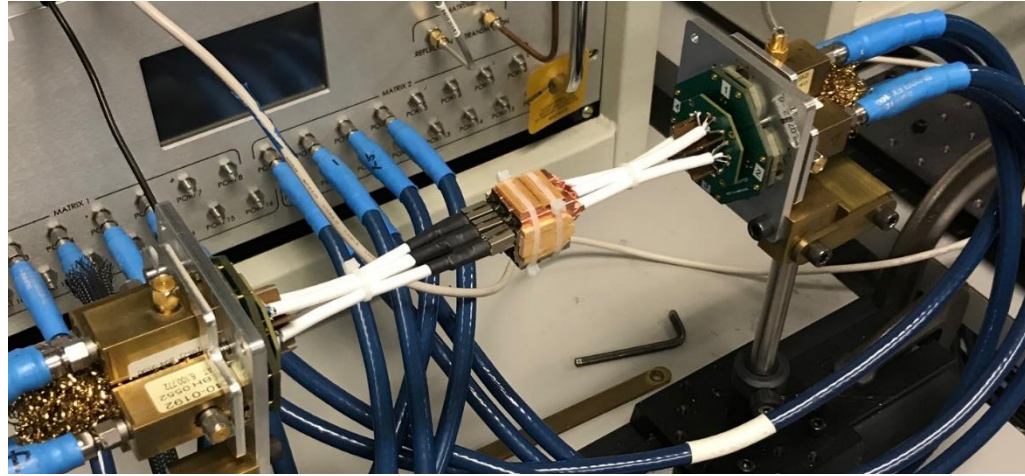
Related to draft 2.3 Clause 147.7 ballot comments

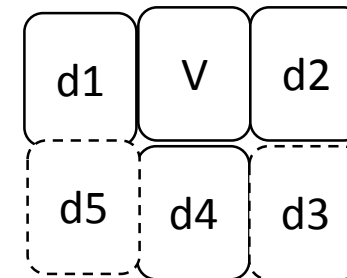Wayne Hopkinson, Jeff Oberski, Masood Shariff

COMMSCOPE®

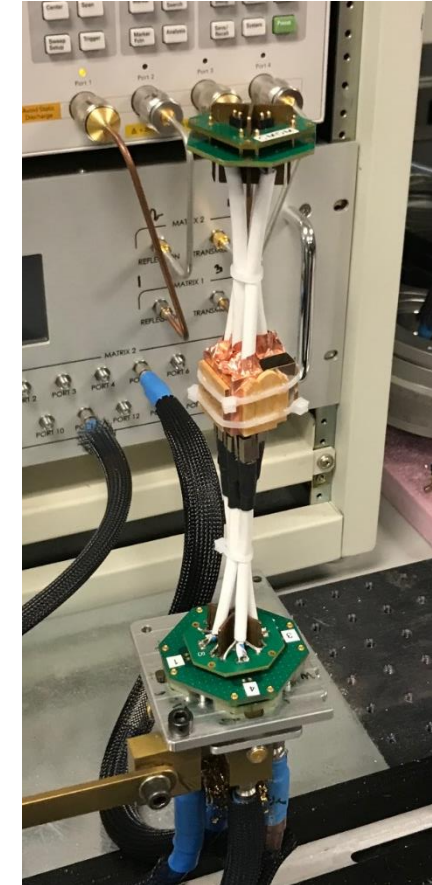# IEC 63171-1 connector alien cross-talk measurement equipment and setup

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AFEXT Measurement

- Network Analyzer: Keysight E5071C
- IF BW: 200 Hz
- 1 MHz – 801 MHz, 801 points
- Power Level: 10 dBm
- Pterodactyl Ver14.2 Measurement Software, Alien NEXT
- Dorothy Ver16a. Measurement Software, Alien FEXT
- Connectors terminated with single pair, 23 AWG, S-FTP cordage
- Six pack test sample constructed with prototype 90° MDI's by cutting off the 90 degree portion of the MDI pins, soldering signal wires to the cut pins, soldering the cable shield to the MDI shield, and then wrapping each MDI with copper tape.

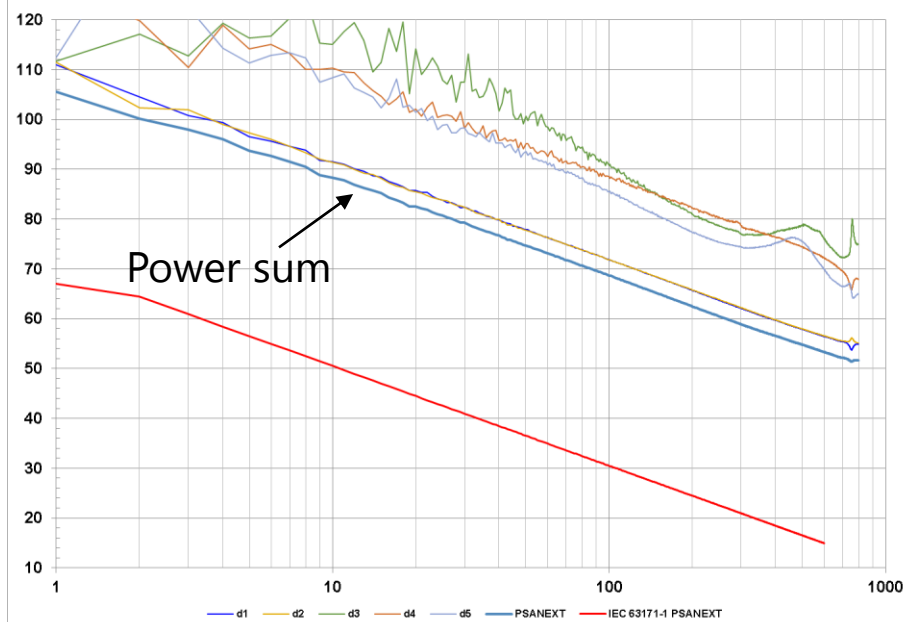| d1	V	d2
d5	d4	d3

Victim-Disturber arrangement
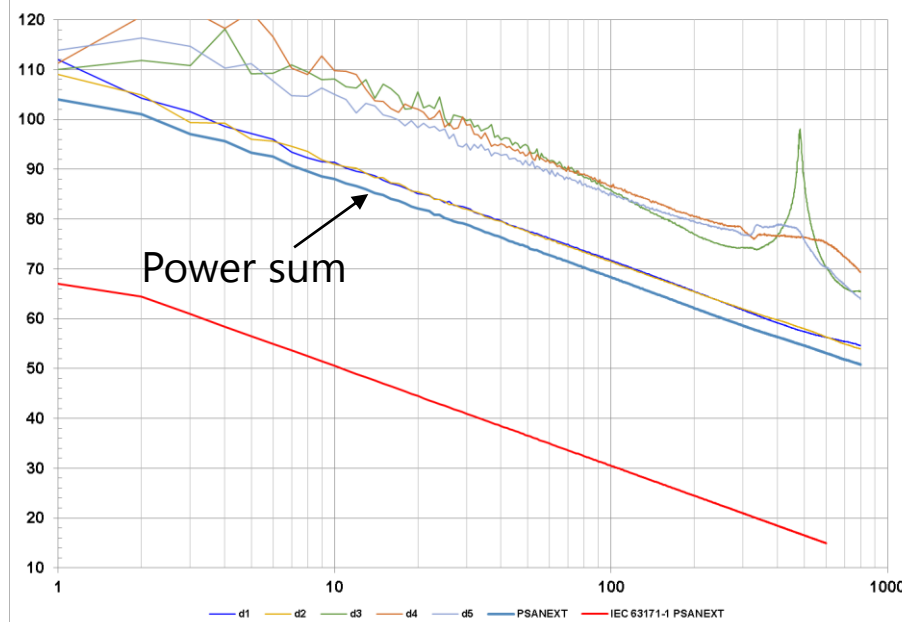

ANEXT Measurement

Results

- Power sum alien NEXT and FEXT both passed by a wide margin in both the forward and reverse directions.

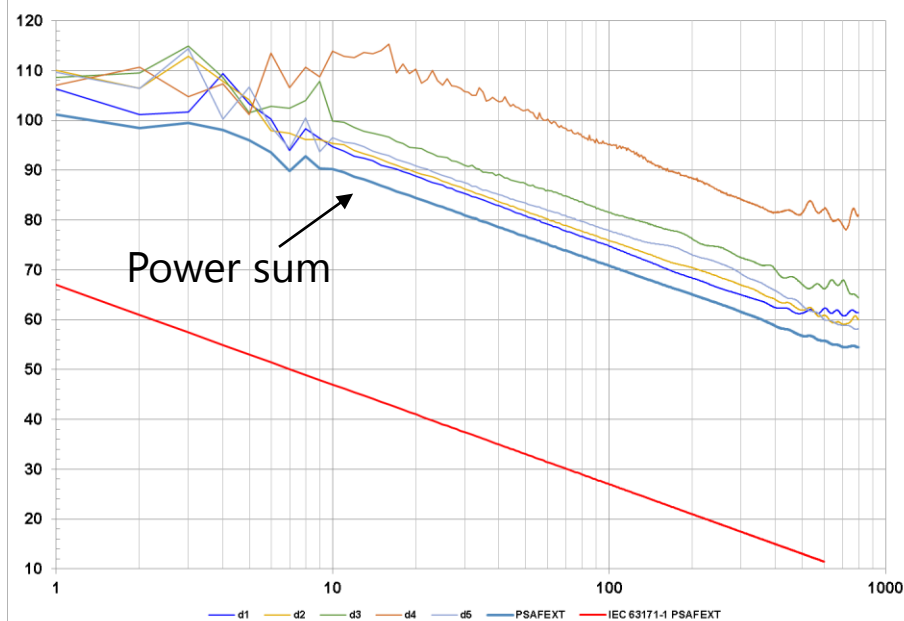- Power Sum data shows a 20 dB per decade slope for PSANEXT and PSAFEXT

One pair AXT results

- DOJ 0.175"

- Six around one AXT result

- 100 meter length

- Proposed IEEE 802.3cg 10BASE-T1S link segment

- $PSANEXT(f) \geq 31.5 - 10 \log_{10}\left(\dfrac{f}{100}\right)$

- $PSAACRF(f) \geq 16.5 - 20 \log_{10}\left(\dfrac{f}{100}\right)$

100m Test:20956

One pair AXT results

- DOJ 0.175"

- Six around one AXT result

- 100 meter length

- Proposed IEEE 802.3cg 10BASE-T1S link segment

- $PSANEXT(f) \geq 31.5 - 10\log_{10}\left(\dfrac{f}{100}\right)$

- $PSAACRF(f) \geq 16.5 - 20\log_{10}\left(\dfrac{f}{100}\right)$

40m Test:20957
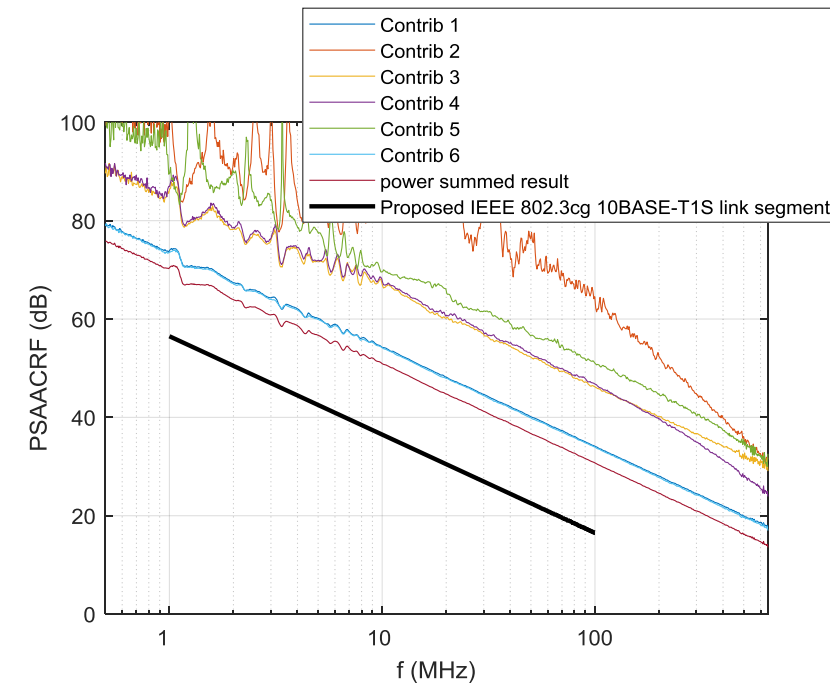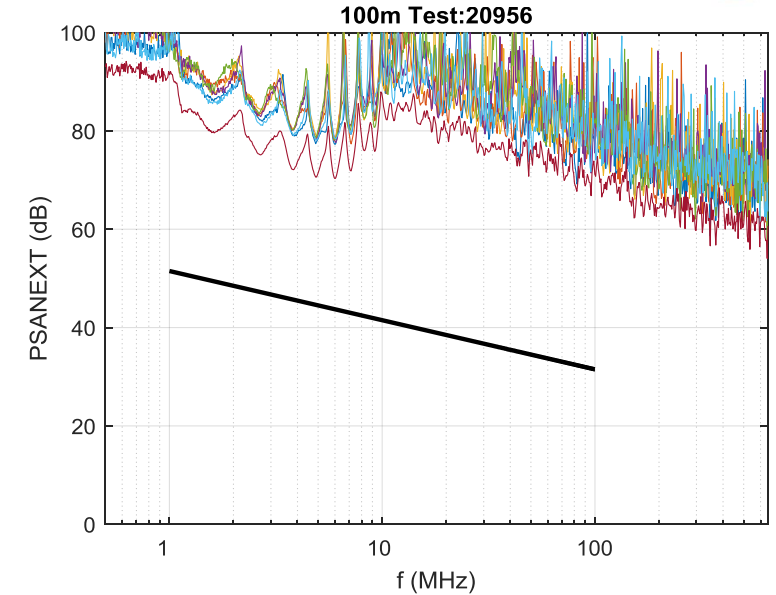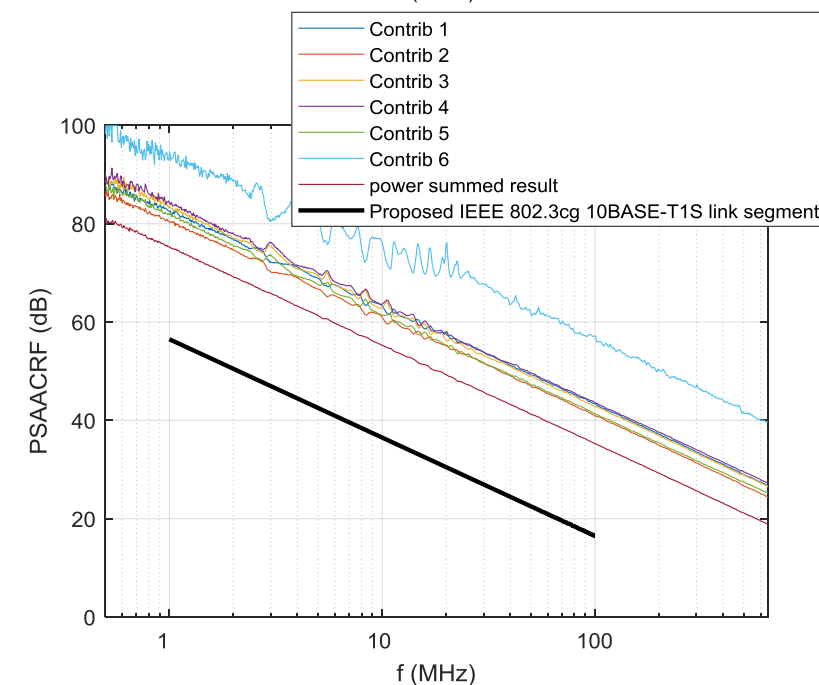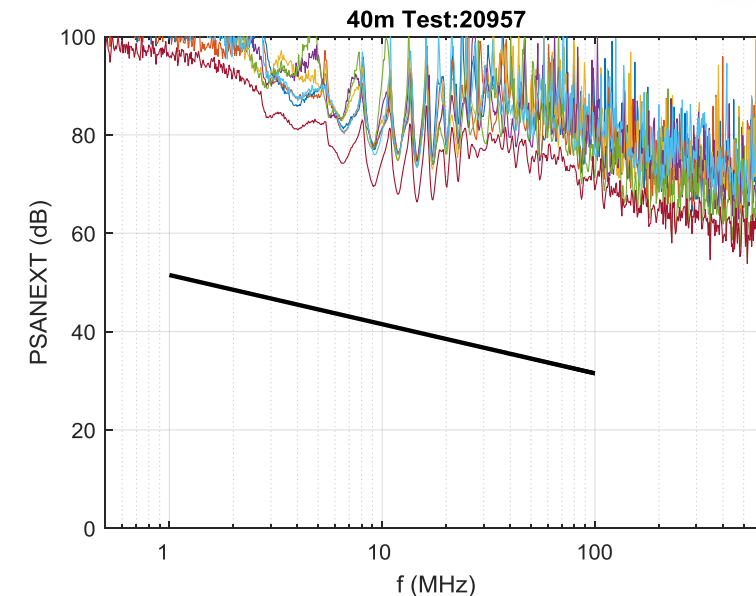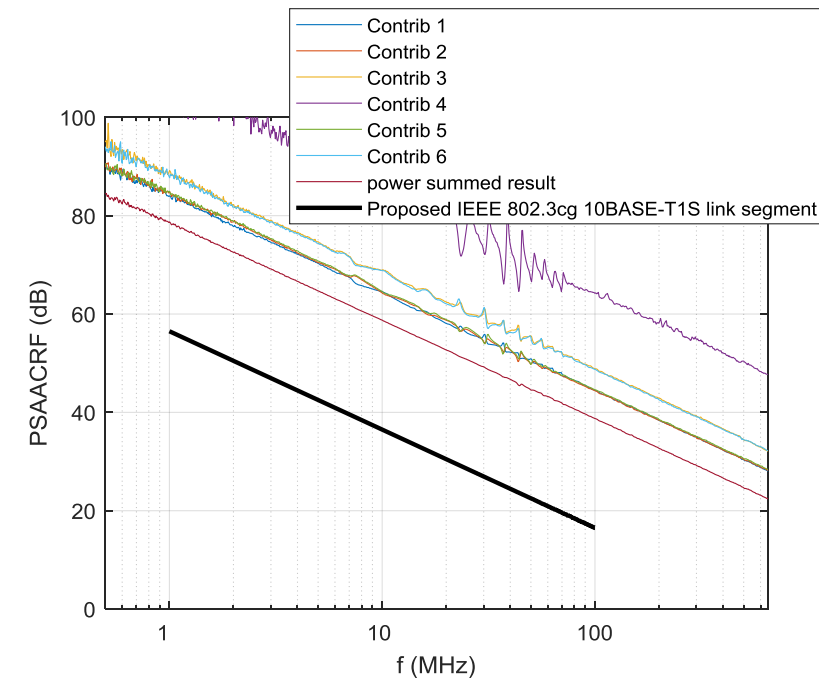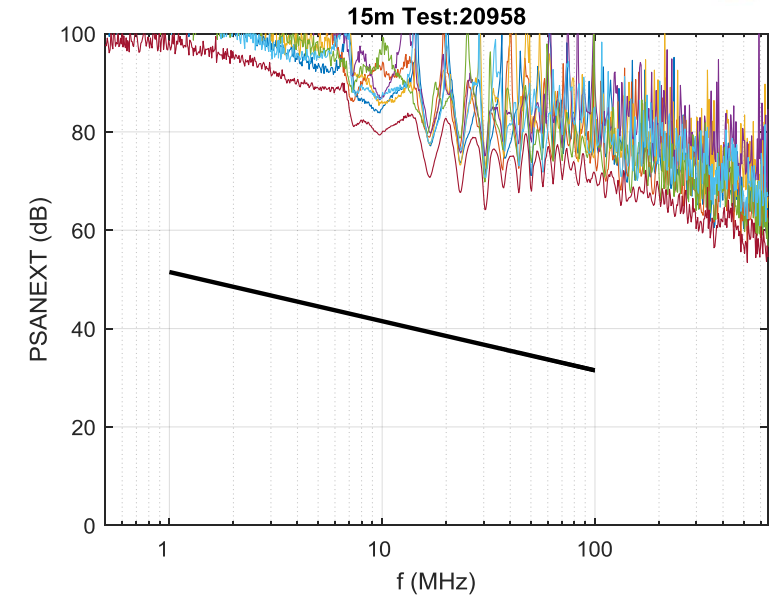
One pair AXT results

- DOJ 0.175"
- Six around one AXT result
- 100 meter length
- Proposed IEEE 802.3cg 10BASE-T1S link segment
- $PSANEXT(f) \geq 31.5 - 10\log_{10}\left(\dfrac{f}{100}\right)$
- $PSAACRF(f) \geq 16.5 - 20\log_{10}\left(\dfrac{f}{100}\right)$

15m Test:20958

Add PSANEXT Requirements for 10BASE-T1S using 100BASE-T1 specifications

96.7.1.5 Power sum alien near-end crosstalk (PSANEXT)

There is no FEXT or NEXT as 100BASE-T1 is a single pair solution. When multiple cable pairs are bundled, the alien XTALK (ANEXT and AFEXT) become interference sources. Since the transmitted symbols from the alien noise source in one cable are not available to another cable, cancellation cannot be done. When there are multiple pairs of cables bundled together, where all pairs carry 100 Mb/s links, then each duplex link is disturbed by neighboring links, degrading the signal quality on the victim pair. In order to limit the near-end crosstalk noise for a 5-around-1 cable bundle (up to 15 m length and up to four in-line connectors, equally spaced), the Power sum alien near-end crosstalk (PSANEXT) loss shall meet Equation (96–9).

$$PSANEXT\ (f) \geq 31.5 - 10 \times \log_{10}\left(\frac{f}{100}\right) \quad dB \qquad for \quad 1\ MHz \leq f \leq 100\ MHz \qquad (96–9)$$

where

$PSANEXT(f)$ is the power sum alien near-end crosstalk loss at frequency f

f is the frequency in MHz

Proposed changes for new Clause 147.7.4

- Adapt the text as follows:
  - Change 100 Mb/s links to 10 Mb/s links and 100BASE-T1 to 10BASE-T1S
  - Change 100 MHz maximum frequency in equation 96-9 to 40 MHz maximum frequency
- Resulting text below:

147.7.4 Power sum alien near-end crosstalk (PSANEXT)

There is no FEXT or NEXT as 10BASE-T1S is a single pair solution. When multiple cable pairs are bundled, the alien XTALK (ANEXT and AFEXT) become interference sources. Since the transmitted symbols from the alien noise source in one cable are not available to another cable, cancellation cannot be done. When there are multiple pairs of cables bundled together, where all pairs carry 10 Mb/s links, then each duplex link is disturbed by neighboring links, degrading the signal quality on the victim pair. In order to limit the near-end crosstalk noise for a 5-around-1 cable bundle (up to 15 m length and up to four in-line connectors, equally spaced), the Power sum alien near-end crosstalk (PSANEXT) loss shall meet Equation (147–xx).

$$\text{PSANEXT}\,(f) \geq 31.5 - 10 \times \log_{10}\left(\frac{f}{100}\right) \quad \text{dB} \qquad \text{for } 1\,\text{MHz} \leq f \leq 40\,\text{MHz} \qquad (147\text{-xx})$$

where

PSANEXT(f) is the power sum alien near-end crosstalk loss at frequency f

f is the frequency in MHz.

Note: These proposed specifications fit the data in slide 11 of kaindl_matheus_3cg_01c_09_2017.pdf

Add PSAACRF Requirements for 10BASE-T1S using 100BASE-T1 specifications

96.7.1.6 Power sum alien attenuation to crosstalk ratio far-end (PSAACRF)

The Power sum alien attenuation to crosstalk ratio far-end (PSAACRF) for a 5-around-1 cable bundle (up to 15 m length and up to four in-line connectors, equally spaced) shall meet Equation (96–10).

$$\text{PSAACRF}(f) \geq 16.5 - 20 \times \log_{10}\left(\frac{f}{100}\right) \text{ dB} \qquad \text{for} \quad 1 \text{ MHz} \leq f \leq 100 \text{ MHz} \qquad (96\text{--}10)$$

where

$\text{PSAACRF}(f)$	is the power sum alien attenuation to crosstalk ratio far-end at frequency f
f	is the frequency in MHz

Proposed changes for new Clause 147.7.5

- Adapt the text as follows:
  - Change 100 MHz maximum frequency in equation 96-10 to 40 MHz maximum frequency
- Resulting text below:

96.7.1.6 Power sum alien attenuation to crosstalk ratio far-end (PSAACRF)

The Power sum alien attenuation to crosstalk ratio far-end (PSAACRF) for a 5-around-1 cable bundle (up to 15 m length and up to four in-line connectors, equally spaced) shall meet Equation (147–yy).

$$\text{PSAACRF}(f) \geq 16.5 - 20 \times \log_{10}\left(\frac{f}{100}\right) \text{ dB} \qquad \text{for } 1 \text{ MHz} \leq f \leq 40 \text{ MHz} \qquad (147\text{–yy})$$

where

PSAACRF(f) is the power sum alien attenuation to crosstalk ratio far-end at frequency f

f is the frequency in MHz

Note: These proposed specifications fit the data in slide 12 of kaindl_matheus_3cg_01c_09_2017.pdf