

Improving the Noise Performance of an Instrumentation Amplifier
Project 5
ECE 6400 Electronic Instrumentation
Summer II 2008
version 5 August 2008

1. Improving the Noise Performance of a Simple Operational Amplifier Circuit

Duplicate the results of examples 7.6 (using a diode as a noise source in SPICE), 7.7 (hand and SPICE analysis of an op-amp circuit noise performance), and 7.8 (improving the noise performance of the circuit of example 7.7) from the Franco text. Be sure to compare hand and SPICE results.

Attached is Dr. Miller's first attempt at example 7.7 that will help you get started, with the following caveats:

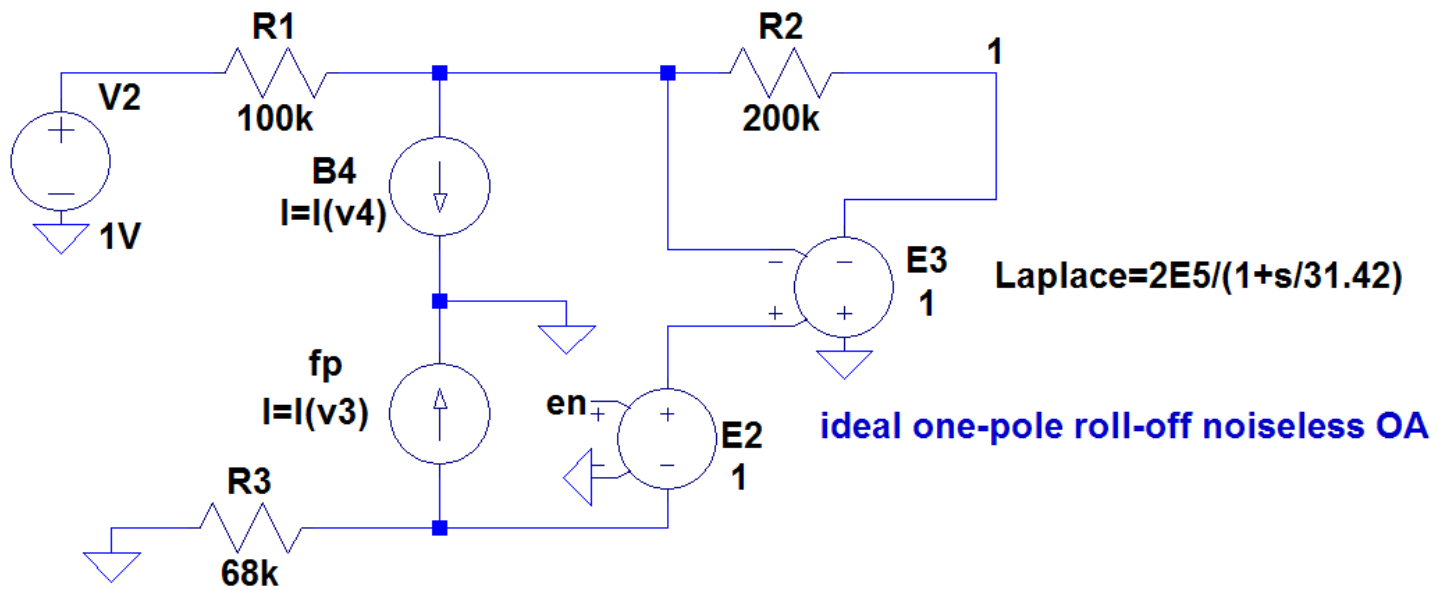
- a. I tuned the diode bias current for the e_n noise source to approximate the curve of Fig. 7.10 in the Franco text. Note that my current was about 100 times the value used in the text; I am not sure of the source of this mismatch. See if you can find (my?) mistake.
- b. I have not tuned the op-amp noise currents.
- c. I am suspicious of the third term in equation (7.22) of the text; derive that equation and identify the impact (if any) of any mistakes in that equation for this project.
- d. .NOISE analysis apparently only enables probing the single output voltage designated in the noise statement; you can change this to different nodes in the circuit.

2. Improving the Noise Performance of an Instrumentation Amplifier

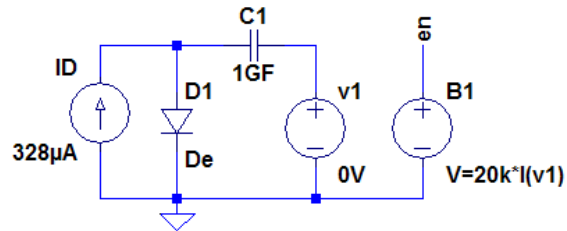
Based on your experience with part 1 of this project, estimate the output noise of your instrumentation amplifier (pre-amplifier and filter stage). Estimate the SNR of your instrumentation amplifier by referring the output noise to the input of the circuit, thus predicting the circuit resolution. Then make at least one modification to improve the SNR performance of the circuit.

SPICE Noise Example: based on Example 7.7, Franco, 3rd edition

**Damon A. Miller
30 July 2008**



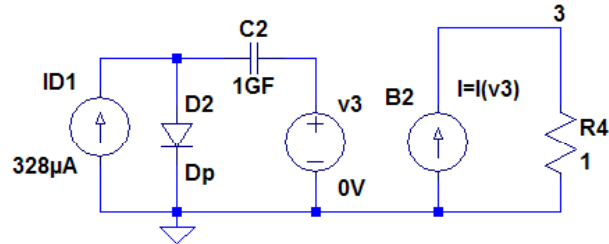
model from Franco with slight modification



```
.model De D( Is=2.682n N=1.836 Rs=.5664 Ikf=44.17m Xti=3 Eg=1.11
+ Cjo=4p M=.3333 Vj=.5 Fc=.5 Isr=1.565n Nr=2 Bv=100 Ibv=100u Tt=11.54n AF=1
+ KF=6.41E-17A)
```

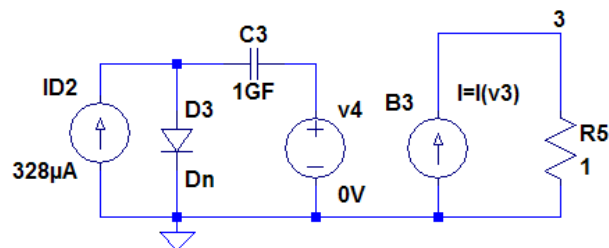
```
.include ECE6400.lib
```

```
.noise v(1) v2 dec 100 0.1 100MEG
.meas noise in_totn INTEG v(inoise)
.meas noise out_totn INTEG v(onoise)
```



```
.model Dp D( Is=2.682n N=1.836 Rs=.5664 Ikf=44.17m Xti=3 Eg=1.11
+ Cjo=4p M=.3333 Vj=.5 Fc=.5 Isr=1.565n Nr=2 Bv=100 Ibv=100u Tt=11.54n AF=1
+ KF=6.41E-16A)
```

```
;ac dec 100 0.1 100k
```



```
.model Dn D( Is=2.682n N=1.836 Rs=.5664 Ikf=44.17m Xti=3 Eg=1.11
+ Cjo=4p M=.3333 Vj=.5 Fc=.5 Isr=1.565n Nr=2 Bv=100 Ibv=100u Tt=11.54n AF=1
+ KF=6.41E-16A)
```

