10BASE-T1S Cnode Measurement

Andy Gardner

Michael Paul

ANALOG DEVICES

AHEAD OF WHAT'S POSSIBLE™

Summary

- Measurement of an example power coupling network
  - No PHY in measurement
  - Power Coupling Inductance Alone
    - 112uH +/- 20%
    - Measured Cnode = 4.02pF
  - Power Coupling Inductance + Common Mode Choke
    - 100uH CMC
    - Measured Cnode = 13.47pF
  - Estimate 12.5pF per node for PHY
    - Estimation from “Koczwara_Griffiths_Brandt_MultidropNodeDistributionChallenges_20201202_v1.1.pdf”
    - (Measured + Expected) Cnode = 25.97pF

10BASE-T1S MDI Electrical Specifications

When in multidrop mode, the MDI shall present a minimum parallel impedance across the MDI attachment points per Equation (147–8) and the limits for R, L, C_{tot}, and C_{node} given in Table 147–4 over the stated frequency range. C_{tot} is the maximum total capacitance across all MDI attachment points, while R, L, and C_{node} are the resistance, inductance, and capacitance for each MDI attachment point.

Inductive elements are often used when power is applied across the data lines, and may be absent in non-powered implementations. Removing the parallel inductance is equivalent to setting L to infinity in Equation (147–8). The parasitic capacitance of inductive elements forms a portion of C_{node}.

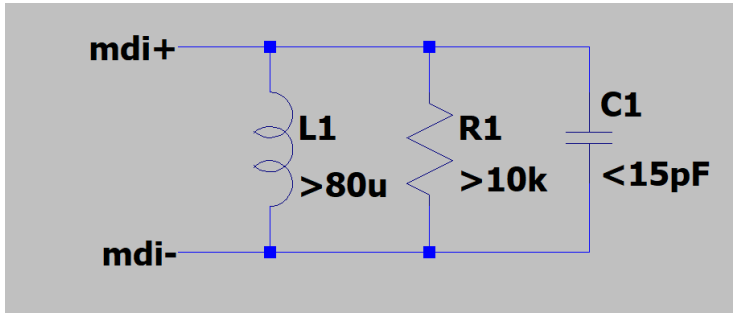
$$|Z| = \frac{1}{\sqrt{\frac{1}{R^2} + \left(\frac{1}{2\pi \cdot f \cdot L} - 2\pi \cdot f \cdot C_{node}\right)^2}} \qquad (147\text{–}8)$$

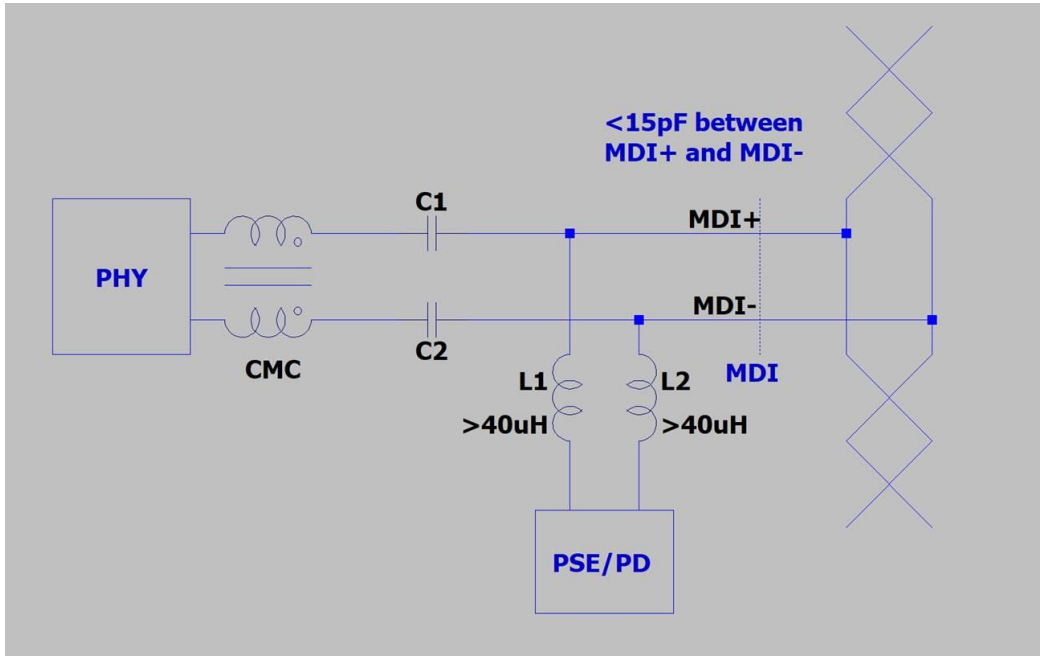
where

f is the frequency in MHz; $0.3 \le f \le 40$

Table 147–4—MDI impedance limit parameters

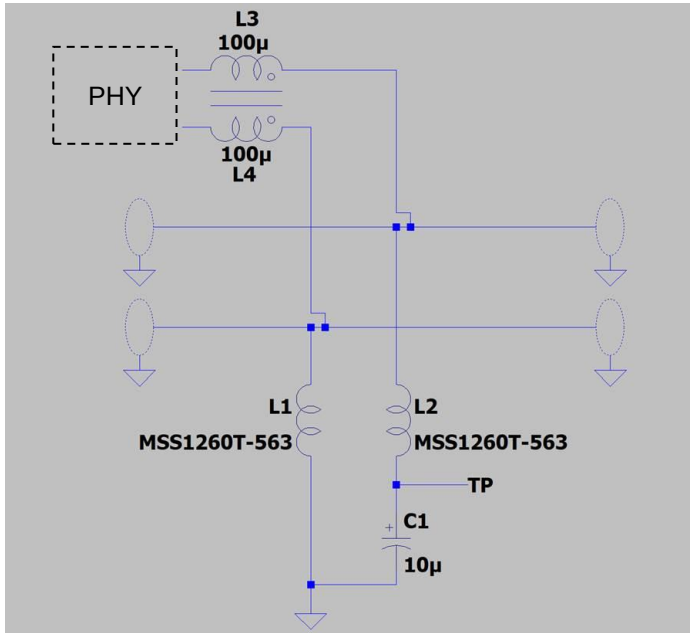
Parameter name	Unit of measure	Minimum value	Maximum value
R	kW	10	—
L	µH	80	—
C_{tot}	pF	—	180
C_{node}	pF	—	15

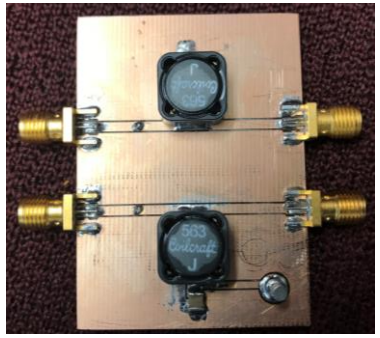




10BASE-T1S Power Coupling Design

PCN Shunt Branch test





CMC: 1210L-101-2P-TL00 100uH

PoDL L: MSS1260T-563 56uH

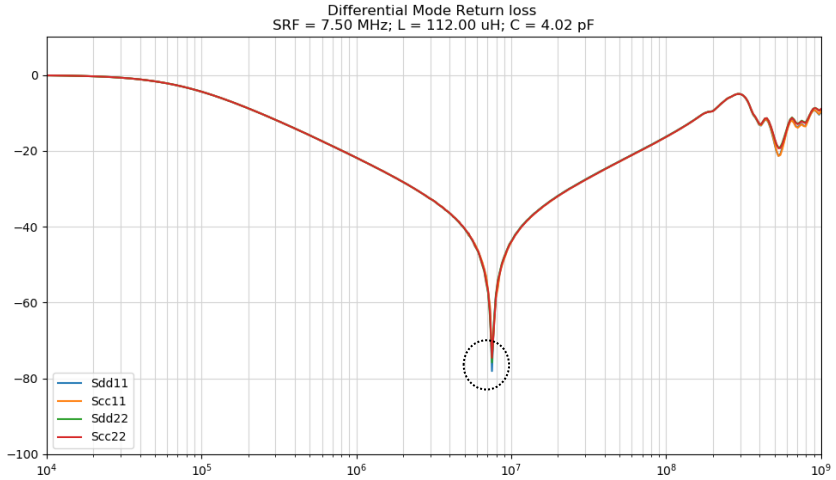
Part number 1	Inductance (µH) 2 *(Tolerance: ±20%)*	DCR (mΩ) 3		SRF typ (MHz) 4	Isat (A) 5			Irms (A) 6	
		typ	max		10% drop	20% drop	30% drop	20°C rise	40°C rise
MSS1260T-563ML_	56	85.0	89.0	10.5	2.6	3.0	3.3	1.8	2.4

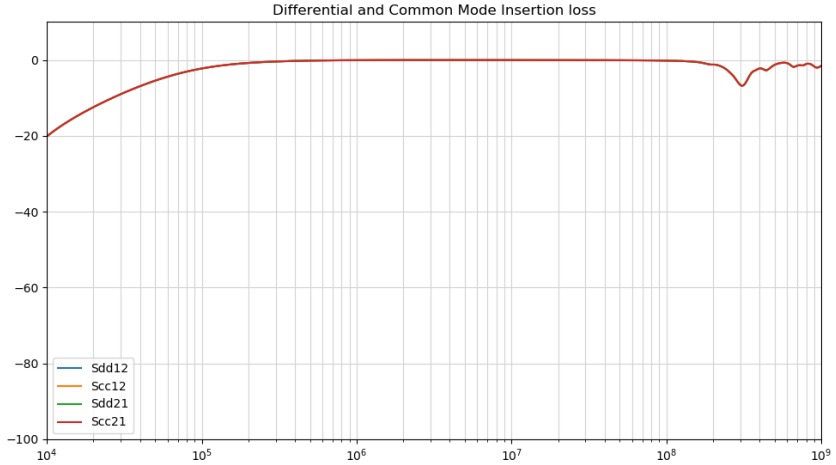
- PoDL inductors and PHY CMC should add to 15pF
- PHY CMCs being researched are mostly >10pF for 10+Mbps

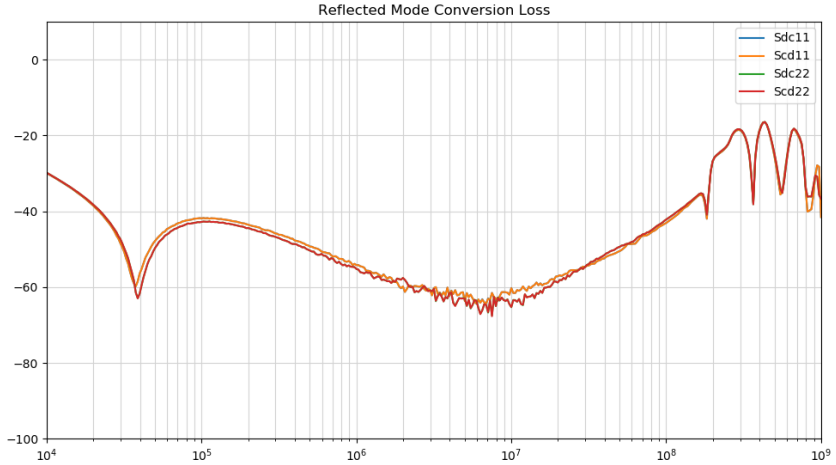
10BASE-T1S Power Coupling Design: S parameters w/o PHY CMC

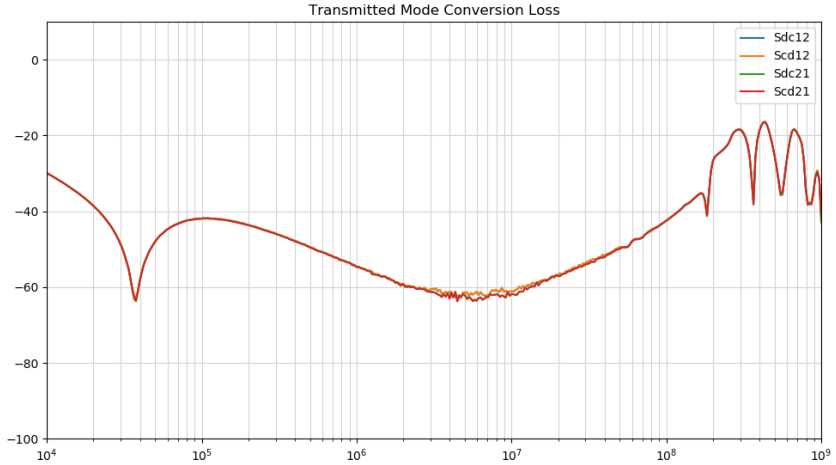
SRF: 7.5MHz; C: 4.02pF; L: 112uH

mss1260t_563_no_phy_cmc.s4p









10BASE-T1S Power Coupling Design: S parameters with PHY CMC

SRF: 4.10MHz; C: 13.47pF; L: 112uH

mss1260t_563_phy_cmc.s4p