PHY Channels based on Class II, with new Bel ARJ45 MDI and variances of PCBs

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Introduction

- At the last Channel ad hoc February 18 a new MDI including magnetics was presented. The electrical performance is on a high level and it is to be seen how it performs with cablings and PCBs.

- It is based on ARJ45 connectivity

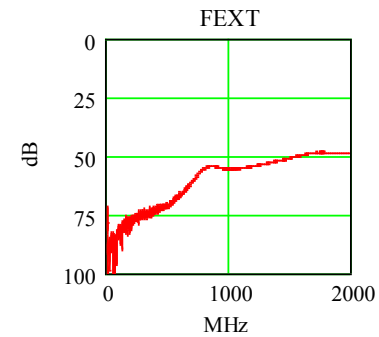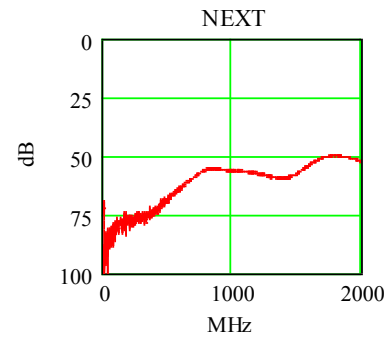# From Indian Wells Presentation
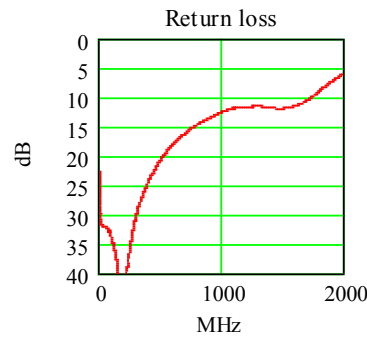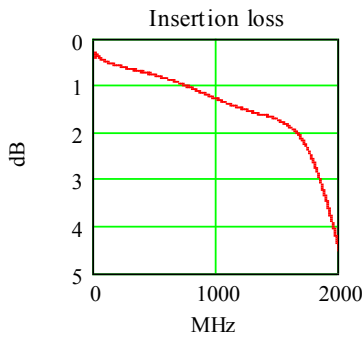
franck_3bq_01a_0114

- The published S16P files for different parts of the PHY channel are read into a program which calculates for two pairs the corresponding 8x8 M-matrix (mixed mode) for each component.

- These matrices are transformed into chain T-matrices which can be multiplied meaning the components are concatenated.

- After transforming back the transmission values of the concatenation are obtained.

- All pair combinations from both sides with all values (dd,cc, cd) can be calculated, but to get a better overview only two pairs at a time for dd are presented.

- If necessary he result can be exported to CSV for all parameters.

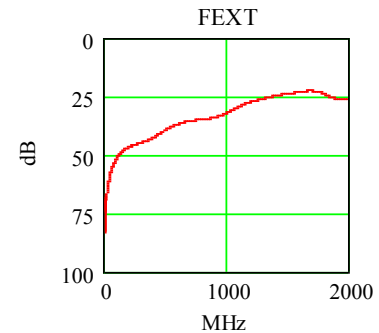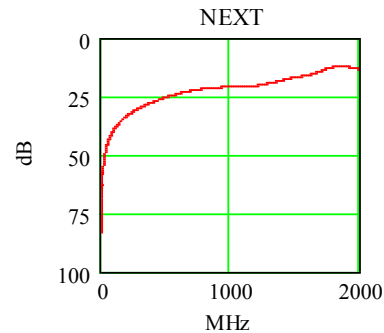# Characteristics of Bel ARJ45 and BEL RJ45 MDI

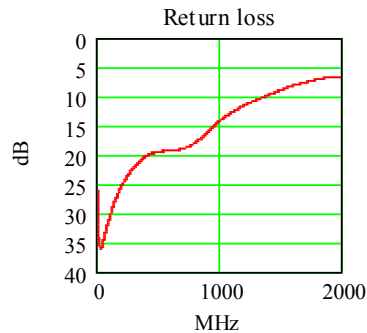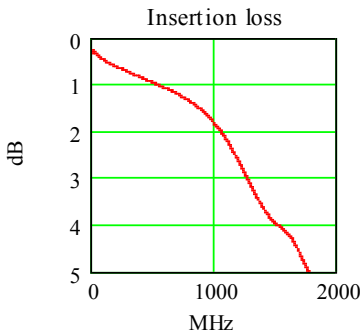Case ≡ 1   **dd** values   **MDI Bell-45**

Insertion loss	Return loss	NEXT	FEXT

ARJ45

NEXT
 +30 dB

dd cc values

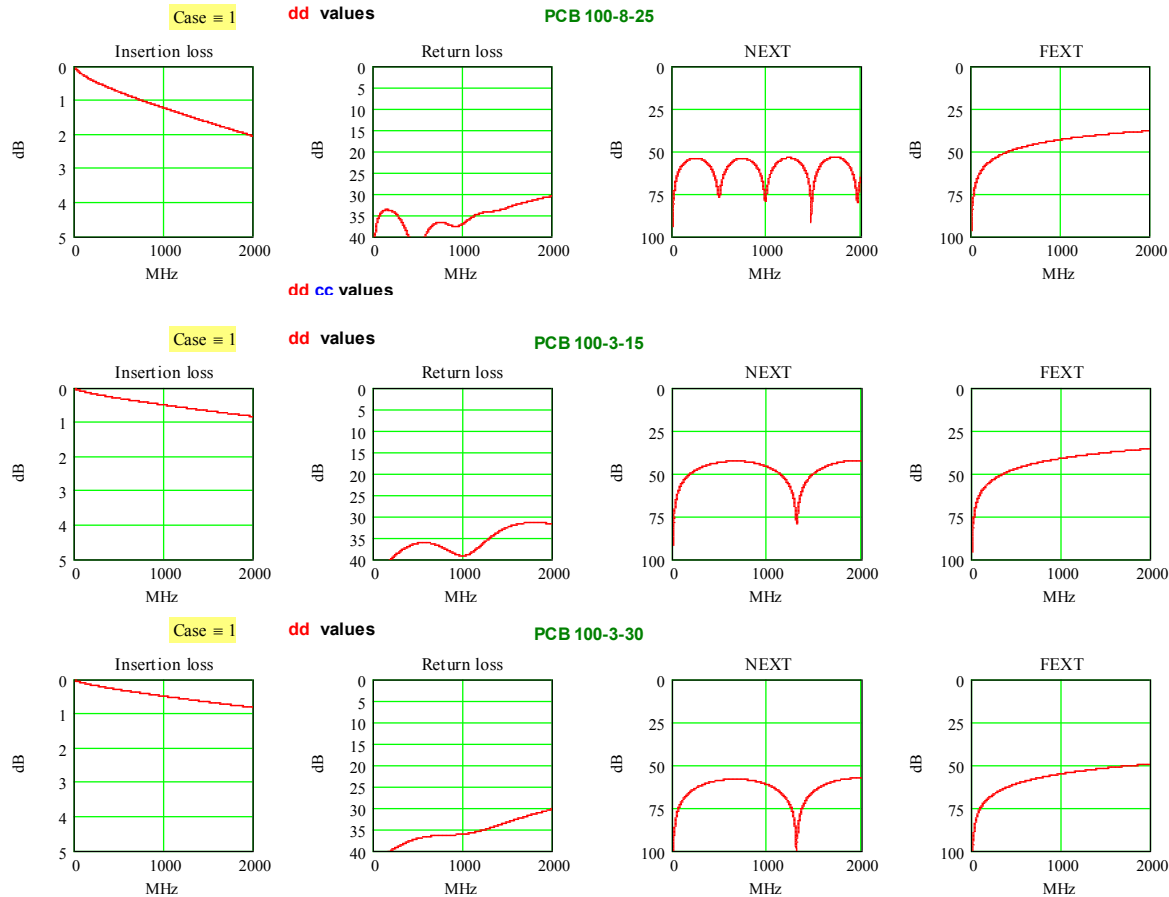| Insertion loss	Return loss	NEXT	FEXT

FEXT
 +20 dB

RJ45
(BEL CM2)

- Difference between pair were minor for the new MDI

- All values from the new MDI were checked for directivity differences, none observed.

- Therefore only one T- Matrix is sufficient to be used for both ends.

Examples of different PCBs

100-8-25
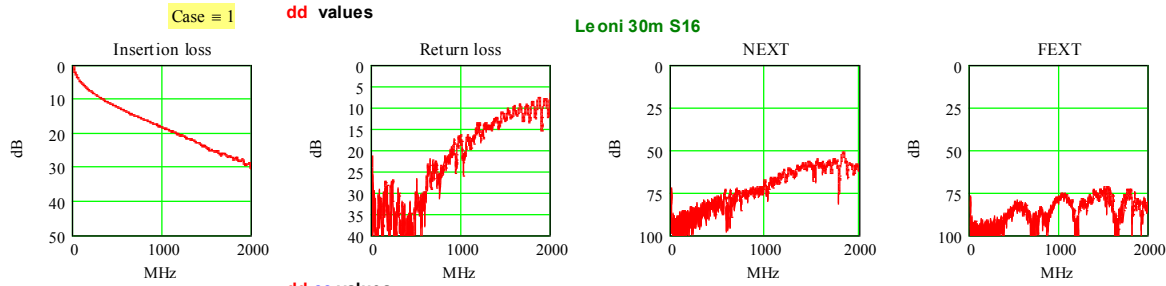Il 2 times higher
But only 1 dB more

100-3-15
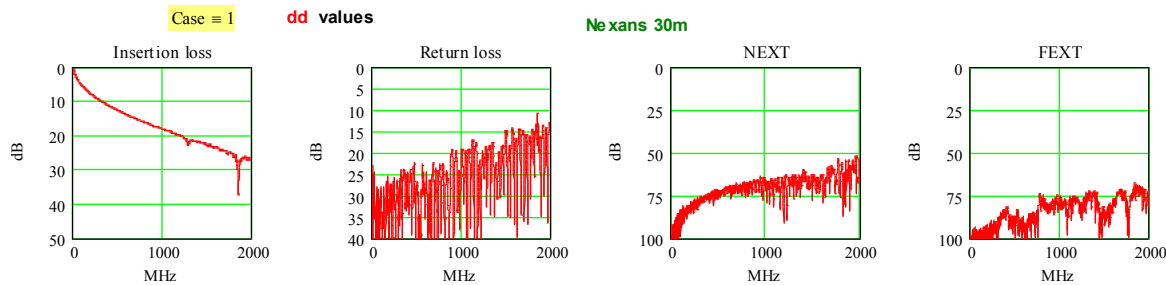
Delta~ 10 dB
In NEXT
In FEXT

100-3-30

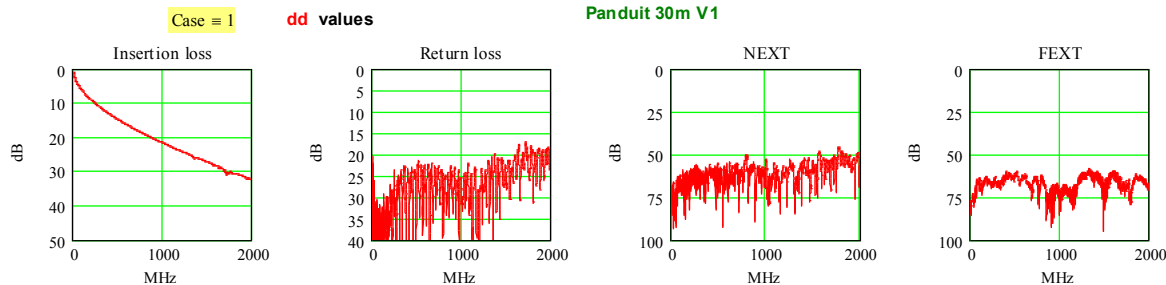3 pairs like presented ones in NEXT and FEXT, 3 pair combinations much better

Examples of different ISO/IEC Class II channels

2-26-2 m
Leoni 12/13

3-24-3 m
NEXANS

Nexans GG45_1800

3-24-3
Panduit
30m_V1
Only two pairs usable from file

similar at all pair combinations
different pachcord length
two presented at Indian Wells franck_3bq_01c_0114

PHY channel with new Bel MDI
(30m Leoni)

Case ≡ 1   dd values   PCB 100-8-25   MDI Bell-45   Leoni 30m S16   MDI Bell-45   PCB 100-8-25

Set up:

➢PCB
- ➢100-8-25
➢Bel ARJ45
- ➢Inc. magnetics
➢Cabling Channel
- ➢30m Leoni
➢Bel ARJ45
- ➢Inc. magnetics
➢PCB
- ➢100-8-25
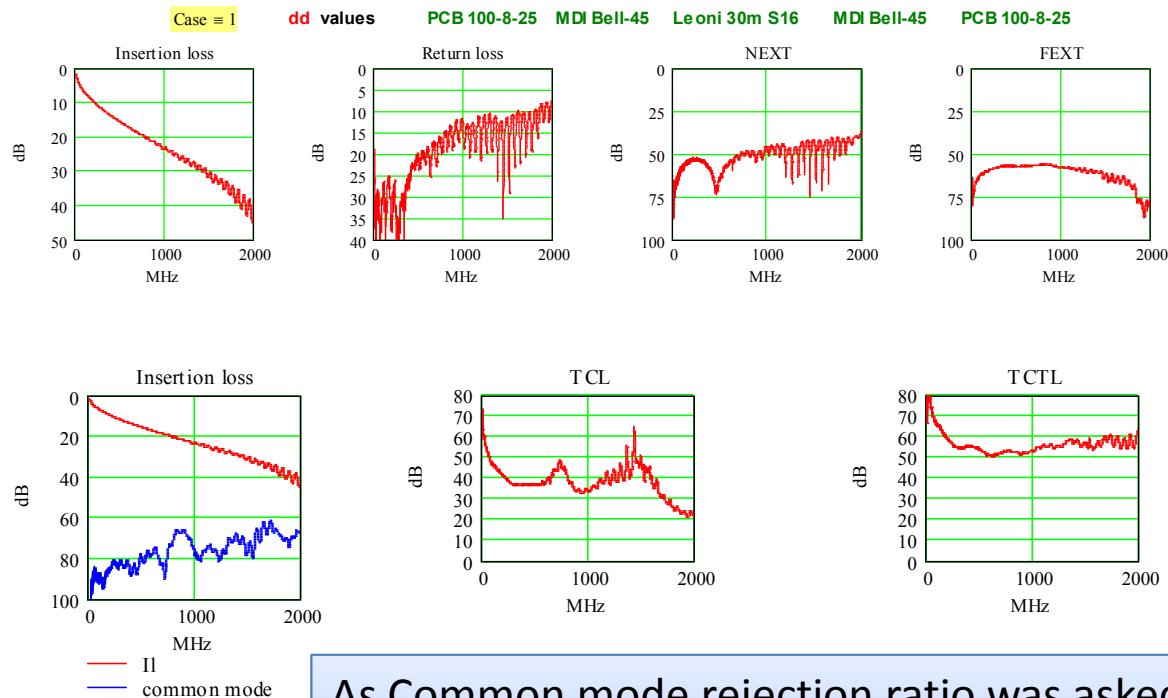
As Common mode rejection ratio was asked for at last channel ad hoc it is shown here (blue curve) together with TCL and TCTL. Other pairs similar.

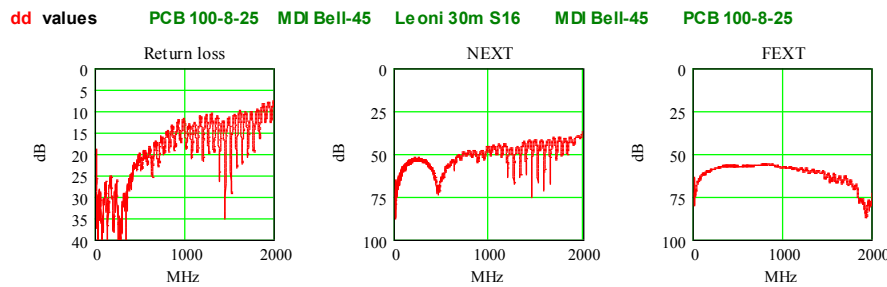# Comparison PHY channel with old and new Bel MDI #1

dd values   PCB 100-8-25   MDI Bell-45   Leoni 30m S16   MDI Bell-45   PCB 100-8-25

ARJ45

dd values   PCB 100-3-25 MDI Bell-   Leoni 30m MDI Bell-PCB 100-3-25
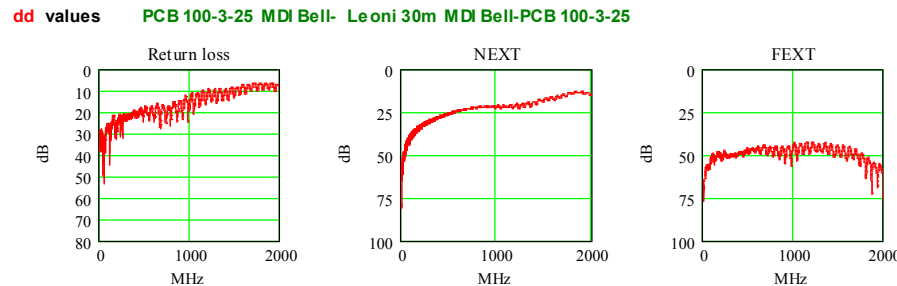
RJ45

Improvement with new MDI:

Rl< 10 dB for:
up to 1700 MHz new
Up to 1200 MHz old

NEXT 25 dB

FEXT @ 1600 MHz
 8 dB

Leoni 30m, PCB 100-8-25

Comparison PHY channel with old and new Bel MDI   #2

Nexans 30m, PCB 100-8-25
Panduit similar
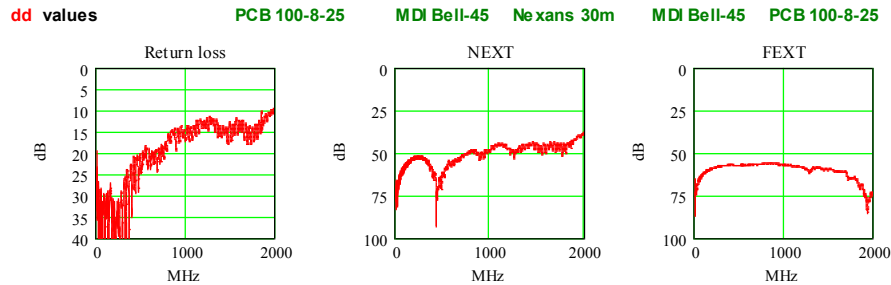
Improvement with new MDI

Rl< 10 dB
up to 1800 MHz new
Up to 1300 MHz old

NEXT 25 dB

FEXT @ 1600 MHz
 8 dB

- As this 8.2 cabling channels presented do not show major differences the only variability is the PCB layout were we have plenty proposals.
- Only the 100 Ohm PCBs will be discussed

Calculation of PHY channels
with new MDI and different PCB layouts #1
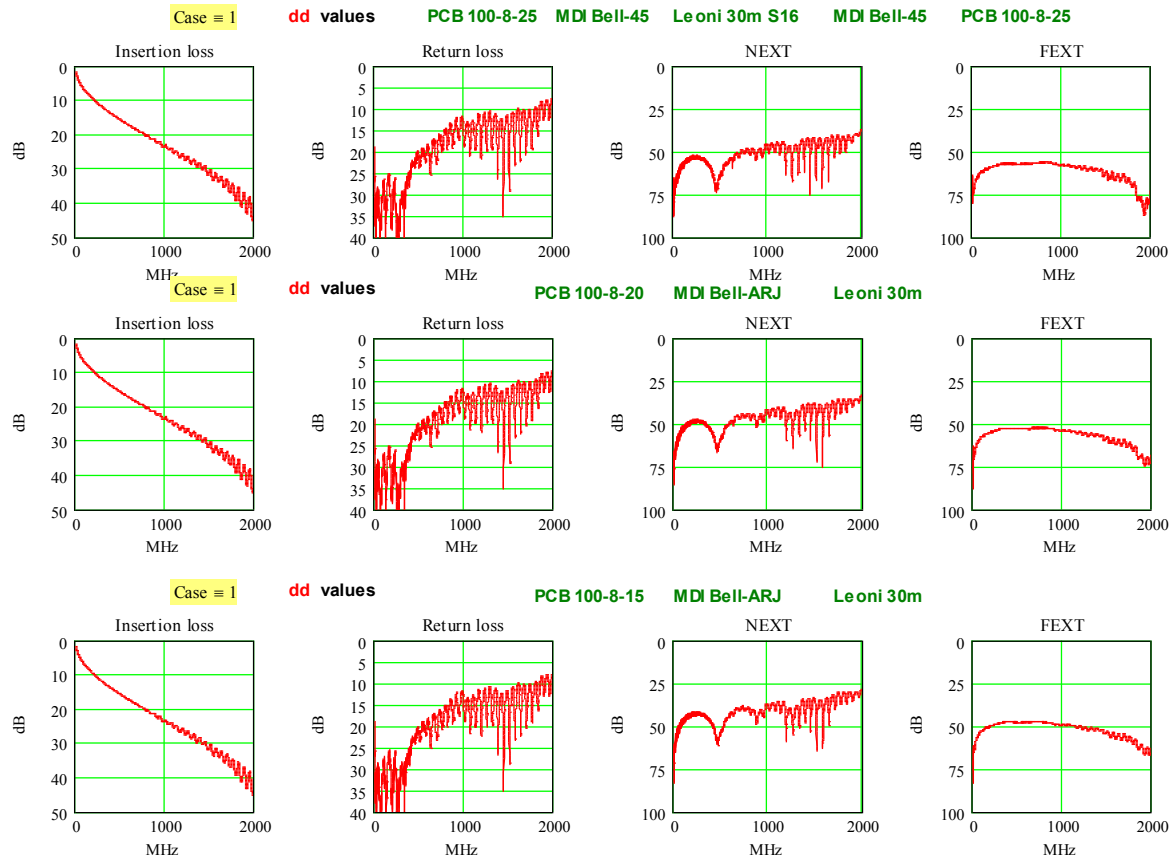
100-8-25

100-8-20

Delta 15 > 25
FEXT~ 6 dB
NEXT~12 dB

100-8-15

30m Leoni, results for NEXANS and Panduit look similar

Calculation of PHY channels
with new MDI and different PCB layouts #2

Case ≡ 1   dd values   PCB 100-3-30

Insertion loss   Return loss   NEXT   FEXT

Case ≡ 1   dd values   PCB 100-3-15   MDI Bell-ARJ   Leoni 30m

Insertion loss   Return loss   NEXT   FEXT
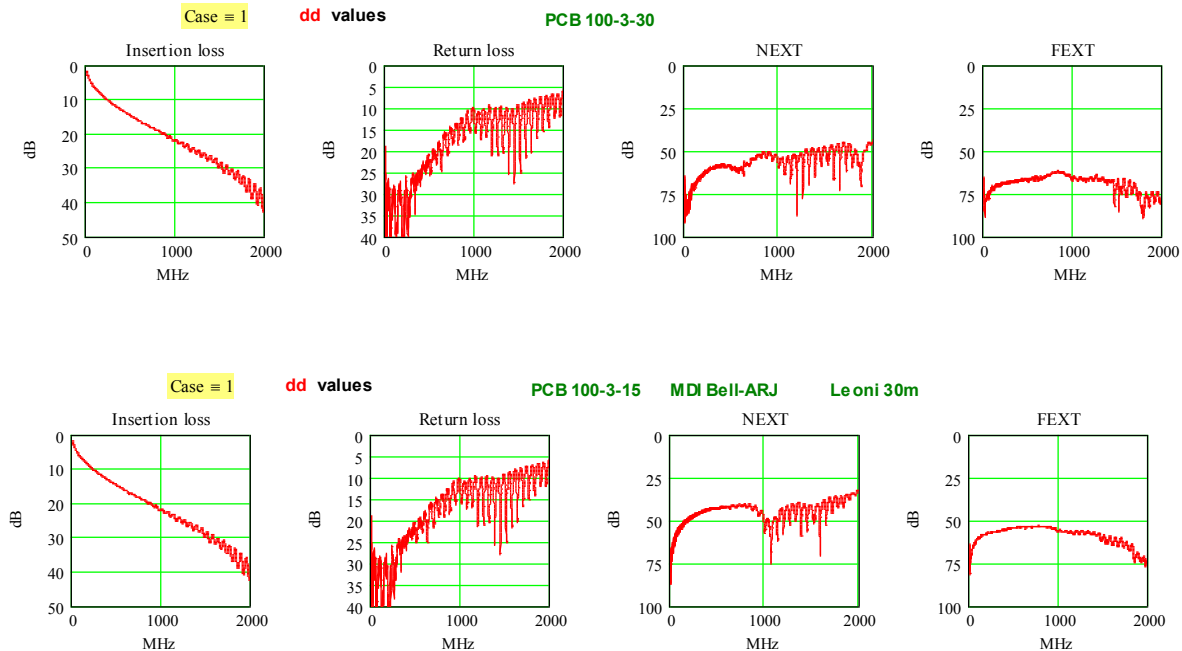
100-3-30

Delta
NEXT   8 dB
FEXT   8 dB

100-3-15

30m Leoni, results for NEXANS and Panduit look similar

Summary and Recommendations

- PHY Channel based on Class II cabling (Non RJ45) with new Bel ARJ45 MDI show much more margin in NEXT and FEXT compared to PHY Channel based Class I cabling (RJ45).
  - Class I see Indian Wells franck_3bq_01c_0114
- IL and RL are still "bad" for frequencies above 1.600 MHz

Summary and Recommendations

- Recommendations for the PCB:
  - For NEXT a minimum of 25 mil separation is recommended , especially for long PCBs, as NEXT is mostly set at the beginning of channels. As only 3 pair combinations are critical it should be viable to think about a crossing halfway if long lines are needed.
    - If 15 mil separation is chosen Channel NEXT is PCB limited and about 12 dB worse.
  - FEXT is not so depending on PCB length and separation because it adds to the rest of the channel.
  - Return loss for 100 Ohm PCB can be neglected, should the non 100 Ohm cases be investigated?
  - For IL up to 1600 MHz there is around 1 dB increase from 3 to 8 inches but as discussed this value is under discussion depending on PCB material.

Shielding

- In the last channel adhoc a question was raised if it is sufficient to get good EMC performance with shielded systems because it may be very dependent on installation.

  - ISO IEC has two standards on installation practices for shielded and unshielded cablings with good explanations (ISO/IEC 14763-2)

  - For stable EMC performance a standard on bonding is under development (ISO/IEC 30129 CD stage)