EE 673, Power Electronics and Power System Laboratory

Indian Institute of Technology, Bombay

Experiment : Transformer characterization

Date- 28/03/2025 ***Duration: 3 hours***

Activity 1:

- Connect the *B-WIC* to *Bode 100* using three BNC cables or BNC-adapter. Use BODE ANALYSER SUITE software to open impedance analysis using impedance adapter (B-WIC component test fixtures).
- Perform the Open, Short and Load calibration in Full-Range calibration.

Activity 2:

- Perform open-circuit and short-circuit tests on given three non-interleaved and interleaved transformers using the Bode 100.
- Conduct a frequency sweep and observe the Impedance magnitude plot, Phase plot and other relevant frequency response plots (eg. Inductance, capacitance)
- Analyze the frequency response data to determine
  - Equivalent resistance (R_{eq})
  - Magnetizing inductance (L_m)
  - Leakage inductance (L_{lk})
  - Parasitic capacitances (C_1, C_2, and C_{12}) based on the three-capacitance model.
- Compare the measured parameters to analyze how different winding configurations affect parasitics capacitance and leakage inductance.

Activity 3:

- Design a non-interleaved transformer (T1) and an interleaved transformer (T2) using the provided AWG22 copper wire and two ETD 44 or EE40 cores with bobbins. Choose the number of turns as per your design, ensuring 3 layers for both the primary and secondary windings.
- Ensure that both T1 and T2 have the same number of turns and identical no of layers to have an better comparison.
- Perform open-circuit and short-circuit tests on the transformers T1 & T2 and determine the equivalent resistance (R_{eq}), magnetizing inductance (Lm), leakage inductance (L_{lk}), and parasitic capacitances (C_1, C_2, and C_{12}) based on the three-capacitance model.

Postlab activity:

Activity 1:

- Model the transformer in LTspice using given values.
  - N_1/N_2= 2
  - Magnetizing inductance (L_m) : 5.3 mH
  - Leakage inductance (L_{lk}) : 192uH
  - Parasitic capacitances (C_1, C_2, and C_{12}): 27pF, 15.2pF & 71.2pF
- Connect a 1A current source to the transformer.
- Conduct open-circuit and short-circuit tests and plot the variation of impedance magnitude with frequencies using frequency sweep in LTSpice. From the plots find the value of L_m & L_{lk} and verify with the given values.
- Find the frequencies at which resonance is happening and find which inductance and capacitances are responsible for the resonance.
- Change the inductance and capacitance values to observe how the resonant frequencies shift.

  Note: If the inductance and capacitance values are too small, resonance will occur at higher frequencies, potentially exceeding the bandwidth of the measuring instrument. Determine the trade-off between bandwidth (BW) and the values of L and C.
- Identify and analyze the multiple resonant peaks at higher frequencies.

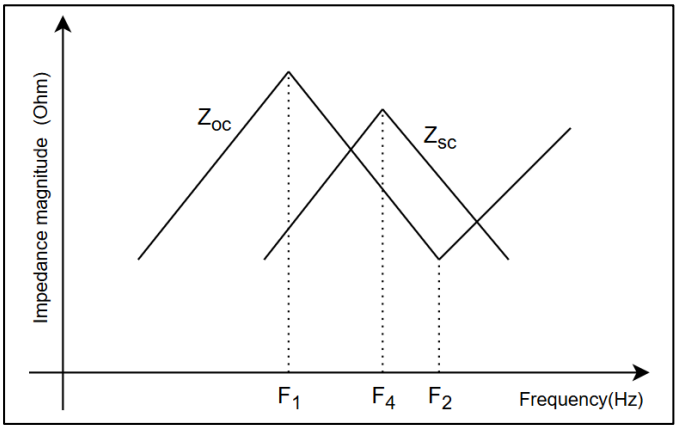

Fig: Impedance plot for OC and SC tests for reference