Draft.
Yair Darshan/PowerDsine 25.4.2002

AC-Disconnect Detection - specifying the ac probing signal spectrum. In addition, specifying the Resistor Detection probing signal spectrum.

The following data based on the following previous work presented in IEEE802.3af meetings.

- Roger Karam, July 2001, file: karam_1_0701, Title: Noise Specification Proposal.
- Rick Brooks, November 2000, file: brooks_5_1100, Title: How much noise is too much
- Rick Brooks, Dec 2001, Slew Rate calculations
    - Data results for 10/100BT presented at July 2000.
    - Data results for 1000BT presented at January 2001
    - Rick Brooks for 100BT presented at November 2000.

The following tests where done:
Data Integrity tests
EMI Tests

Type of noise tested:
Common-Mode
Differential (Pair-Pair)

Type of operating modes tested:
10BT
100BT
1000BT

Location of the noise source:
Data pairs between the center of the data transformer for DM noise measurements.
Between center tape of TX transformer and GND for CM noise measurements.

20DB margin was placed to create a proposal for the draft.

TEST RESULTS

	Roger's data: Zero error level @ Cable length=167m	Rick's data	Worst case
10/100BT	5Vpp @ 1MHz	0.795Vp @ 7MHz	0.795Vp @ 7MHz
1000BT	12Vpp @ 0.5MHz	No data	12Vpp @ 0.5MHz
Worst case			0.795Vp @ 7MHz

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Now I'll use the worst-case data for determine the signal spectrum:

The general signal is: $V(t) = A \cdot \sin(2 \cdot p \cdot f \cdot t)$

The slew rate of the signal is: $\frac{d(V(t))}{dt} = 2 \cdot p \cdot f \cdot A \cdot \cos(2 \cdot p \cdot f \cdot t)$

Worst case slew rate is occurred when t=0. $SR\max = 2 \cdot p \cdot f \cdot A$ [V/sec]

The point of getting CRCs is: 0.795Vp @ 7MHz and this point is a slew rate constant limit

(Same as Gain*BW=1=Constant)

$$SR\max = 2 \cdot p \cdot 7MHz \cdot 0.795V = 3.497 \cdot 10^7 Volt/\sec = 35\frac{Volt}{uSec}$$

$$SR\max = 35\frac{Volt}{uSec} = 35000\frac{Volt}{mSec}$$

We have 5Vpp max for ac disconnect probing signal hence 7000x margin…
We have 30Vpp max for resistor detection signal 700x margin…

Actually for the draft we took 20DB margin,

$$SR\max = 3.5\frac{Volt}{uSec} = 35\frac{Volt}{10uSec} = 3500\frac{Volt}{mSec}$$

That's why we have tr/tf=10us (*Rick Brooks work) which is to control the resistor detection case.

Now lets check what happen if we will take higher margin as per Roger's concerns:

For **40dB** margin from the original limit we will get the following new constrains:

$$SR\max = 350\frac{Volt}{mSec}$$ (Original was: $SR\max = 35000\frac{Volt}{mSec}$

Due to the fact that $SR\max = 2 \cdot p \cdot f \cdot A$

Than $F\_\max = \frac{SR\max}{2 \cdot p \cdot A}$

$$F\_\max = \frac{350V/ms}{2 \cdot p \cdot 30V} = 1850Hz$$

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F_max=500Hz was chosen for the standard. (Additional margin)

Hence if F_max=500Hz and Probing voltage is 30Vp than the SR would be:

$$SR\max = 2 \cdot p \cdot f \cdot A = 2 \cdot 3.14 \cdot 500 \cdot 30 = 30V / 318uS$$

$$SR\max = 1V / 10uS$$

Recommendations:

Change the IEEE802.3af draft paragraphs TBD to the following:

Detection voltage:
Max frequency: 500Hz
Max voltage rate of change (slew rate) = 1V/10us.

Disconnect detection ac probing voltage:
Max frequency: 500Hz
Max voltage rate of change (slew rate) = 1V/10us.

Most important conclusion (that has been confirmed many times):
If you meet EMI, DATA must be OK too.
Confirmed by Roger's and Rick's as indicated above.

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