

Re: low noise amplifier for high impedance source

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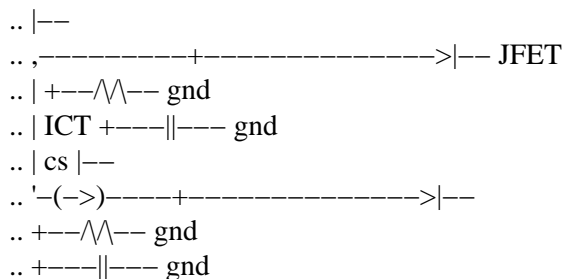
archiees wrote

I am a student who has been working on a low noise preamplifier for a high impedance current source. I have put the model of the detection circuit here:
<http://img146.imageshack.us/img146/9748/detectmodelid8.jpg>
 Its a differential ac current source with an instrinsic capacitance ~ 20pF on each side. I use 1M ohm resistors to bias my input JFETs. The bandwidth I need is only from 10 Khz to couple of MHz.

archiees wrote...

Thanks for your reply Phil.
 ** Do you really have a current source ???
 Yes, to my understanding. The source consists of 2 electrodes (Penning trap). Charged particles rotate between these electrodes and induce an image charge. This image charge is allowed to flow in an external circuit (like resistors) to constituting differential image current out of the electrodes.

The schematic you give in your .jpg drawing is



where the resistors are 1M, and the capacitors 20pF. The signal voltage developed across a low-value resistor like 1M will likely be much less than you like, as Phil implied. Resistor noise density is $i_n = (4kT/R)^{1/2}$, so you'll want

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a high R, like 100M or higher. The load capacitance will start reducing the signal (including the resistor noise) voltage above a frequency $f_c = 1 / 2\pi R C$, which is only 8kHz for 1M, and 80Hz for 100M. So clearly you want to lower value of the load C if you can.

One point, a portion of the JFET's capacitance, C_{rss} , will be added to C, unless you employ tricks to prevent this.

Once you know the signal voltage vs. current, as a function of frequency, you can compare it to e_n , the JFET's voltage noise at that frequency. You will find low e_n JFETs have high capacitance. Just a little gotcha from Mother Nature.

For example, a classic 2n4392 has $e_n = 3\text{nV}$ and $C_{rss} = 3\text{pF}$. Compare this to a bf862 with $e_n = 0.9\text{nV}$ and $C_{rss} = 1.9\text{pF}$. Ooops!! Actually, that's a bad example, contrary to Mother Nature, as well as Murphy's Law, because the Philips bf862 JFET is far, far better than it should be! :-)

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Thanks,
— Win
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