ELECTRICAL ENGINEERING

Find transfer function of Op Amp system

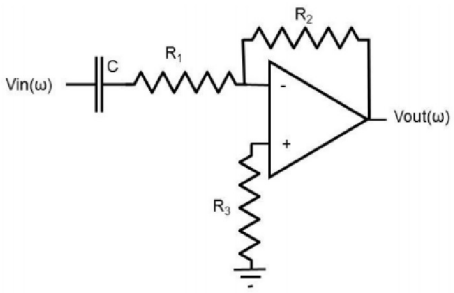
Asked 6 years, 1 month ago Modified 6 years, 1 month ago Viewed 2k times

0

Trying to determine the transfer function for this Op Amp circuit using the rules that $V- = V+$ and that no current flows into the Op amp. I think that $Vout = IR2$ and determined the trasnfer function to be

$TF = (1 - R2^2/(Zc + Zr2))/(Zc + Zr2)$, where Zc is impedance of capacitor and Zri is the impedance of the respective resistor. This was found using the voltage divider across $V-$ to then determine the current

I have been informed that this is incorrect and am unsure where I have gone wrong. Any help is appreciate



operational-amplifier circuit-analysis transfer-function

Share Cite Follow

asked Aug 20, 2016 at 7:25

Joe Speedmen

1 1

3 Answers

Sorted by:

Highest score (default)

1

Your assumption that $V^- = V^+$ is correct in order to avoid the operational amplifier to saturate, and you are right in affirming that $V_{out} = IR_2$, where I is the current flowing across the C-R_1 series as well as across R_2 due to the fact that no current flows into an ideal op amp ($I^- = I^+ = 0$), so that $V^+ = I^+R_3 = 0 = V^-$.

Knowing what V^- is, you just need to compute I from V_{in} and the C-R_1 series, then substituting it into the expression $V_{out} = IR_2$ in order to obtain the correct transfer function.

As you may have realized, your mistake was the computation of the current through voltage divider across V^-, which is 0 and thus doesn't allow such an operation.

Share Cite Follow

answered Aug 20, 2016 at 7:53

DavideM

564 4 16

1

Here is the solution in $\mathcal{L}$-domain:

$$V^-(s)\left(\frac{1}{R_1+\frac{1}{sC}}+\frac{1}{R_2}\right)=V_{in}(s)\frac{1}{R_1+\frac{1}{sC}}+V_{out}(s)\frac{1}{R_2}$$

$$V^+(s)=V^-(s)=0$$

Finally, this gives:

$$G(s)=\frac{V_{out}(s)}{V_{in}(s)}=-\frac{R_2Cs}{1+R_1Cs}$$

Share Cite Follow

edited Aug 20, 2016 at 8:19

answered Aug 20, 2016 at 8:07

Marko Gulin

1,481 2 13 32

1

For your information, here is an alternative method for finding the transfer function.

- Assuming an IDEAL opamp, we set the voltage at the inverting opamp input terminal to zero. EDIT: This is allowed because (a) for an IDEAL opamp there is no input current (the series Resistor at the non-inv. input has no effect) and (b) the small differential voltage between both inputs (µV range) can be neglected in comparison to the input and output voltages.
- This voltage is determined by two voltage sources: Vin and Vout. Therefore, applying the rule of superposition we can calculate this voltage in two separate steps. For this purpose, apply the voltage divider principle for the following two cases: (1) Vin finite and Vout=0; (2) Vout finite and Vin=0.
- The sum of both results gives the voltage at the inv. node which, then, must be set to zero.
- As a final step, you can solve for the ratio Vout/Vin

As a final step, you can solve for the ratio v_{out}/v_{in}.

Share Cite Follow

edited Aug 21, 2016 at 9:24

answered Aug 20, 2016 at 17:00

LvW
23.1k 2 21 46