EE P 592 / EE 579A

Electromagnetic Compatibility

HW4

Q1 [12 pts]: A 100 MHz, antenna is used to generate a plane wave. The input power to the antenna was 10/6 W and its gain was 20dB. The antenna is placed 10m away from the circuit. The generated wave propagated parallel to an air filled two-wire transmission line as shown in Figure 1. The E-field is in the plane of the two wires. Compute,

(a) The level of the E-field and H-fields as they impinge on the circuit.
(b) The per-unit length capacitance value and induced source values.
(c) The magnitude of the induced voltage at the 50Ω resistor.
(d) The magnitude of the induced voltage at the 100Ω resistor.

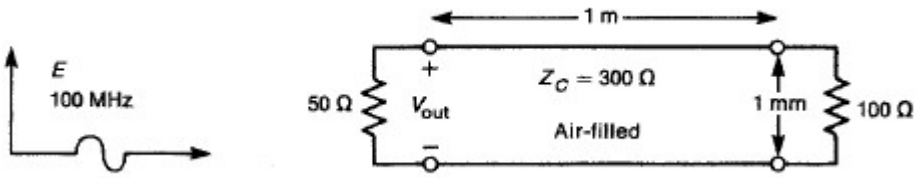

Figure 1

Q2 [11 pts]: The radiated emissions from a cable are conducted as shown in Figure 2 at 100MHz. Calculate the radiated emission values of the radiated E-field due to differential-mode (DM) currents and common-mode (CM) currents measured by the Spectrum Analyzer (SA) if the antenna contribution at 100MHz is 15dB and the antenna is oriented parallel to and in the plane of the wires.

[**Note**: the SA measurement is obtained by considering the antenna contribution to the E-field value]

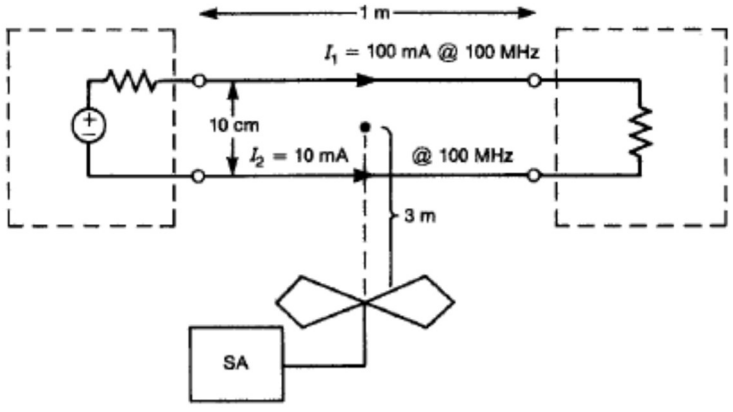

Figure 2

Q3 [15 pts]: The effect of a power supply filter on the common-mode (CM) currents is sometimes characterized by the CM impedance defined as $Z_C = V_C/I_C$, with reference to **Figure 3**. If L_{GW}=1mH, L = 28mH, k=0.98 and C_{CL}=C_{CR}=3300pF, use **LTSPICE** to plot Z_C from 150 kHz to 30 MHz, and calculate the values of Z_C as these two frequency points. Repeat this for the differential-mode (DM) impedance Z_D with respect to **Figure 4** using C_{DR}=C_{DL}=0.1μF.
[**Hint**: you need to specify a source value, i.e. 1mA and then find the corresponding voltage and their ratio to get the impedance.]

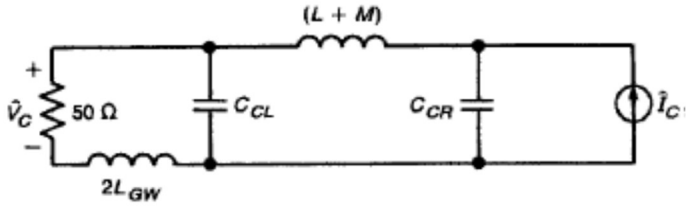

Figure 3

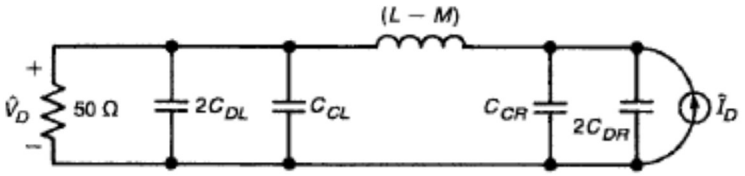

Figure 4

Q4 [12 pts]:

(a) A shield contains 10 identical holes in a linear array in required to have 30dB of shielding effectiveness at 100MHz. What is the maximum linear dimension of one hole?

(b) A shield ventilation panel consists of a 20 x 20 array of 400, 1/8 inch round holes. The panel is ½ inch thick (hence the holes have a depth of ½ inch). What is the approximate shielding effectiveness of the panel at 250MHz?

(c) A product requires 20dB of shielding at 200MHz. It is planned to use 100 small round cooling holes (all the same size) arranged in a 10 x 10 array. What is the maximum diameter of one hole?

<u>Submission Notes</u>:

(1) submit a PDF file for your solutions including ALL figures, plots, circuit models, etc.

(2) Attach the LTSPICE files as separate files for each problem that asks for such a solution/model/file, name them according to the problem number, i.e. "HW4_Q2_b_Student_Name".

(3) Send the PDF file along with the individual circuit files in Canvas.