

40/100G Copper Feasibility

Nov 2007

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Channel & Crosstalk Models

Insertion Loss and Power Sum crosstalk are modeled from the measured data presented at 802.3 and from the industry in the past.

Signaling Selection

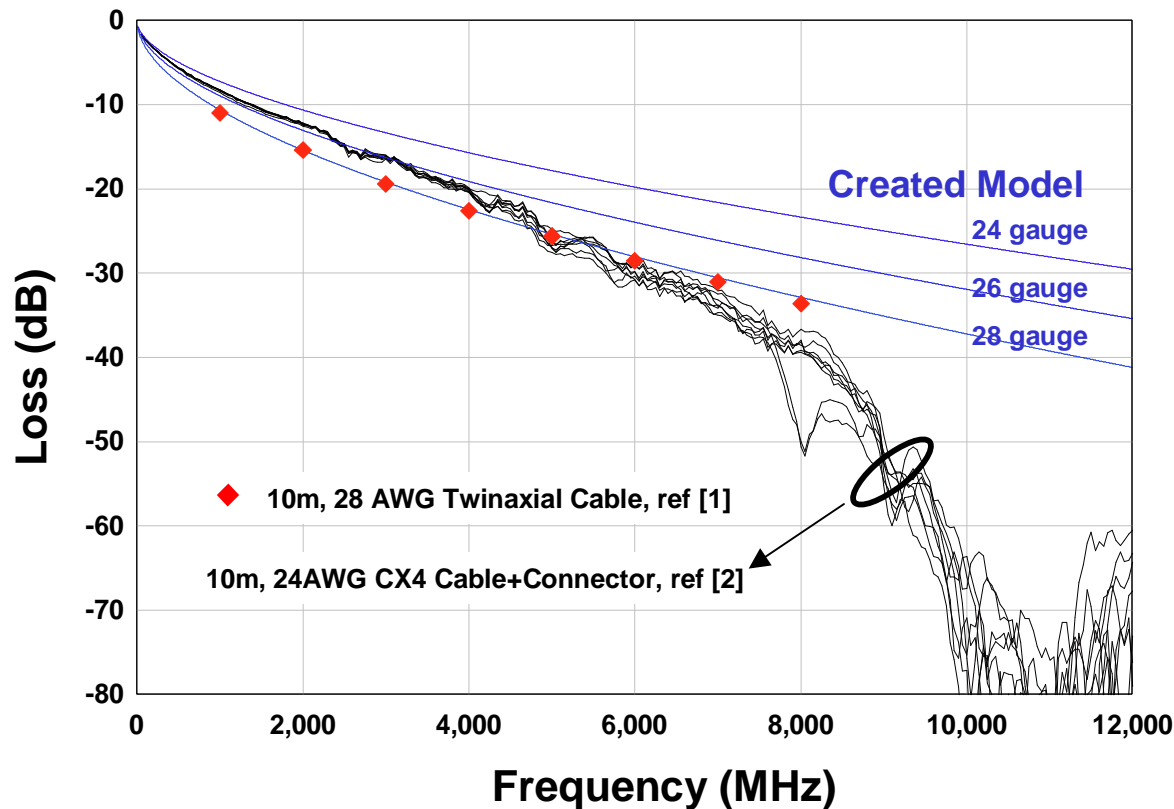
Optimal PAM level is discussed based on the created IL and crosstalk Models.

SNR Margin

Summary



Cable Model



IL model are created for 24, 26 and 28 AWG.

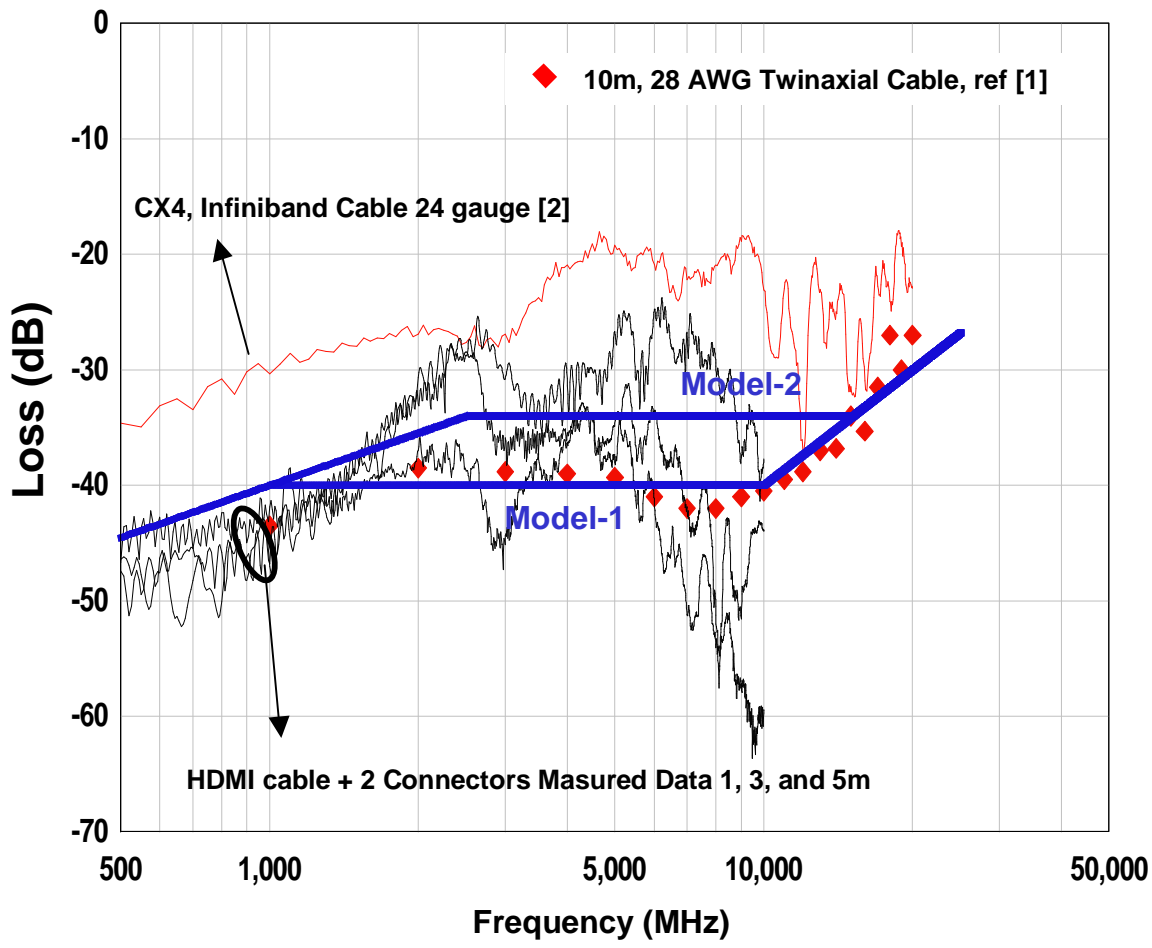
Matched with the measured data presented in the past.



[1] http://www.ieee802.org/3/hssg/public/nov06/diminico_02_1106.pdf

[2] <http://www.ieee802.org/3/ak/public/june03/index.html> Comment #388-Zipped Cable Data

Crosstalk Model



Model-1

- 15dB/dec. ~1GHz
- 40dB/Hz 1 ~ 10GHz
- 10dB/oct. 10GHz~

This model fits to Chris's measured data[1].

Model-2

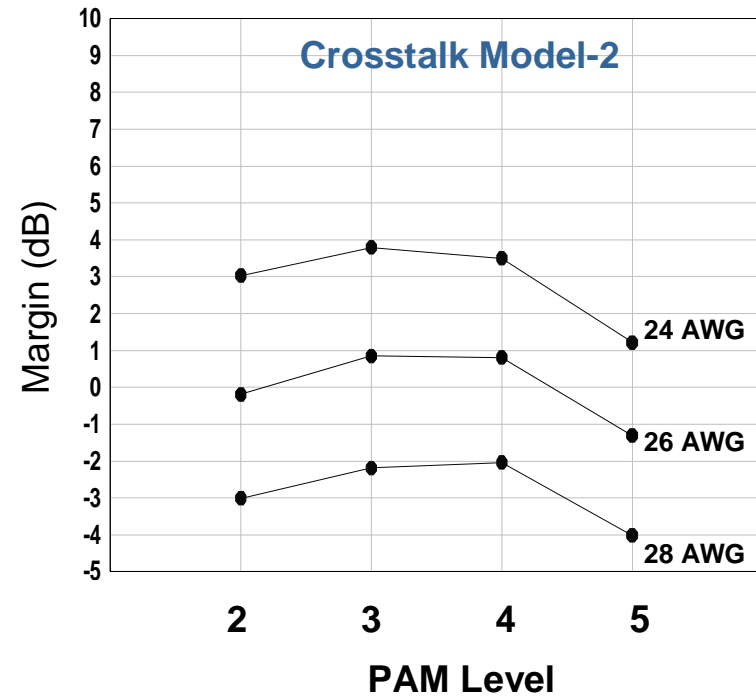
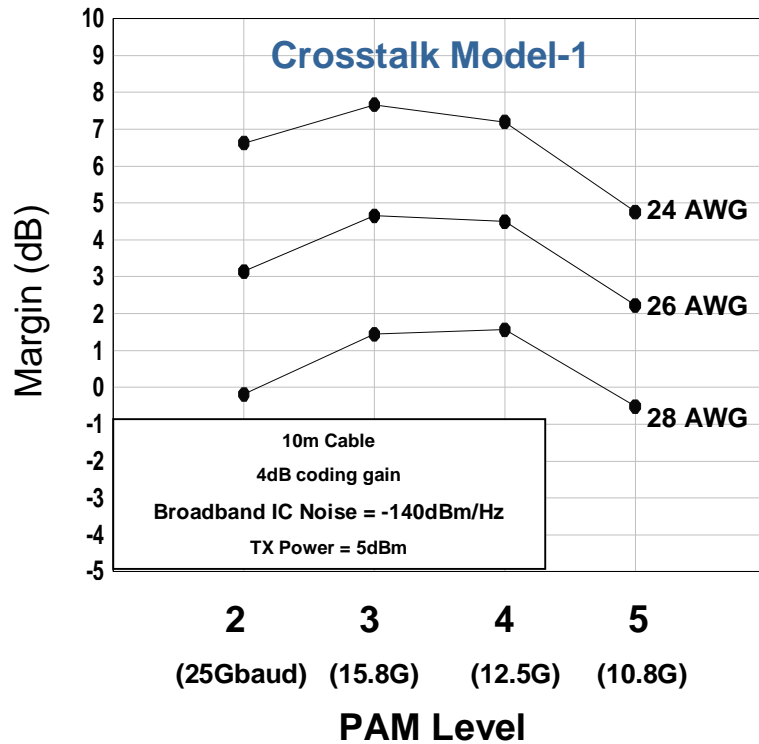
- 15dB/dec. ~2.512GHz
- 34dB/Hz 2.512 ~ 15.16GHz
- 10dB/oct. 15.16GHz~

2nd model is relaxed by 6dB reflecting CX4 and HDMI measured data with connectors.



Signaling for 100G, 4-lane

Saltz noise margin is calculated for different PAM signaling

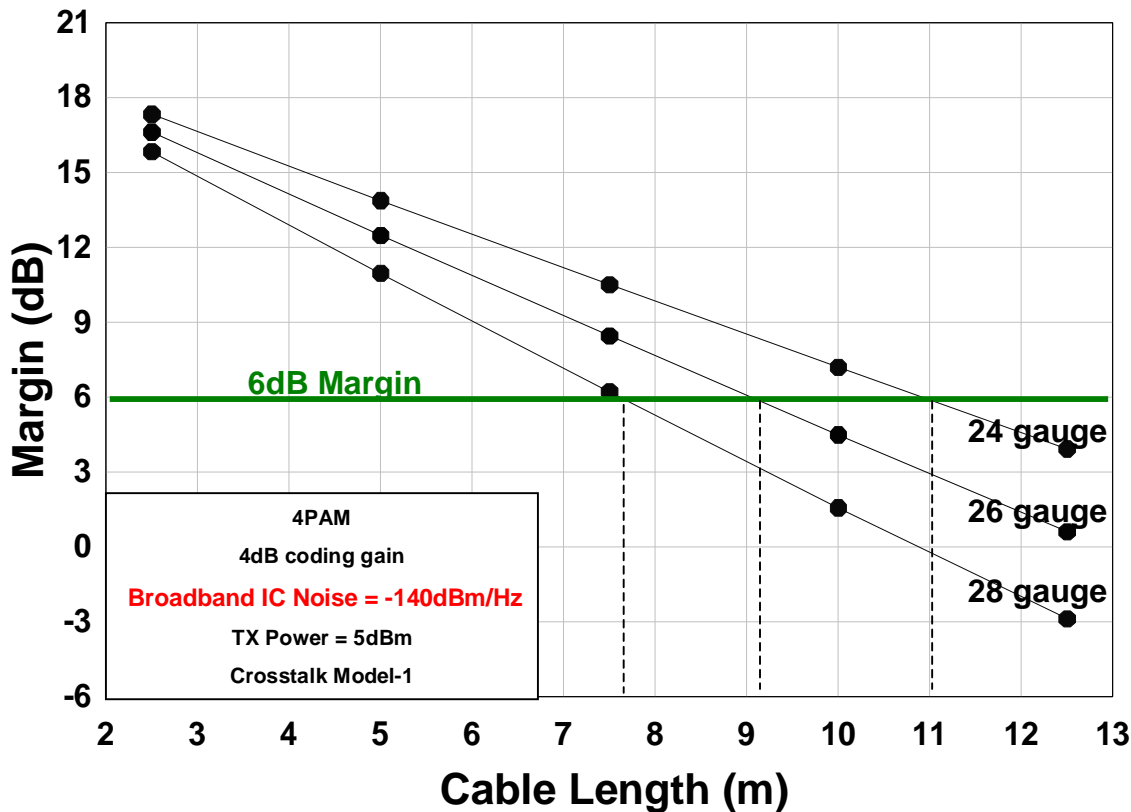


4 PAM is recommended

for the reduction of IC complexity and power.



Margin vs. Cable Length, 100G



**Achievable Length
with 6dB margin**

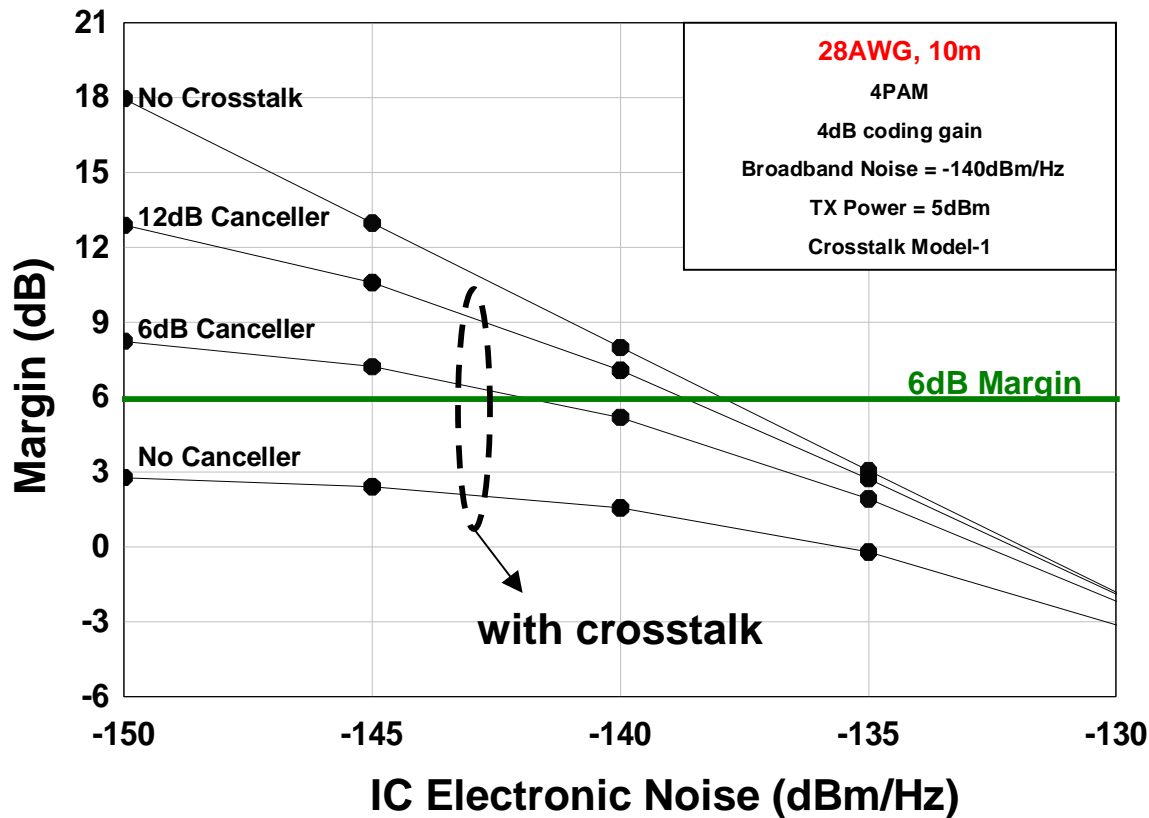
- 24AWG 11m**
- 26AWG 9.1m**
- 28AWG 7.6m**

**5dBm transmit power
is assumed (less EMI
concern with a
shielded cable).**

**Without crosstalk
cancellation**



Crosstalk Canceled, 100G 28AWG, 10m

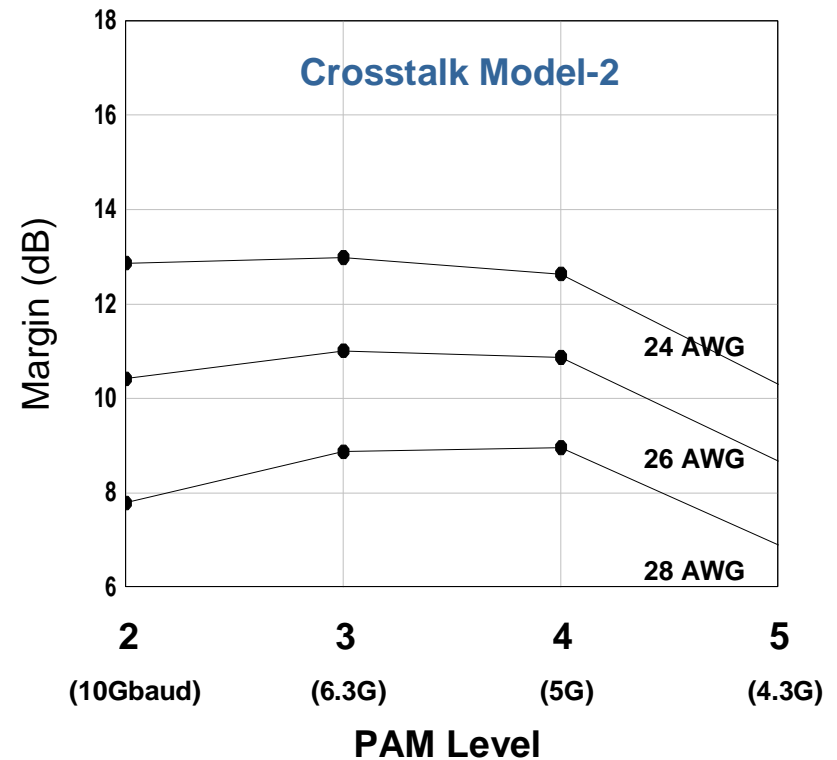
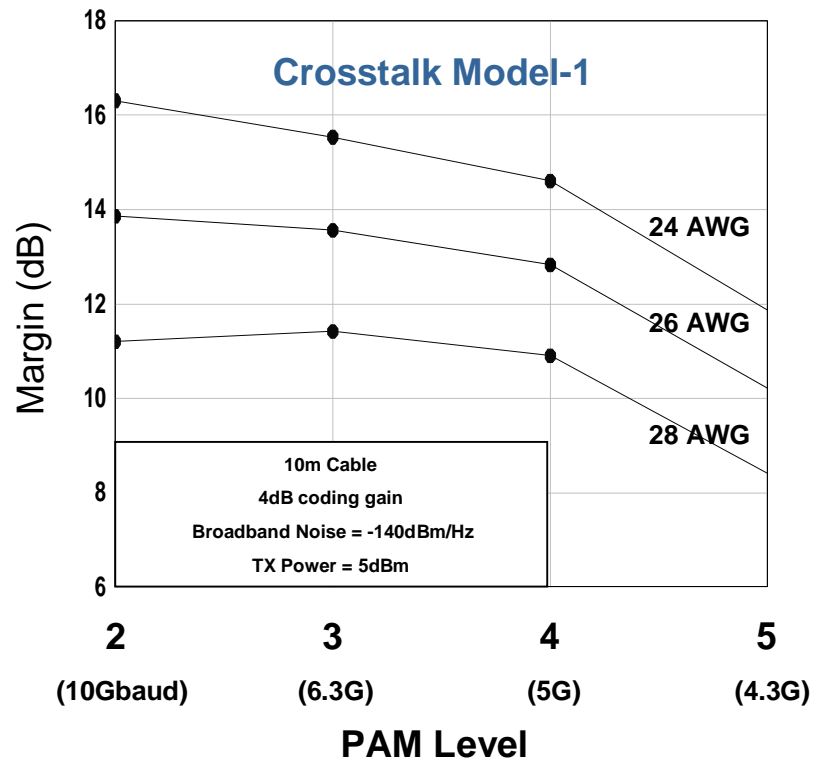


Noise margin for 28AWG, 10m cable is calculated.

The system seems sensitive to the IC noise.

However, 6~12dB crosstalk canceller enables 6dB margin.

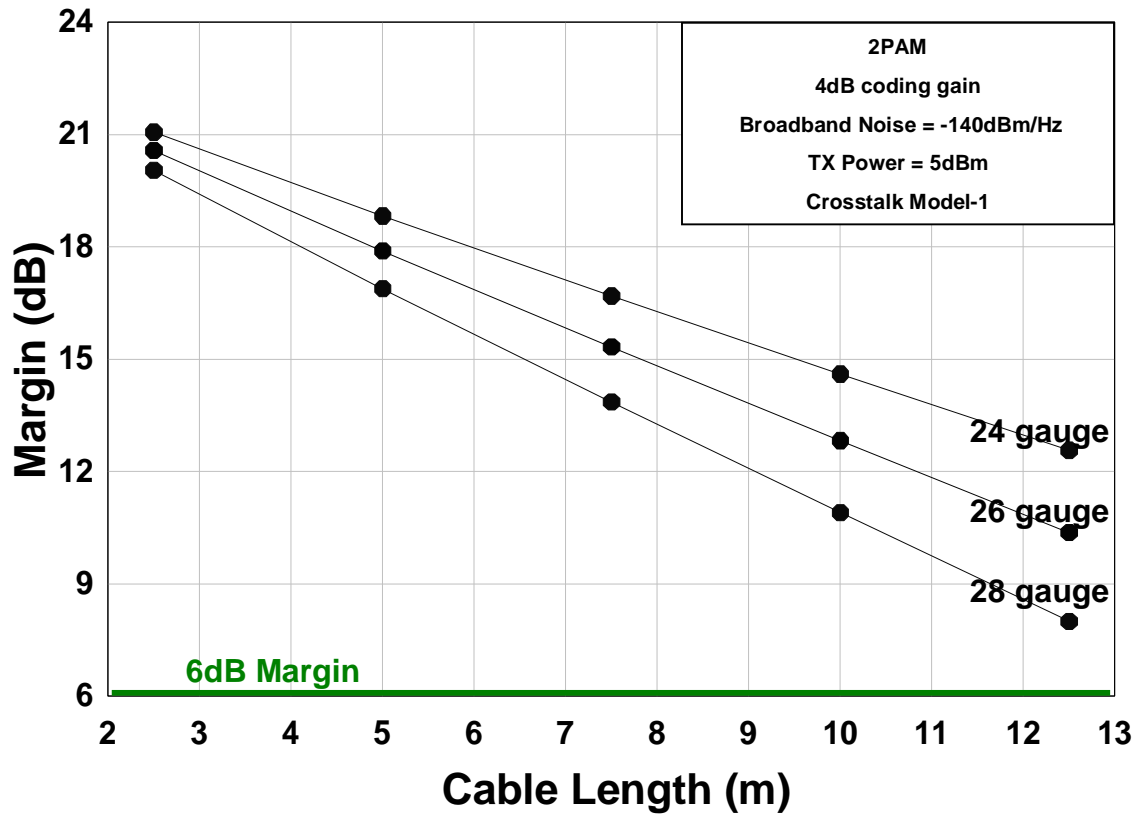
Signaling for 40G



2 PAM is recommended
Worst case only 1dB loss



Margin vs. Cable Length, 40G

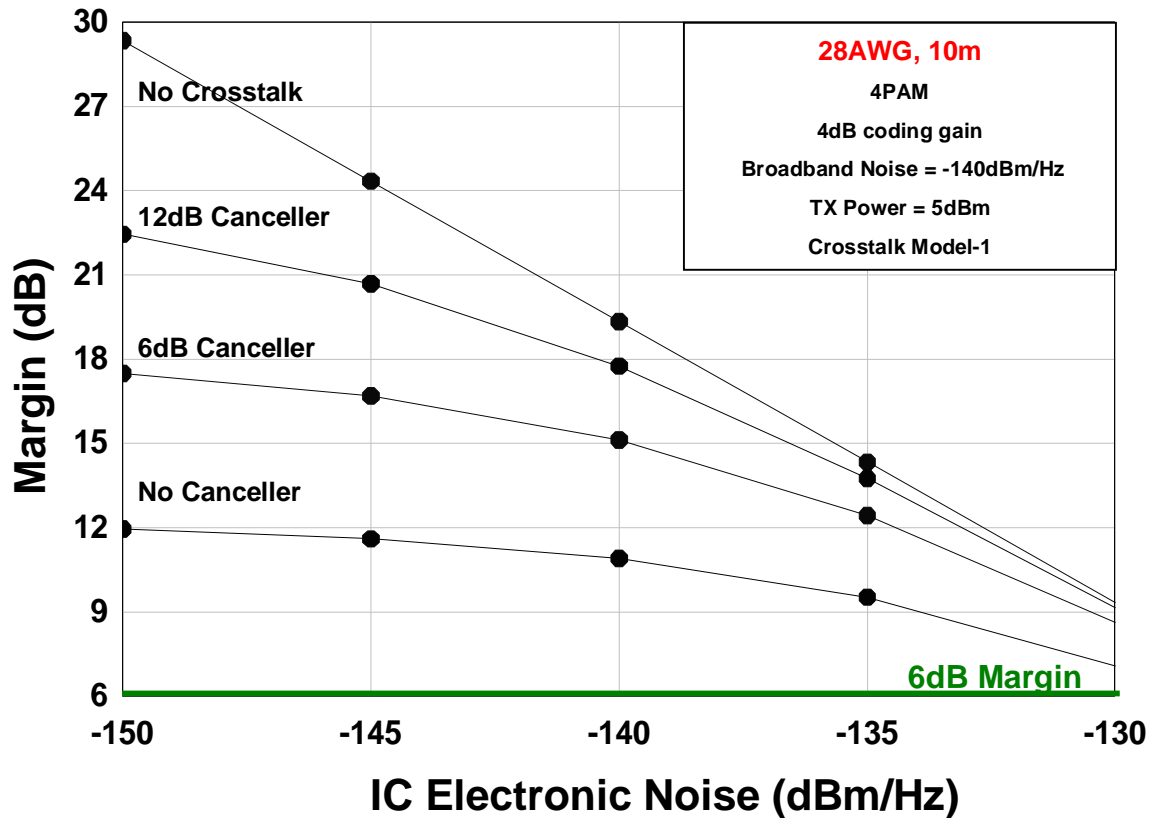


More than 10m can be achievable on any type of cables

(Without crosstalk cancellation)



Crosstalk Canceled, 40G 28AWG, 10m



Sufficient margin w/o
crosstalk canceller.



Summary

Performance is calculated for 40/100G copper interconnect based on the models of cable and crosstalk for the initial discussion.

Followings are the recommendations based on the result.

1. 4PAM-12.5Gbaud for the 100G copper considering a minor performance loss from 3PAM and for ease for IC implementation,
2. Power boost, ~5dBm to relax the sensitivity to the receiver IC noise,
3. Use 2PAM-10Gbaud for the 40G (2PAM as subset mode of 100G IC).

100G, 10m on 28AWG as par ref [1] is feasible with crosstalk canceller and FEC as an option.

[1] http://www.ieee802.org/3/hssg/public/nov06/diminico_02_1106.pdf

