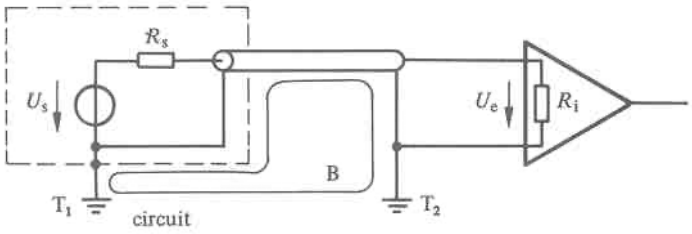
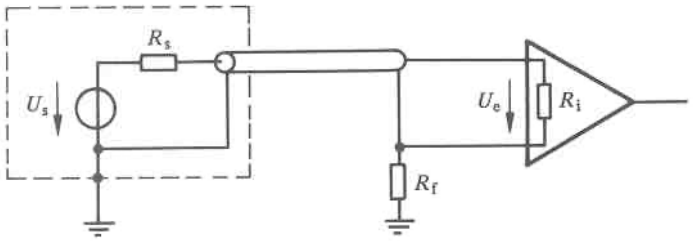
Electromagnetic Compatibility
Problem Set 5

Problem 1: Common mode induced voltage

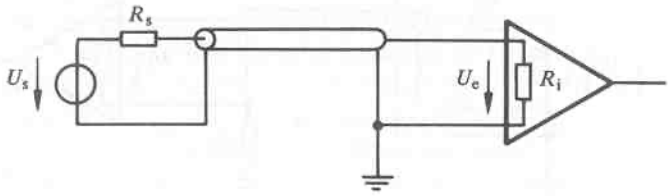
a) Determine the expression of the induced voltage at the input of the amplifier, due to a common-mode disturbing voltage UT between the two groundings T1 and T2.
Numerical application: UT=100 mV, equivalent resistance between T1 and T2 : RT=0.01 Ω, resistance of the internal conductor Rc= 1 Ω, resistance of the shield Rb=1 Ω, Rs=500 Ω, Ri=10 kΩ.



b) We insert a resistor Rf=10 Ω between the amplifier and the ground (see figure). Calculate the vaue of the resulting voltage at the input of the amplifier.

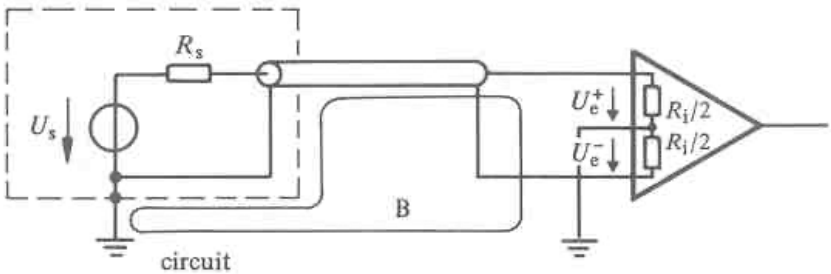


c) Is it appropriate to use a floating source, as shown in the figure below ?



Problem 2 : Use of a Differential Amplifier

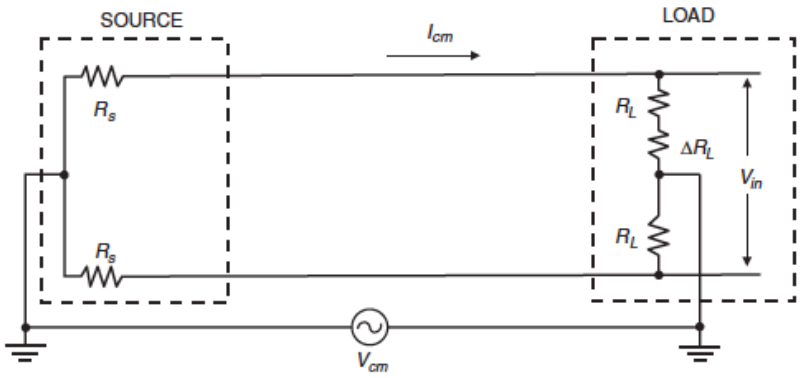
We replace the amplifier in Problem 1with a differential (balanced) amplifier. Calculate the induced voltage at the input of the amplifier. Ri1= Ri2= Ri /2.



Problem 3 : Common-Mode Rejection Ratio

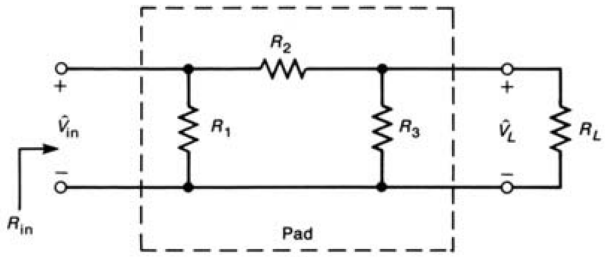
Consider the circuit shown below in which we have an unbalanced load resistance.

1. Calculate the expression for the Common-Mode Rejection Ratio (CMRR) as a function of source and load impedances.
2. Simplify the obtained expression for RL>>RS.
3. Calculate CMRR in dB for RS = 100 Ω, RL = 10 kΩ , and ΔRL = 100Ω.

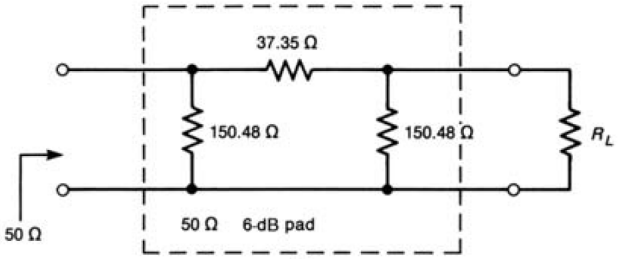


Problem 4 : Insertion Loss of a Pad

A pad is a resistive network whose input impedance remains fairly constant regardless of its termination impedance.
A typical topology of a pad is the "Pi" structure shown in the figure below. It is also possible to choose other structures such as the "tee" (T) structure. Being resistive circuits, these pads provide matching over wide frequency ranges but they also give an insertion loss.



The resistor values and schematic of a 50-Ω, 6-dB pad are shown in the figure below. A photograph of a commercially available pad is also shown.



1. Calculate the input impedance of the pad for extreme values of termination impedances: open circuit and short circuit.
2. Calculate the insertion loss of the pad for a source with an internal impedance of 50 Ohms.