HPA 2017

Improvements in Data Cables and Connectors

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BELDEN
SENDING ALL THE RIGHT SIGNALS

New Category Cable Design

- Category 6A “Augmented” Category 6
  - 500 MHz per pair
  - PAM 16 multilevel coding
  - 10 gigabits data rate
  - 10GbaseT

Shielded? Unshielded?

- Shielded
  - Helps prevent signals between cables (“Alien Crosstalk”)
  - Concentrates emissions inside the cable, between pairs
    - Increased crosstalk between pairs (4-6 dB)
  - Ground loops and ground-induced noise
  - Shield is more work to install
  - Shield is more expensive (more steps to manufacture)
    - “Telescopic shielding”is NOT a solution

Shielded? Unshielded?

- Unshielded
  - Cheaper (fewer steps to manufacture)
  - Easier to install
  - Lowest crosstalk between pairs
  - Worse alien crosstalk when cables are bundled
    - Bonded pairs help reduce emission
    - Bonded pairs have to be split to connectorize “more work”

Too Bad There Isn’t a Better way…..

- Belden 10GXSxx series
- Category 6A (10GbaseT)
- A layer inside the cable
  - Absorptive layer
  - Covered in plastic, no way to make contact
  - No drain wire
  - Uses unshielded connectors at both end
- Dissipates energy absorbed
  - Continuous layer
- 25% smaller than ‘regular’ Cat 6A cable

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Cable is Only as Good as the Connector

- Belden REVConnect
- Dramatic Improvement in
  - Performance
    - The best we have ever seen in an RJ-45
  - Speed of Assembly
    - With practice, easily 1 minute.
  - Price
    - On a par with most other Cat 6A connectors

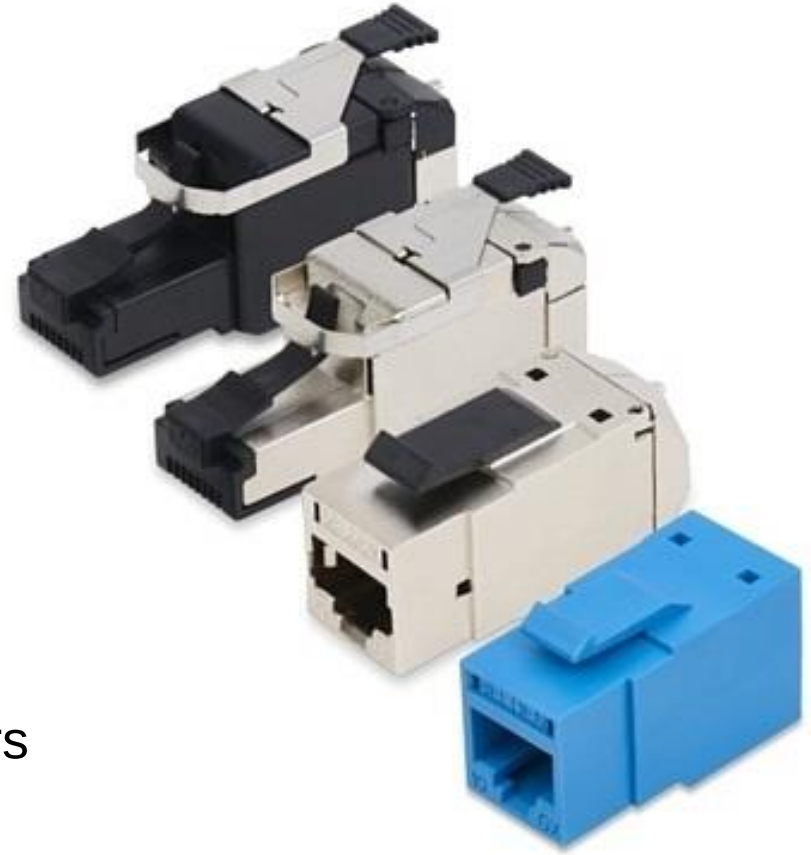
Belden REVConnect…

- Starts with a “cable Manager”
  - All the work is here
  - Choose 568A or 568B
    - Color code dots guide you
    - White wire faces outside
- Let’s watch the video

REVConnect Animated Video - Final.mp4

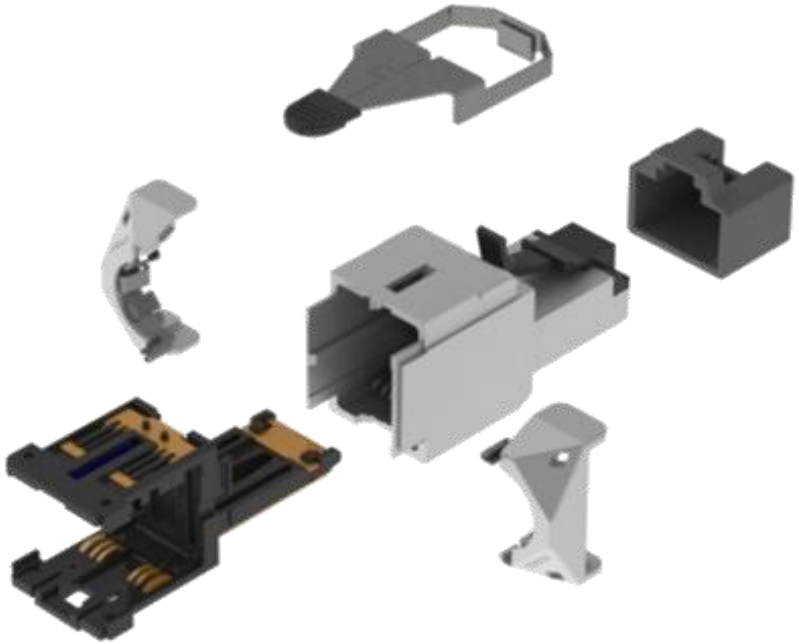
REVConnect

- Shielded
- Unshielded
- Cat 5e
- Cat 6
- Cat 6A
- Almost any cable
- Bonded or unbonded
  - The best ever with bonded pairs
  - No pair splitting required



Lots of New Technology

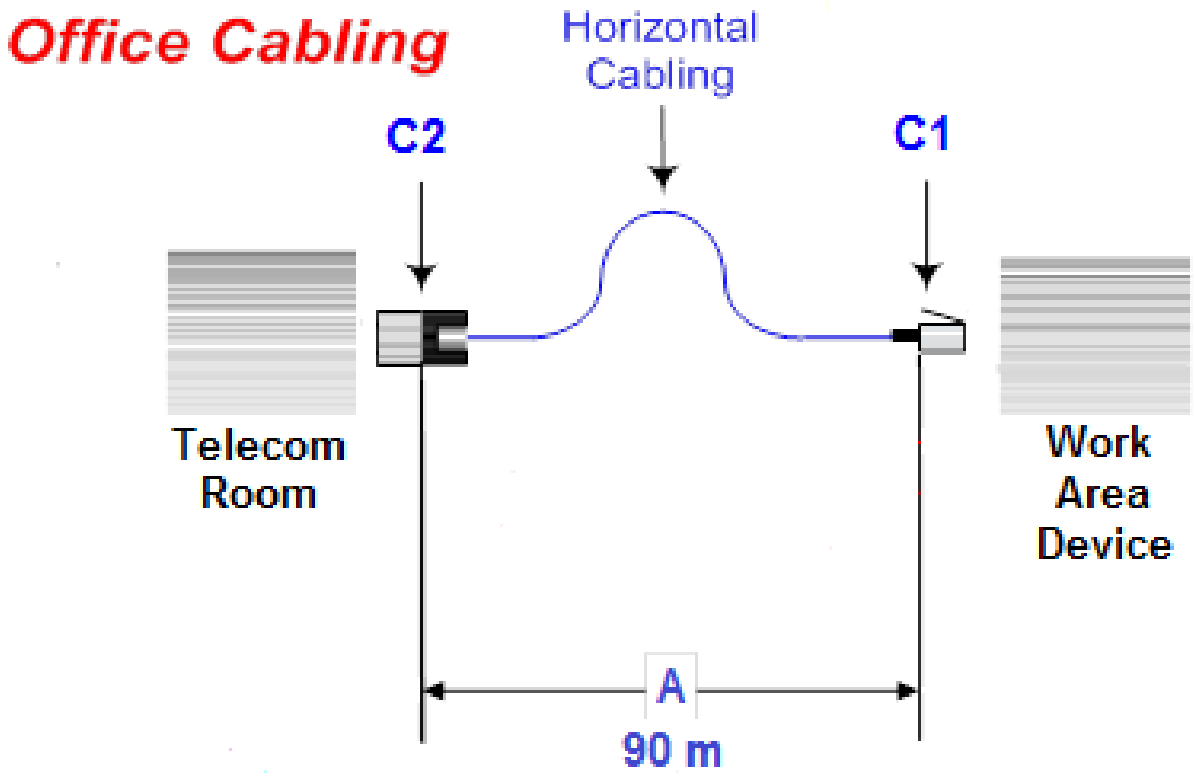
- Pull tab to unlock from behind
- Flexible circuit board
  - Compensation components
- Can remove/change housing up to five times
- Front pins good for 750 insertions
  - TIA standard
  - 50 µin of gold



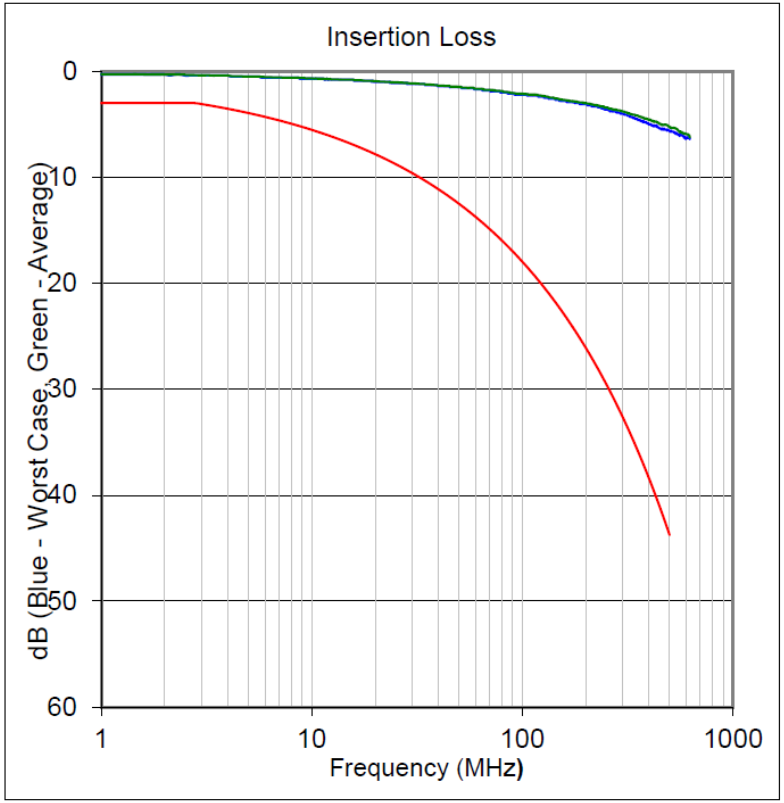
REVConnect Crimper

- Simple crimp tool
  - Completes cable manager
  - Safety interlock
- Note stripping tool in handle
- MSRP: $115

Cable and Connectors – Tested Together

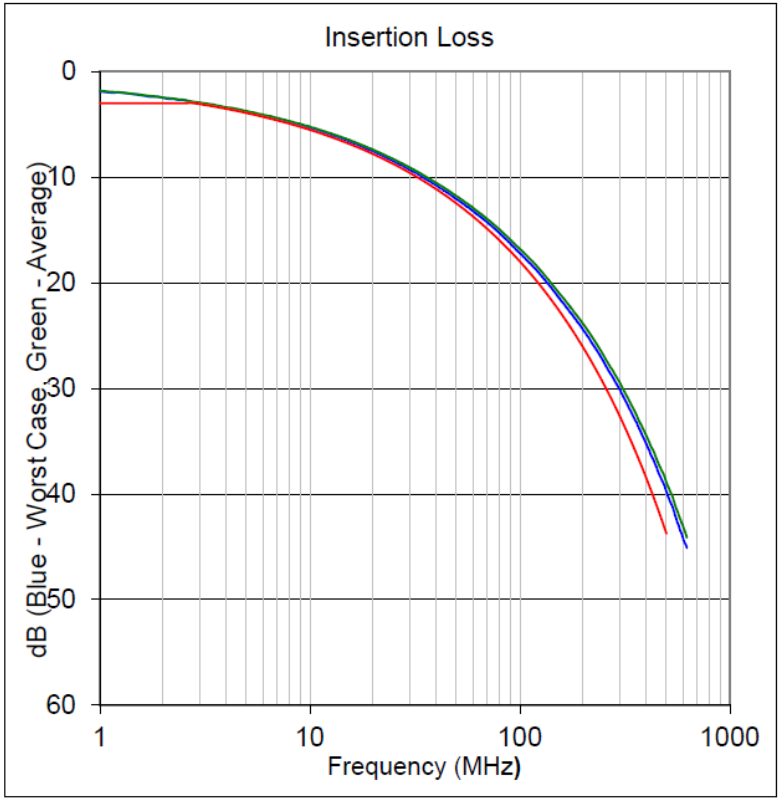


Insertion Loss – 10 Metres



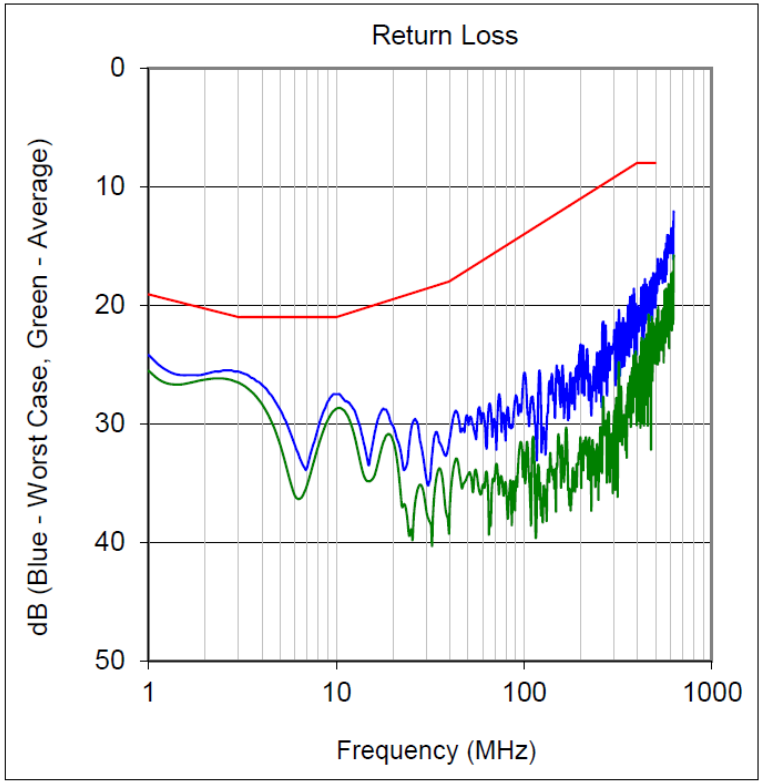
Insertion Loss			
Freq.	Worst Case	Average	Spec. TIA
1	0.3	0.3	3.0
4	0.4	0.4	3.5
8	0.6	0.6	5.0
10	0.7	0.7	5.5
16	0.9	0.9	7.0
20	1.0	0.9	7.8
25	1.1	1.1	8.8
31	1.2	1.2	9.8
62	1.7	1.7	14.0
100	2.2	2.1	18.0
160	2.8	2.7	23.1
200	3.1	3.0	26.1
250	3.6	3.4	29.5
300	4.0	3.8	32.7
350	4.5	4.2	35.6
400	5.0	4.6	38.4
450	5.4	5.0	41.1
500	5.6	5.3	43.8
550	6.0	5.6	na
600	6.3	5.9	na
625	6.4	6.2	na

Insertion Loss – 90 Metres



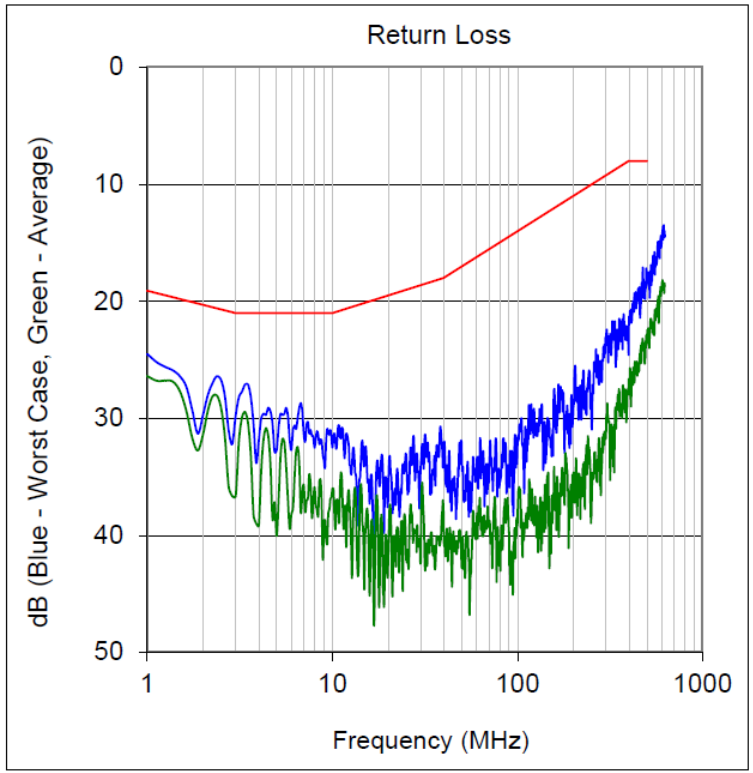
Insertion Loss			
Freq.	Worst Case	Average	Spec. TIA
1	1.9	1.8	3.0
4	3.5	3.4	3.5
8	4.8	4.7	5.0
10	5.3	5.2	5.5
16	6.8	6.6	7.0
20	7.6	7.4	7.8
25	8.5	8.3	8.8
31	9.5	9.3	9.8
62	13.5	13.2	14.0
100	17.2	16.8	18.0
160	21.9	21.4	23.1
200	24.4	23.9	26.1
250	27.4	26.9	29.5
300	30.1	29.5	32.7
350	32.8	32.0	35.6
400	35.2	34.5	38.4
450	37.5	36.8	41.1
500	39.8	38.9	43.8
550	42.0	41.1	na
600	44.2	43.1	na
625	45.1	44.1	na

Return Loss – 10 Metres



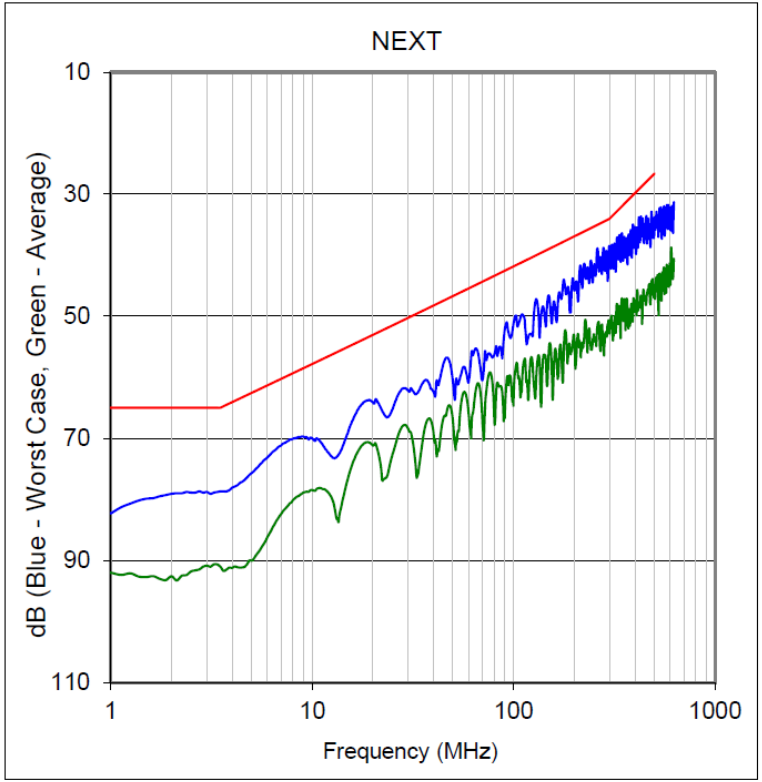
Return Loss			
Freq.	Worst Case	Average	Spec. TIA
1	24.2	25.5	19.1
4	26.7	28.3	21.0
8	30.3	31.9	21.0
10	27.5	28.7	21.0
16	30.7	34.3	20.0
20	30.2	31.4	19.5
25	30.4	38.9	19.0
31	35.1	38.1	18.5
62	30.7	34.5	16.1
100	25.7	33.0	14.0
160	25.1	33.2	12.0
200	23.4	31.5	11.0
250	27.4	32.5	10.0
300	22.6	29.3	9.2
350	23.8	29.9	8.6
400	21.5	25.7	8.0
450	20.0	23.0	8.0
500	20.2	23.0	8.0
550	16.7	20.3	na
600	15.5	21.5	na
625	12.2	15.8	na

Return Loss – 90 Metres



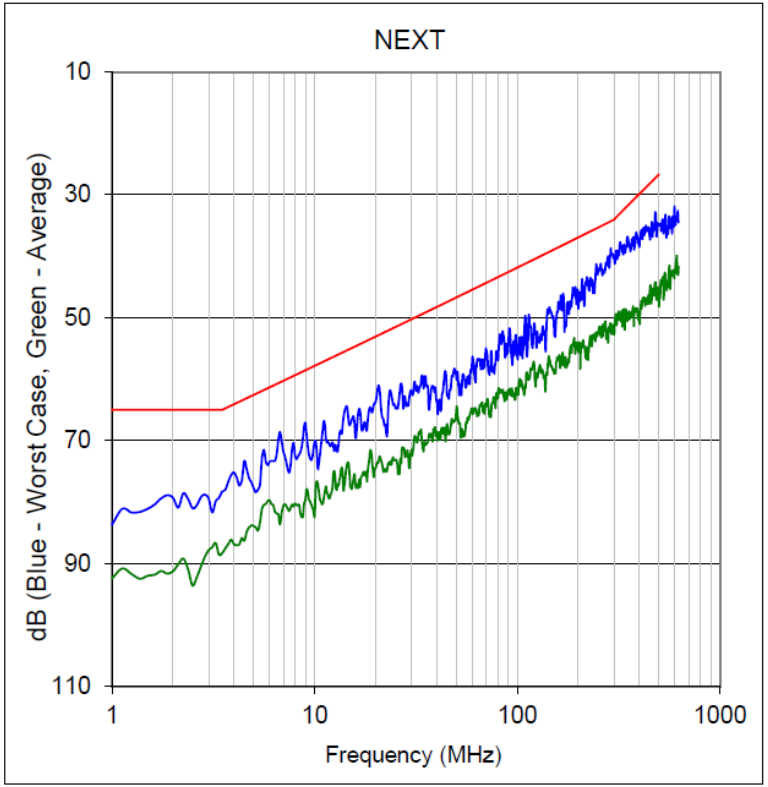
Return Loss			
Freq.	Worst Case	Average	Spec. TIA
1	24.5	26.4	19.1
4	31.9	39.2	21.0
8	32.5	35.9	21.0
10	32.5	36.0	21.0
16	36.0	43.3	20.0
20	36.8	42.2	19.5
25	33.1	42.1	19.0
31	34.0	38.0	18.5
62	34.7	38.1	16.1
100	31.7	38.2	14.0
160	29.7	37.2	12.0
200	29.5	35.6	11.0
250	29.3	38.6	10.0
300	23.1	31.6	9.2
350	23.5	28.7	8.6
400	21.3	27.4	8.0
450	18.9	26.1	8.0
500	17.8	23.0	8.0
550	16.8	21.2	na
600	14.8	18.9	na
625	14.5	18.7	na

Near-End Crosstalk – 10 Metres



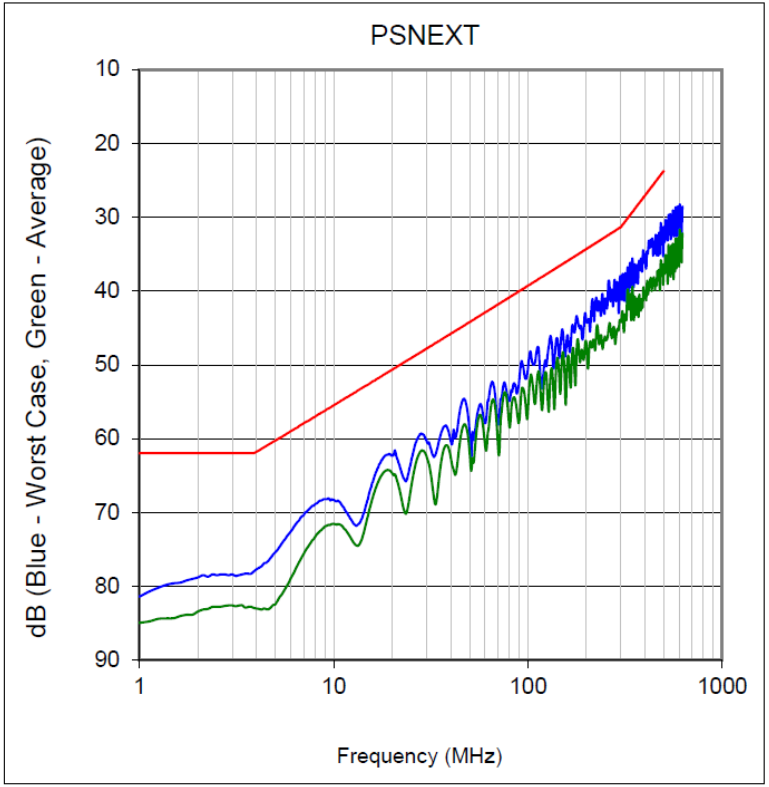
NEXT			
Freq.	Worst Case	Average	Spec. TIA
1	82.3	92.0	65.0
4	78.1	91.2	64.1
8	70.1	80.2	59.4
10	70.0	78.5	57.8
16	66.8	73.8	54.6
20	64.1	71.2	53.1
25	65.3	72.7	51.5
31	61.8	69.2	50.0
62	55.7	66.8	45.2
100	51.1	62.9	41.8
160	48.1	55.8	38.5
200	45.7	53.6	36.9
250	41.9	53.0	35.3
300	39.2	52.6	34.0
350	40.9	50.5	31.8
400	35.4	49.3	29.9
450	37.0	46.8	28.2
500	36.1	46.3	26.7
550	32.8	44.4	na
600	35.9	44.9	na
625	31.3	41.0	na

Near-End Crosstalk – 90 Metres



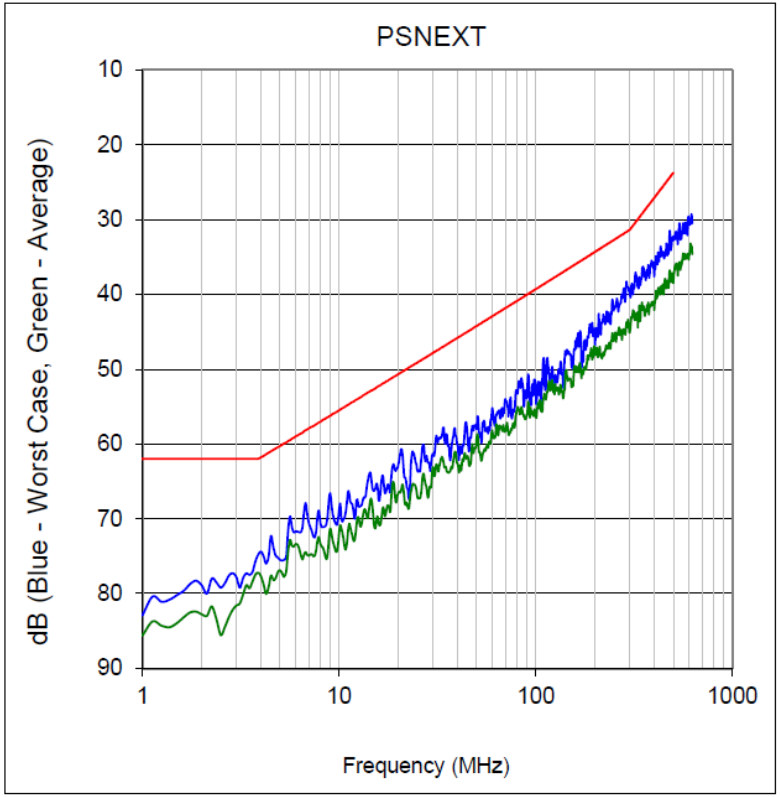
NEXT			
Freq.	Worst Case	Average	Spec. TIA
1	83.7	92.5	65.0
4	75.2	86.9	64.1
8	72.3	80.2	59.4
10	70.2	82.4	57.8
16	69.6	77.7	54.6
20	63.7	74.5	53.1
25	64.6	73.1	51.5
31	60.7	69.7	50.0
62	60.2	64.8	45.2
100	56.4	62.5	41.8
160	48.0	56.9	38.5
200	48.5	55.3	36.9
250	42.3	52.5	35.3
300	40.5	52.8	34.0
350	36.8	50.0	31.8
400	38.5	50.8	29.9
450	36.9	45.9	28.2
500	34.8	48.2	26.7
550	36.1	44.4	na
600	34.4	42.4	na
625	34.4	41.7	na

Power Sum Near-End Crosstalk – 10 Metres



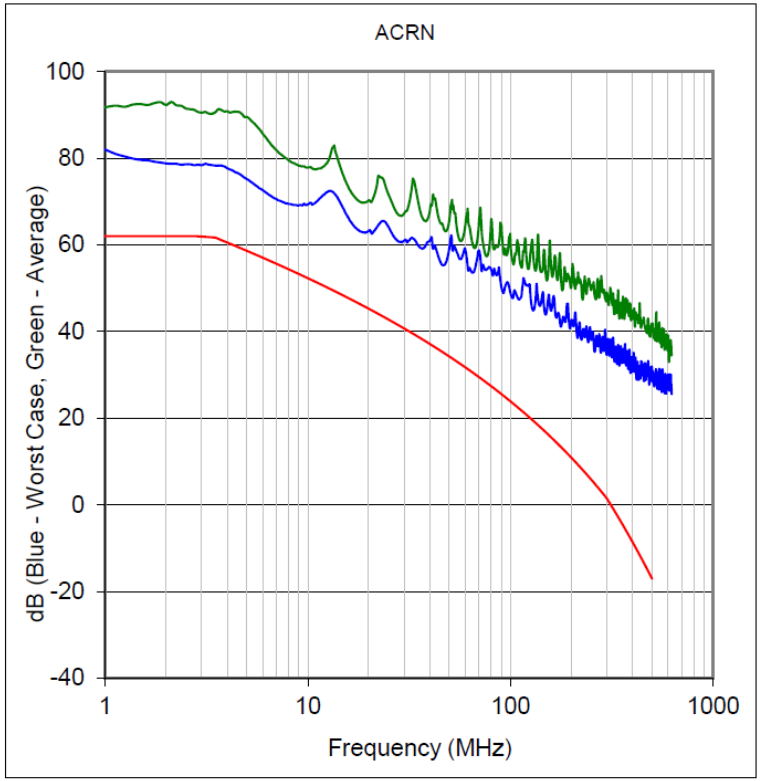
PSNEXT			
Freq.	Worst Case	Average	Spec. TIA
1	81.4	85.0	62.0
4	77.7	83.0	61.8
8	68.9	73.4	57.0
10	68.3	71.5	55.5
16	65.6	67.7	52.2
20	62.3	64.7	50.7
25	63.2	66.7	49.1
31	60.6	63.6	47.6
62	55.0	59.5	42.7
100	50.5	56.1	39.3
160	46.0	49.1	35.9
200	44.3	47.2	34.3
250	41.3	46.3	32.7
300	38.5	44.1	31.4
350	39.5	43.6	29.1
400	35.0	40.8	27.1
450	34.9	39.6	25.3
500	32.7	36.6	23.8
550	30.1	35.3	na
600	32.5	36.7	na
625	28.8	32.7	na

Power Sum Near-End Crosstalk – 90 Metres



PSNEXT			
Freq.	Worst Case	Average	Spec. TIA
1	82.9	85.6	62.0
4	74.4	77.7	61.8
8	70.3	73.2	57.0
10	68.8	71.8	55.5
16	67.6	70.9	52.2
20	62.7	66.6	50.7
25	63.6	67.1	49.1
31	59.4	63.0	47.6
62	57.6	59.2	42.7
100	53.3	56.3	39.3
160	46.8	50.4	35.9
200	46.8	48.1	34.3
250	41.6	45.9	32.7
300	39.9	45.1	31.4
350	36.3	41.8	29.1
400	37.6	42.1	27.1
450	35.1	39.0	25.3
500	32.8	38.5	23.8
550	32.6	36.1	na
600	30.3	35.2	na
625	30.4	34.4	na

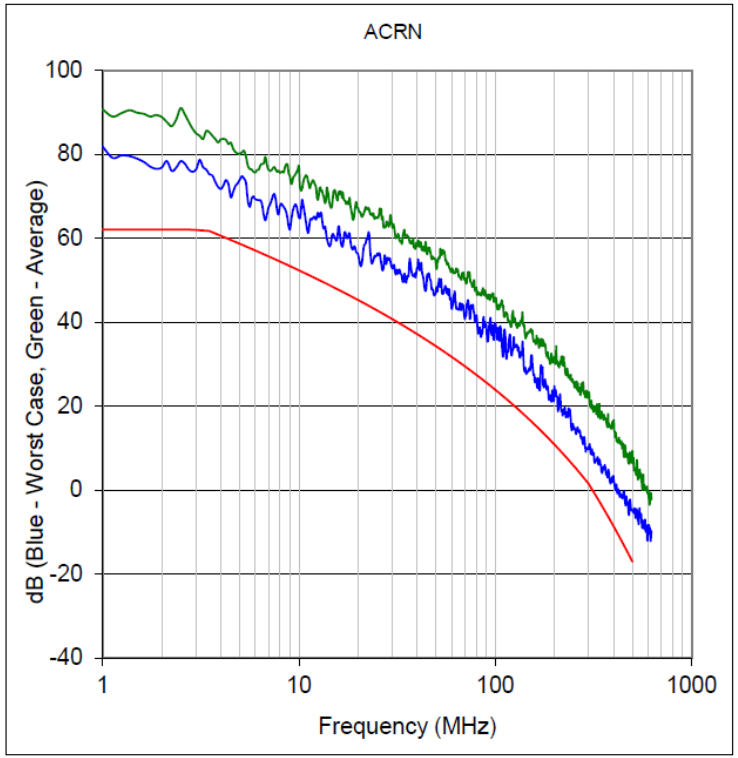
Attenuation/Crosstalk Ratio – Near End - 10 Metres



ACRN			
Freq.	Worst Case	Average	Spec. TIA*
1	82.0	91.8	62.0
4	77.7	90.8	60.5
8	69.5	79.6	54.4
10	69.3	77.8	52.3
16	65.9	72.9	47.6
20	63.2	70.3	45.2
25	64.2	71.7	42.8
31	60.6	68.1	40.3
62	54.0	65.1	31.2
100	48.9	60.8	23.9
160	45.3	53.1	15.4
200	42.6	50.6	10.8
250	38.4	49.6	5.8
300	35.3	48.8	1.3
350	36.6	46.4	-3.8
400	30.7	44.8	-8.6
450	31.9	41.9	-13.0
500	30.7	41.0	-17.1
550	27.0	38.9	na
600	30.0	39.1	na
625	25.5	35.0	na

* ACR N derived from NEXT and IL limits

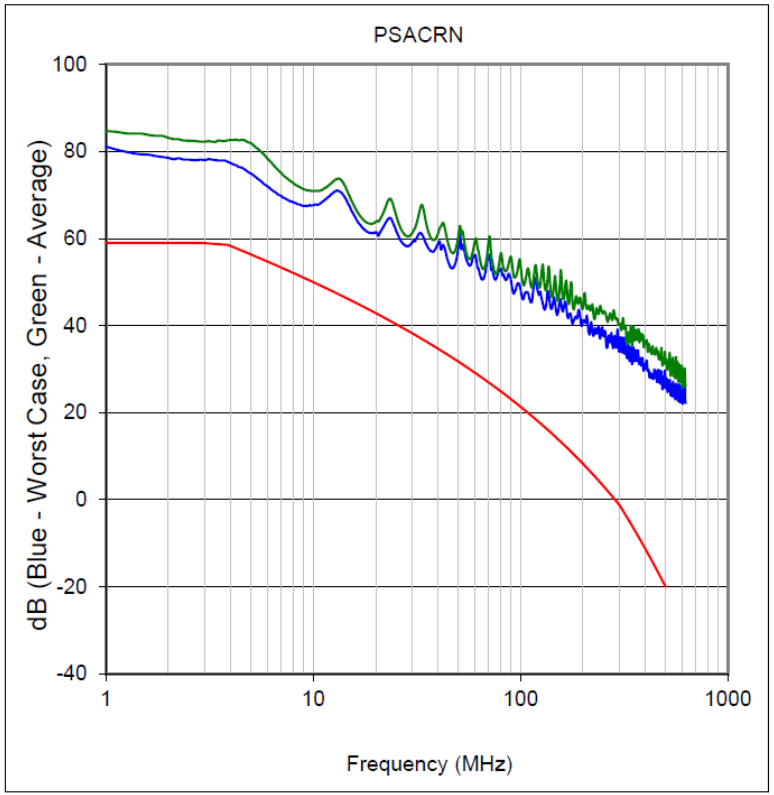
Attenuation/Crosstalk Ratio – Near End - 90 Metres



ACRN			
Freq.	Worst Case	Average	Spec. TIA*
1	81.8	90.7	62.0
4	71.7	83.5	60.5
8	67.5	75.5	54.4
10	64.9	77.2	52.3
16	62.8	71.1	47.6
20	56.1	67.2	45.2
25	56.1	64.9	42.8
31	51.6	60.4	40.3
62	46.7	51.6	31.2
100	39.7	45.8	23.9
160	26.1	35.5	15.4
200	24.1	31.5	10.8
250	14.9	25.7	5.8
300	10.4	23.3	1.3
350	4.0	18.0	-3.8
400	3.3	16.5	-8.6
450	-0.6	9.2	-13.0
500	-5.0	9.3	-17.1
550	-5.9	3.4	na
600	-8.9	-0.6	na
625	-9.8	-2.3	na

* ACR N derived from NEXT and IL limits

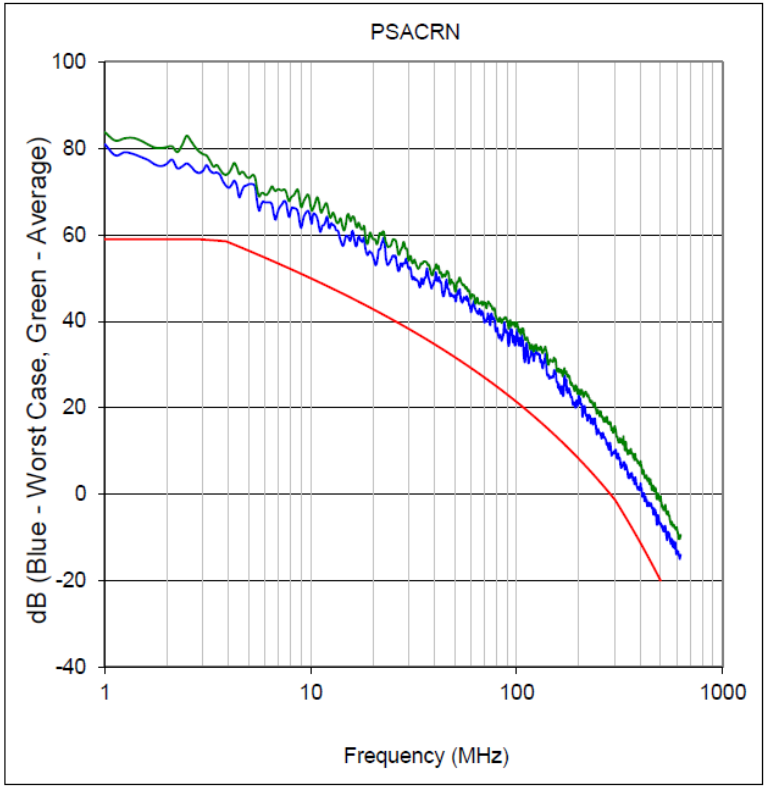
Power Sum Attenuation/Crosstalk Ratio – 10 Metres



PSACRN			
Freq.	Worst Case	Average	Spec. TIA*
1	81.1	84.7	59.0
4	77.3	82.6	58.3
8	68.3	72.8	52.1
10	67.6	70.9	50.0
16	64.7	66.8	45.2
20	61.4	63.8	42.8
25	62.1	65.6	40.4
31	59.4	62.4	37.8
62	53.3	57.8	28.7
100	48.3	54.0	21.3
160	43.2	46.4	12.8
200	41.2	44.2	8.2
250	37.8	42.8	3.2
300	34.5	40.3	-1.3
350	35.0	39.4	-6.5
400	30.0	36.2	-11.4
450	29.5	34.7	-15.8
500	27.1	31.4	-20.0
550	24.1	29.7	na
600	26.2	30.8	na
625	22.4	26.5	na

* PSACR N derived from PSNEXT and IL limits

Power Sum Attenuation/Crosstalk Ratio – 90 Metres



PSACRN			
Freq.	Worst Case	Average	Spec. TIA*
1	81.0	83.8	59.0
4	70.9	74.3	58.3
8	65.5	68.5	52.1
10	63.5	66.6	50.0
16	60.9	64.3	45.2
20	55.2	59.2	42.8
25	55.1	58.8	40.4
31	50.3	53.8	37.8
62	44.3	46.0	28.7
100	36.9	39.5	21.3
160	25.2	29.0	12.8
200	22.4	24.2	8.2
250	14.4	19.1	3.2
300	10.0	15.7	-1.3
350	3.7	9.8	-6.5
400	2.5	7.6	-11.4
450	-2.3	2.2	-15.8
500	-6.7	-0.4	-20.0
550	-9.0	-5.0	na
600	-13.4	-7.8	na
625	-14.2	-9.8	na

* PSACR N derived from PSNEXT and IL limits

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