IEEE 802.3bz 2.5G Impedance Balance Specification

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Background

- IEEE 802.3bz draft 2.0 specifies Impedance Balance for 2.5G/5G to be same as the 10G (Clause 55)

- For 2.5G Systems, meeting 10G Impedance Balance specification adds complexity and higher cost

- Impedance Balance is specified for a system which includes Magnetic/PCB/PHY, but mostly misinterpretation by implementers as the magnetic specification ONLY

- This investigation shows that the impedance balance requirement for 2.5G can be relaxed without impacting Radiated Emission, Conducted Emission, Radiated Immunity and Conducted Immunity performance (FCC 15 A)

Supporters

- Victor Renteria (Belfuse)

- George Zimmerman (CME Consulting)

- …

Impedance Balance Specification

- 1G Clause 40: PAM-5

  f in MHz

  ➤ $34 - 19.2\log_{10}(f/50)$ $1 \le f \le 100$ (dB)

- 10G Clause 55 and 802.3bz: PAM-16
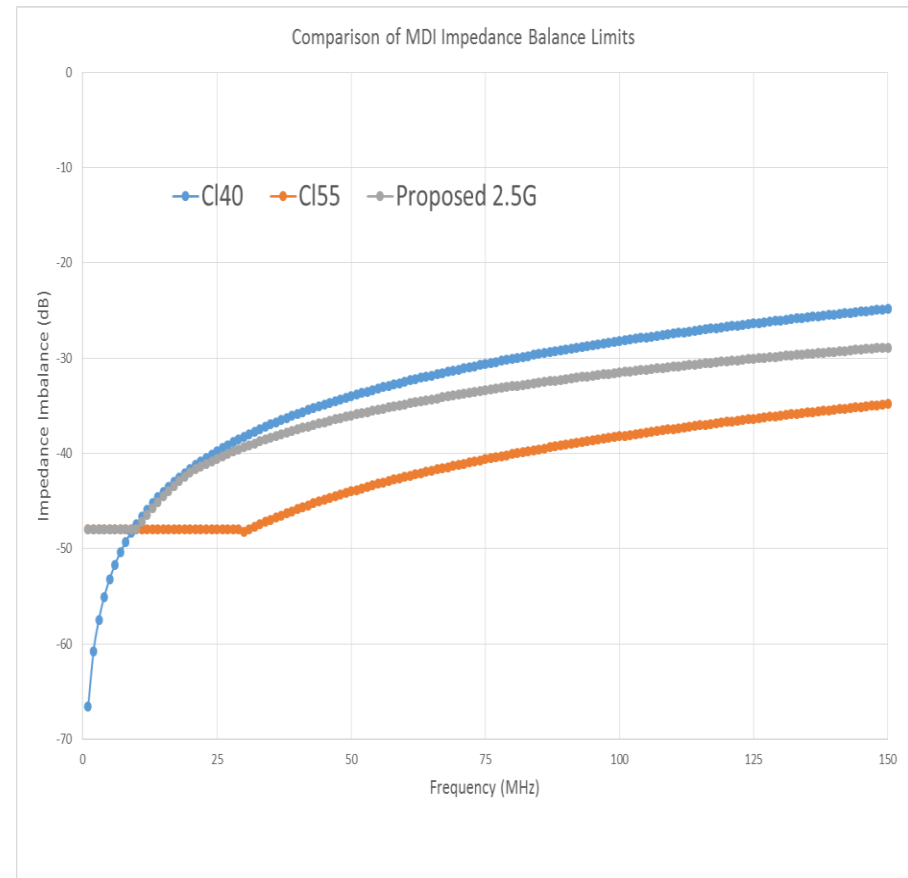
  ➤ 48 $1 \le f < 30$ (dB)

  $44 - 19.2\log_{10}(f/50)$ $30 \le f \le 500$ (dB)

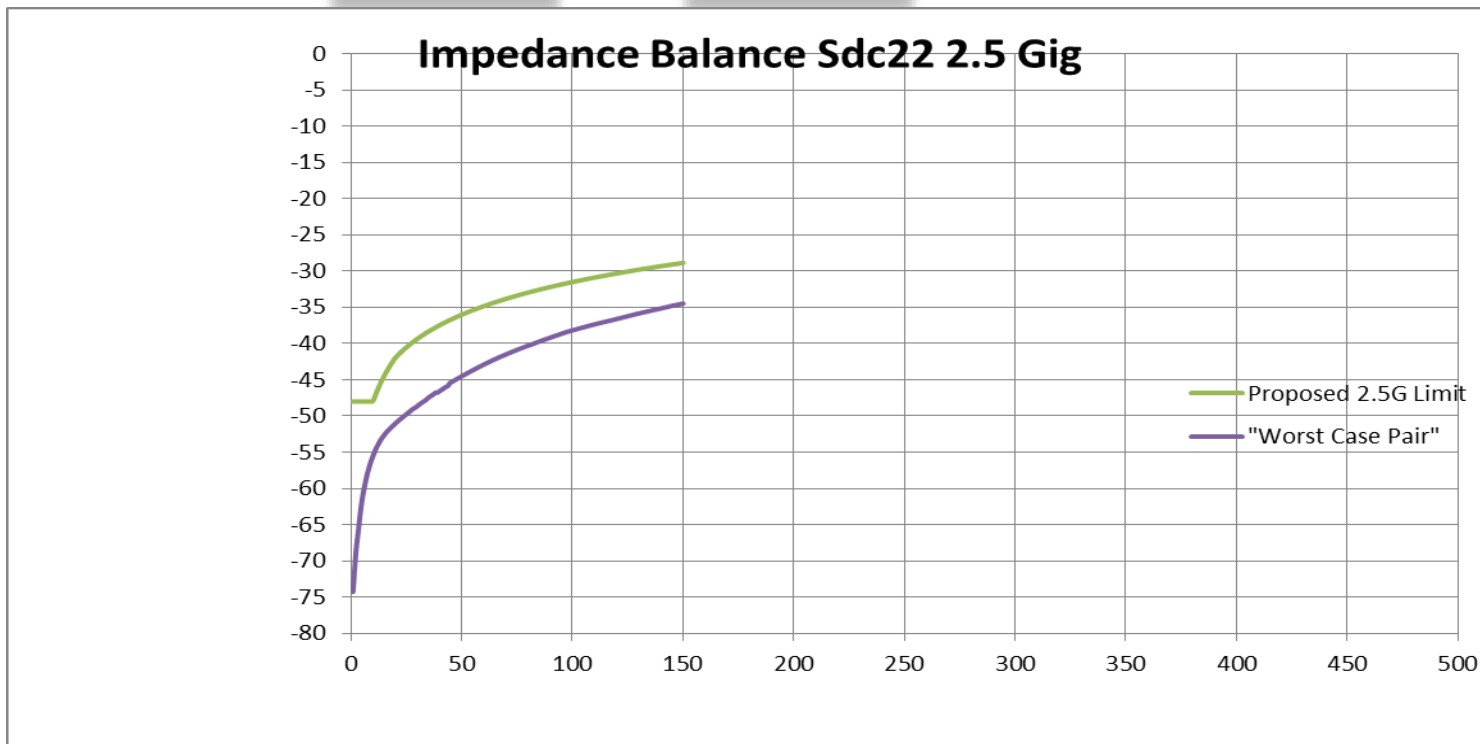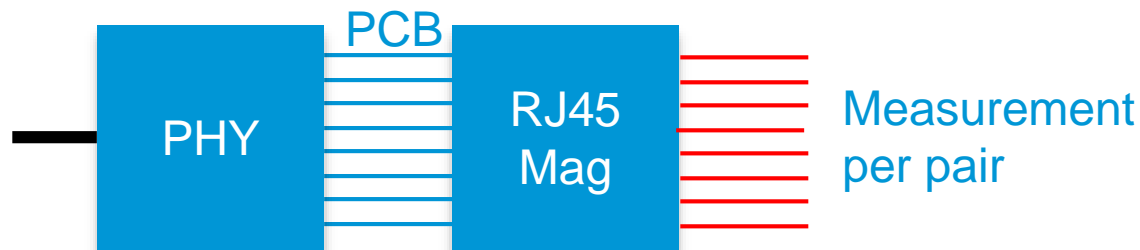- Proposed 2.5Gbs 802.3bz: PAM-16

  ➤ 48 $1 \le f < 10$ (dB)
  $48 - 20\log_{10}(f/10)$ $10 \le f < 20$ (dB)
  $42 - 15\log_{10}(f/20)$ $20 \le f \le 150$ (dB)

Comparison of MDI Impedance Balance Limits

Cl40   Cl55   Proposed 2.5G

Impedance Imbalance (dB)
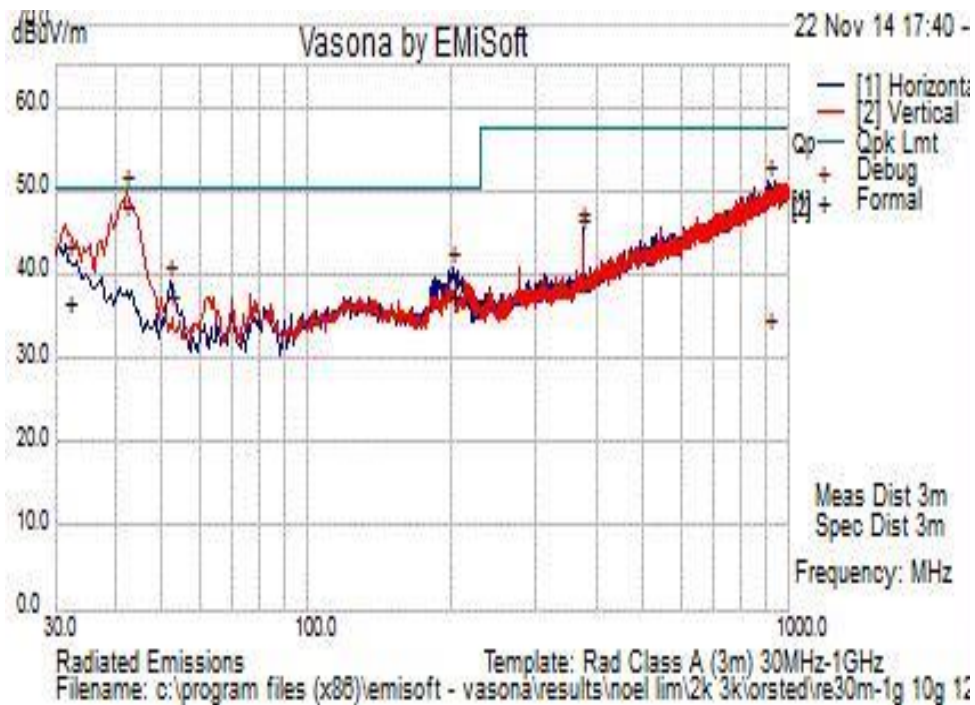
Frequency (MHz)

Impedance Balance: Test Channel
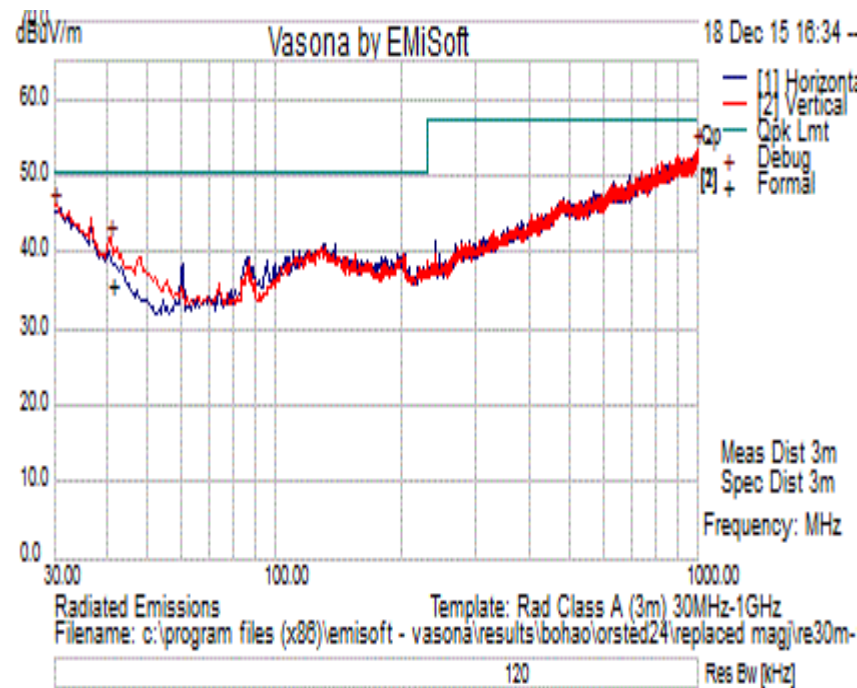
- ➢ Magnetic
- ➢ PCB
- ➢ PHY

EMI Test Chamber: 10m Cat5e (2.5G)

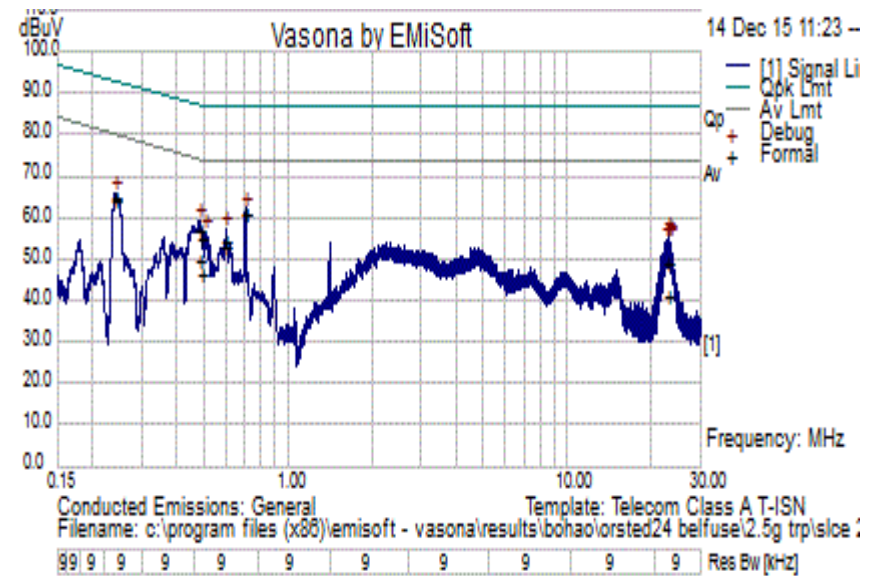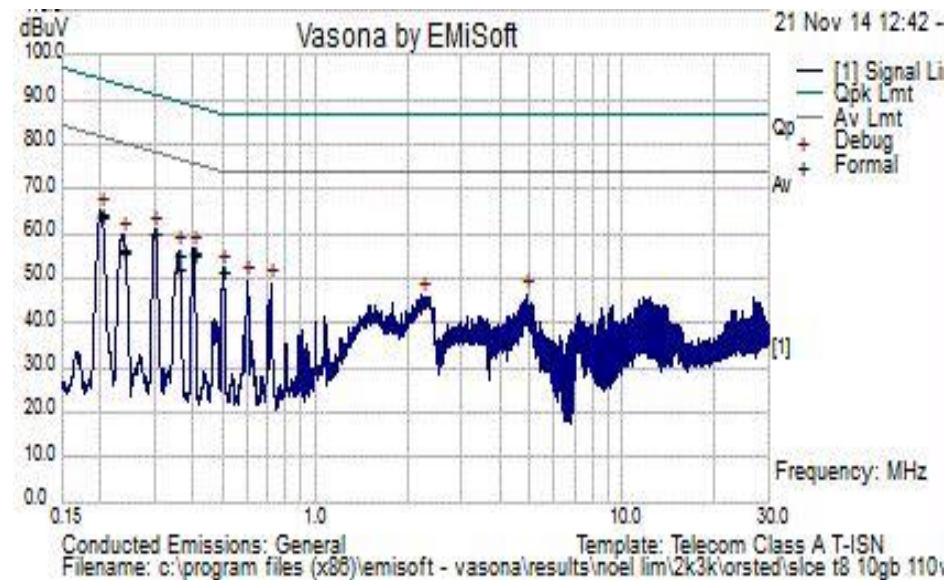# Radiated Emission: 10G vs. 2.5G Magnetic Comparison

10G plot with 10G Magnetic/ 3m Cat 6a Worst Emission at ~ 41 MHz with **4dB** margin

2.5G plot with 2.5G Magnetic/2m Cat5e Worst emission at ~41 MHz with **14dB** margin

Conducted Emission: 10G vs. 2.5G Magnetic Comparison

10G plot with 10G Magnetic/3m Cat6a Worst Emission at ~ 0.2 MHz with **17dB** margin

2.5G plot with 2.5G Magnetic/3m Cat5e Worst emission at ~0.2 MHz with **12dB** margin

Radiated/Conducted Immunity

	10G Magnetic	2.5G Magnetic
Radiated Immunity Cat 5e with 3V/m	Pass	Pass
Conducted Immunity: 3V Modulation :1kHz 80% AM. 1% step size.	Pass	Pass

Pass Criteria: The system will continue to operate without user intervention. Data losses will be <1% packet drops with no link drops.

Summary

- Impedance Balance for 2.5G can be relaxed to:

  - 48 $\qquad\qquad$ $1 \leq f < 10$ (dB)
    48 - $20\log_{10}$(f/10) $\qquad$ $10 \leq f < 20$ (dB)
    42 - $15\log_{10}$(f/20) $\qquad$ $20 \leq f \leq 150$ (dB)

- No performance impact to RE, CE, RI, CI and BER

- 2.5G RJ45 price 25% of 10G RJ45

- Reduce complexity

- Add note to 802.3bz:

  - "Implementers should note that the MDI impedance balance is influenced by the impedance balance of the magnetics interface, but includes contributions from the PHY electronics port, the connector, and the remainder of the interface circuitry on seen looking into the MDI. Care should be taken not to allocate all the imbalance to a single component"

Thank you.