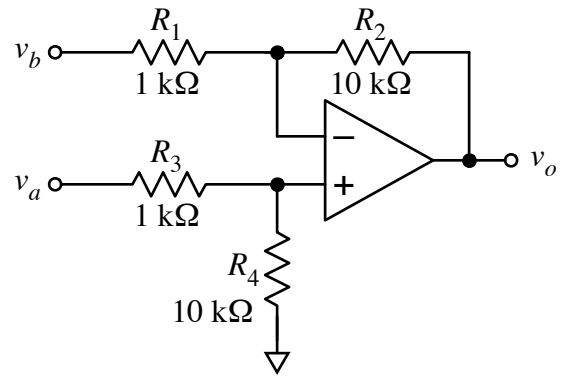


A simple difference amp is shown at right. The op amp is ideal and the resistors have the nominal values shown, and if the resistors are perfectly matched, the difference-mode gain will be 10 and the common-mode gain will be zero.



Of course, real resistors are not perfect and come with some tolerance, $R = R_{nom}(1 \pm x)$, where R_{nom} is the nominal resistor value and x is the resistor tolerance. If the resistors are randomly chosen from a collection, they will not be perfectly matched.

Calculate an expression for the worst-case (i.e. biggest) common-mode gain in terms of the resistor tolerance x . Calculate values for the worst-case G_c and the corresponding common-mode rejection ratio for $x = 5\%$, 1% , and 0.1% .

$x = 5\%$: $G_c =$ _____ $CMRR =$ _____

$x = 1\%$: $G_c =$ _____ $CMRR =$ _____

$x = 0.1\%$: $G_c =$ _____ $CMRR =$ _____