Impedance balance requirements for 2.5G & 5GBASE-T link segments

IEEE P802.3bz 2.5G/5GBASE-T TASK FORCE

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Recent Fluke Comment (Atlanta)

ISO/IEC includes impedance balance requirements

TIA 568 does not

Both cabling standards are referenced for use in 802.3bz.

2.5G/5GBASE-T link segment should be explicate about impedance balance parameters so as to remove any ambiguity for equipment and system implementers.

ISO/IEC 11801:2002, Class D, Class E

Table 20 - Unbalance attenuation for channel

Class	Frequency MHz	Maximum unbalance attenuation dB
A	f = 0,1	30
B	f = 0,1and 1	45 @ 0,1 MHz; 20 @ 1 MHz
C	1 ≤ f ≤ 16	30 - 5log(f) f.f.s.
D	1 ≤ f ≤ 100	40 - 10log(f) f.f.s.
E	1 ≤ f ≤ 250	40 - 10log(f) f.f.s.
F	1 ≤ f ≤ 600	40 - 10log(f) f.f.s.

Note: The 2002 edition of 11801 has no regard for screened or unscreened cabling constructions.

ISO/IEC 11801 Class D, Ed. 2.2, 2011

Table 21 – TCL for channel for unscreened systems

Class	Frequency MHz	Minimum TCL [a] dB
A	f = 0,1	30
B	f = 0,1 f = 1	45 20
C	$1 \le f \le 16$	$30 - 5\lg(f)$
D, E, E_A, F, F_A	$1 \le f < 30$ $30 \le f \le$ NOTE [b]	$53 - 15\lg(f)$ $60{,}3 - 20\lg(f)$
NOTE This equation for TCL applies to upper frequency of the class.		
[a] *TCL* at frequencies that correspond to calculated values of greater than 40,0 dB shall revert to a minimum requirement of 40,0 dB. [b] TCL at frequencies above 250 MHz are for information only.		

ISO/IEC 11801 Class D, Ed. 2.2, 2011

Table 22 – ELTCTL for channel for unscreened systems

Class	Frequency MHz	Minimum ELTCTL dB
D, E, E_A, F, F_A	$1 \leq f \leq 30$	$30 - 20\lg(f)$

Additional considerations

MDI has explicit impedance balance requirements (clause 126.8)

- Historically these are derived to provide margin against the CM output voltage being sufficient to exceed the Class A emission limits (see Cobb_0705).

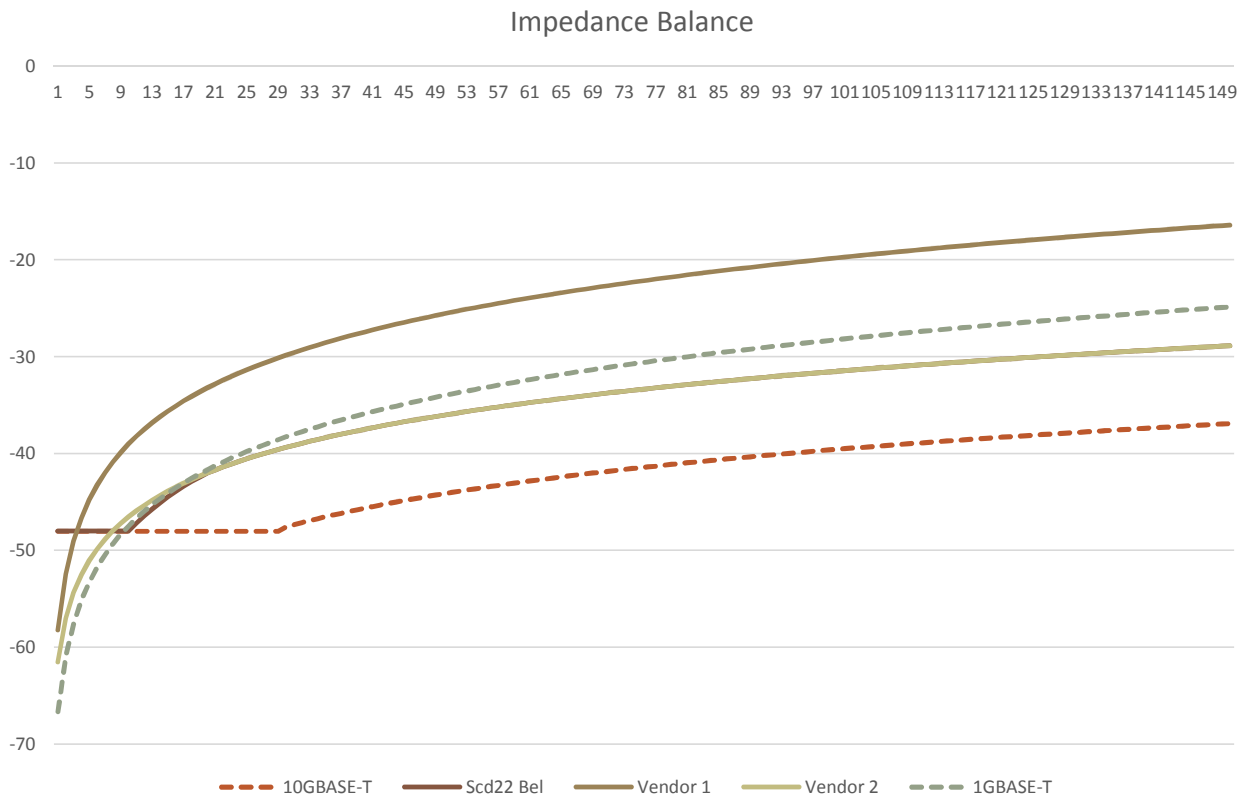
The CMRR test has *implied* minimum mode conversion requirements for the media used in the test setup (Annex 113A)

- The +6 dBm input voltage is similarly derived from immunity test limits (see Cobb_0505).

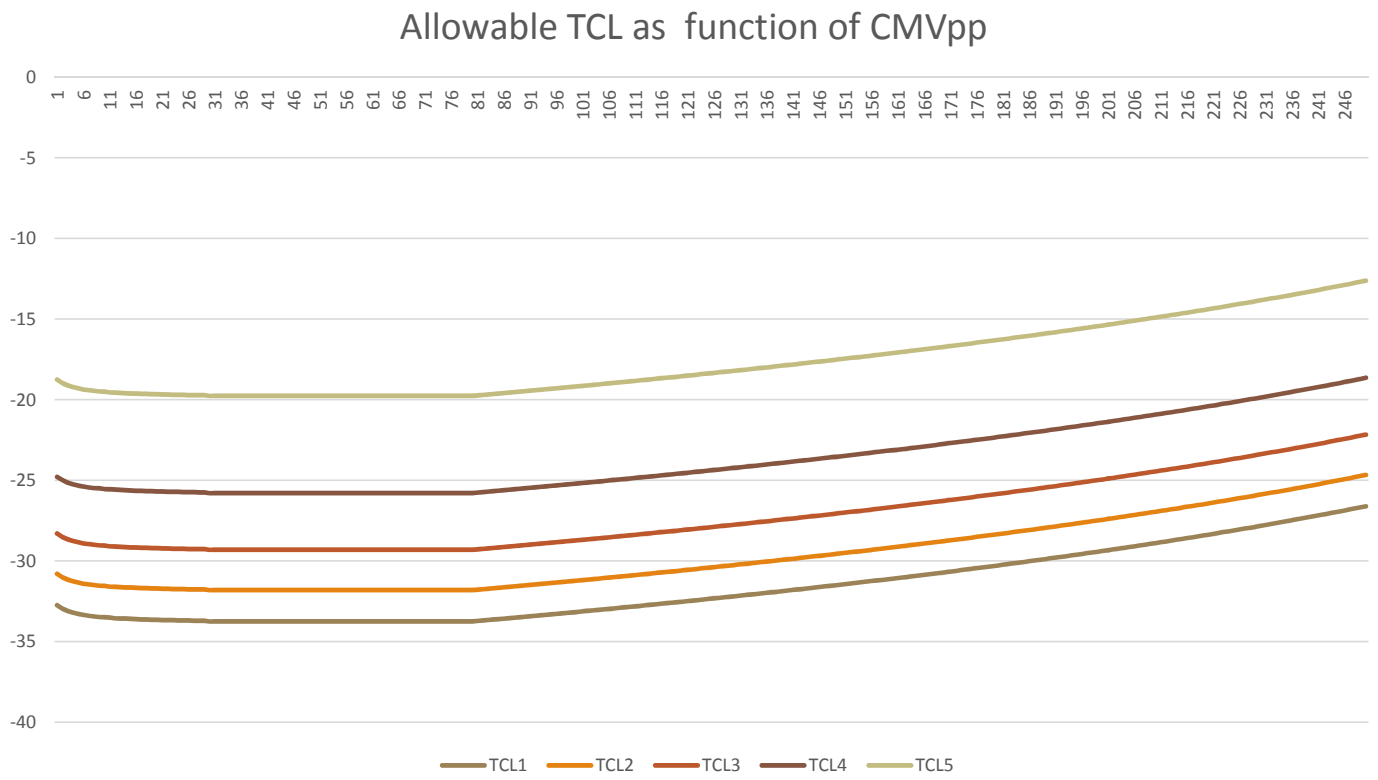
Poorly balanced cabling can contribute to failing EMC tests.

Prudent system design would seem to dictate that these minimums be compared to the link segment requirements.

MDI Impedance Balance proposals



CMR Test – Implied link segment TCL



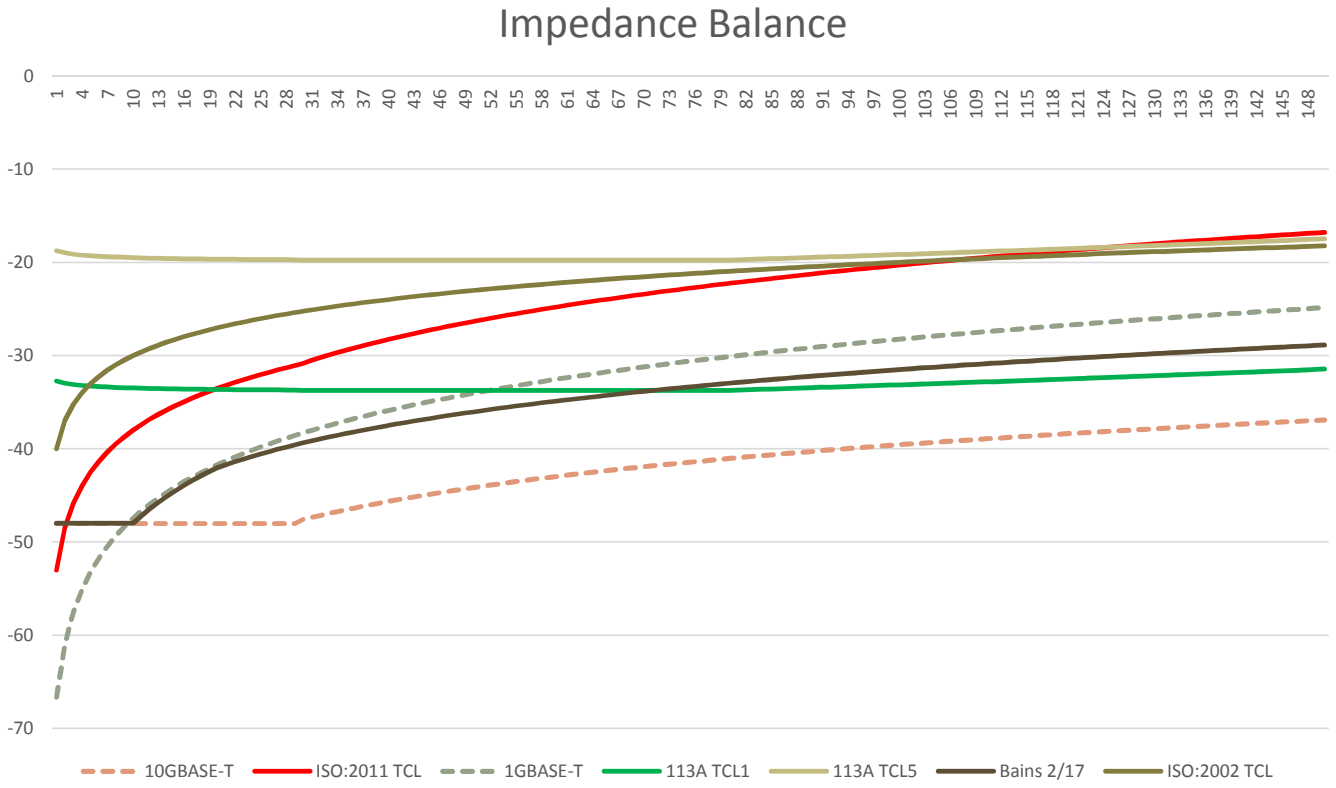
Impedance balance is important

A minimum requirement has been deemed important for the MDI

A minimum requirement has been deemed important for setting up the CMR validation test

Impedance balance for the link segment should not be left ambiguous

Compare Class D channel TCL



Conclusions

Prudent system design would seem to dictate that impedance balance minimums be compared to the link segment requirements for TCL, in order to assure reliable operation of the PHY at speed. (We just did that.)

I have no desire to throw out, or even challenge, the ISO limits. They are what they are.

Personal experience: poorly balanced cabling will not hold a 1Gb/s link, let alone 2.5G or 5G transmission.

Based on these comparisons, and the existing ambiguity, we have good reason to make the ISO limits as an explicate minimum for 802.3bz, listed in clause 126.7.