

802.3bp 1000BASE-T1 EMC & Noise Ad Hoc Report

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EMC Ad Hoc Status (03/17/2014)

- **In January 2014 meeting, fast transient noise modeling and test results were presented to the Task Force and slow transient noise effect was requested to be provided. In this meeting, we will have an update for that.**

- **Since Indian Wells 14' meeting, there were contributions and request for discussions. Therefore, we had a conference call on February 26th and discussed:**
 - Balance measurements were provided for various link segments (further study was suggested)
 - The effect of the new proposed limit line for Alien NEXT was discussed.
 - PoDL noise effect on 1000BASE-T1 was discussed and PoDL chair has committed to provide an official liaison letter pertaining to 802.3bp Task Force.

- **Comments & discussion?**

Previous Work Summary

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RTPGE EMC & Noise Ad Hoc

- Chartered during September 2012 meeting to develop EMC & Noise models and measurements
- Conference calls & meetings held in 11/07/2012, 12/17/2012, 01/25/2013, 3/4/2013, 3/20/2013, 4/30/2013, 5/8/2013, 6/26/2013, 7/16/2013, 8/20/2013, 8/29/2013, 09/03/2013, 10/18/2013, 11/05/2013, 11/12/2013, 01/14/2014, 02/26/2014
- Communications via RTPGE/802.3bp reflector. Minutes & contributions were sent to the reflector
- Thanks to those who attended the ad hoc calls

Work-plan Summary

- **First Phase (Data Collection as of 7/14/2013)**
 - Ingress modeling
 - Define the noise sources (in-car background noise, alien XTALK, EMC noise, impulse noise, battery noise, etc.)
 - Need input for in-car broadband noise
 - Define the channel transfer function/measurement modeling methodology

 - Egress modeling
 - Block diagram for PHY emissions
 - Balance measurements of the proposed RTPGE channels were provided
 - Define emissions' mask
 - Define mode conversion limit line
 - Mode conversion data for connectors was provided on 7/16/2013.

Work-plan Summary (cntd.)

■ Second Phase

- Reach consensus on a baseline limit for EM emissions (emissions' mask) and based on that define the Transmit PSD mask
- Reach consensus for mode conversion limit line
- Build consensus of all discrete noise sources and background noise ← **We are here**

■ Third Phase

- Develop text for standard

Overview

- ❑ Differential Channel Impairments
- ❑ EMC Noise & Limit Lines
- ❑ EMC Channel Transfer Function Modeling
- ❑ Alien XTALK
- ❑ In-Car Background Noise
- ❑ Impulse Noise
- ❑ Other Noise sources?

Differential Channel Impairments

- ❑ Insertion Loss (aka channel attenuation) varies as a function of length, frequency and temperature.
- ❑ Return Loss needs to be properly constrained for FDX systems and can have a direct impact on input dynamic range.
- ❑ Both of these impairments can be handled by digital equalization and echo cancellation.
- ❑ Status: Channel Ad-Hoc made progress for defining the differential parameters.

EMC Modeling & Limit Lines

- ❑ Stefan Buntz (Daimler) proposed DPI technique for component level emission & immunity testing (similar to IEC 62132-4) and provided the limit lines in http://grouper.ieee.org/groups/802/3/RTPGE/public/nov12/buntz_01_1112_rtpge.pdf
- ❑ CISPR 25 also addresses Conducted and Radiated Emissions' measurement techniques. If CISPR 25 is preferred method of testing then, **Limit lines (dBUV vs. frequency [0.1MHz–1GHz])**
- ❑ ISO 11452-2/4/5 define Radiated Immunity via Antenna, BCI and Strip Line measurement techniques. If they are preferred method of testing then, **Limit lines (dBm vs. frequency [0.1MHz–1GHz])**

EMC Channel Transfer Function

- ❑ CM-to-CM and CM-to-DM conversion transfer functions must be attained for RTPGE channels in order to compute the input-referred noise for the PHY.
- ❑ Mehmet Tazebay (Broadcom), Richard Mei (Commscope), Thomas Muller (Rosenberger) made proposals for method and techniques for attaining these transfer functions
http://www.ieee802.org/3/bp/public/jan13/tazebay_3bp_01a_0113.pdf
http://www.ieee802.org/3/bp/public/jan13/mei_3bp_01_0113.pdf
http://www.ieee802.org/3/bp/public/jan13/mueller_3bp_01_0113.pdf
- ❑ In principle, 3-port network analyzer measurements can be used to analyze the mode conversion transfer functions.
http://www.ieee802.org/3/bp/public/may13/tazebay_3bp_01_0513.pdf

Alien XTALK modeling

- ❑ Kirsten Matheus (BMW) proposed a few select cable bundle topologies based on use cases agreed-upon by participating OEMs:
http://www.ieee802.org/3/bp/public/jan13/matheus_3bp_02_0113.pdf
- ❑ Several measurements were made based on the presented topologies (Mei et al, Commscope and Donahue & Estes, UNH) using UTP channels
http://www.ieee802.org/3/bp/public/jan13/mei_3bp_01_0113.pdf
http://www.ieee802.org/3/bp/public/jul13/donahue_3bp_01_0713.pdf
- ❑ Preliminary results indicate that alien XTALK is within the limit lines for the select cables. More test results are expected with the final channel parameters.

In-Car Background Noise

- ❑ Stefan Buntz (Daimler) provided a direct measurement technique and results for BG in the car http://www.ieee802.org/3/bp/public/mar13/buntz_3bp_01_0313.pdf
- ❑ The background noise was measured as common mode noise (dBuV versus frequency [0.1MHz-1GHz]).
- ❑ The EMC channel transfer functions dictate the input-referred common mode and differential mode noise observed by the PHY.

In-Car Impulse Noise

- ❑ [ISO 7637-2](#) lists tests for transient immunity testing (pulses 1-5) for supply lines
 - Is RTPGE with PoE expected to pass these immunity pulses?
 - Are there additional requirements in excess of ISO 7637-2?
 - What criteria is considered passing for this test?
 - Class A requires a BW of the pulse within the PSD of RTPGE!

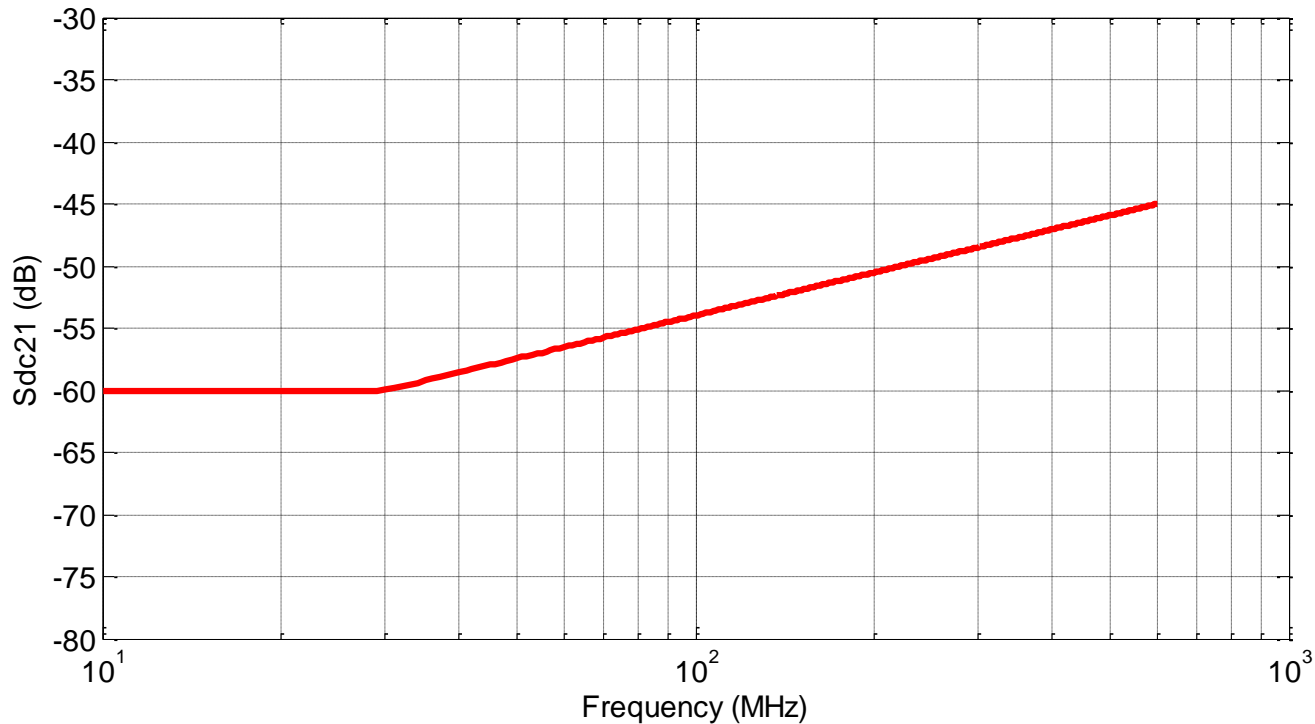
- ❑ [ISO 7637-3](#) lists tests for transient immunity testing for signal lines.
 - Is RTPGE MDI expected to pass these immunity transient test pulses?
 - Are there additional requirements in excess of ISO 7637-3?
 - What criteria is considered passing for this test? Is it different from the ISO 7637-3 standard?

- ❑ Thomas Hogenmuller (Bosch) made a contribution showing empirical, simulation and emulation results for in-car impulse noise. This work extensively provides information for the impulse-noise model. The mathematical parameters are provided by Mr. Hogenmuller.
<http://www.ieee802.org/3/bp/public/jul13/jul13.htm>

Other Noise Sources

- ❑ Battery Noise, PoDL considerations and etc.
- ❑ A contribution was made by Yair Darshan (Microsemi) which discussed the noise sources over a single data & power pair http://ieee802.org/3/bp/public/may13/darshan_3bp_01_0513.pdf
- ❑ What else are we missing?

Mode Conversion Limit Line for Component Level (as adopted)



$$- 60_{\text{dB}}$$

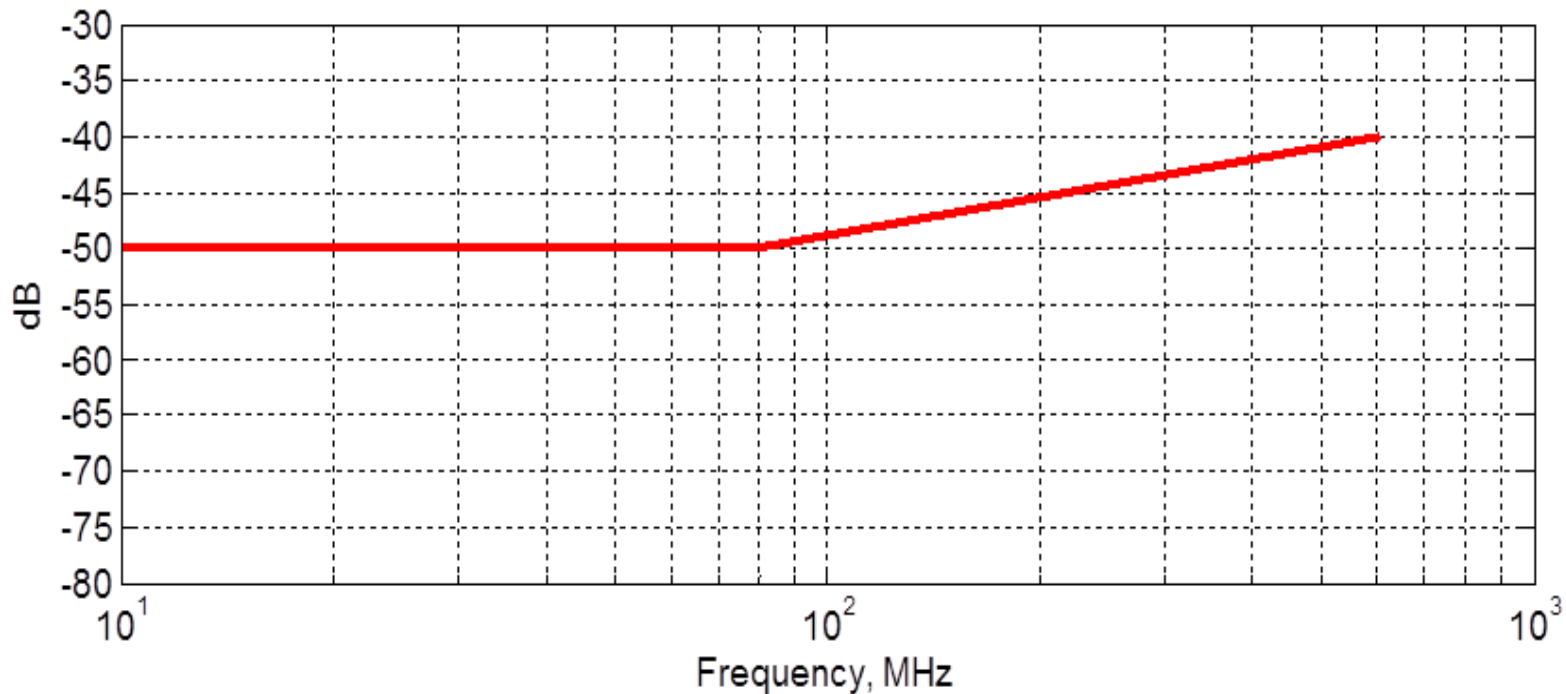
$$10 < f_{\text{MHz}} < 30$$

$$[5 \log_n (f_{\text{MHz}}) - 77]_{\text{dB}}$$

$$30 < f_{\text{MHz}} < 600$$

Mode Conversion Limit Line for Link Segment (as adopted)

- The mode conversion limit line for a 15m UTP link segment with 4-inline connectors



$$- 50_{\text{dB}} \quad 10 < f_{\text{MHz}} < 80$$

$$[5 \log_n (f_{\text{MHz}}) - 72]_{\text{dB}} \quad 80 < f_{\text{MHz}} < 600$$