Re: Low Current Measurement (without ammeter)

Source: http://sci.tech−archive.net/Archive/sci.electronics.basics/2006−08/msg00330.html

- *From*: "John O'Flaherty" <quiasmox@xxxxxxxxx>
- *Date*: 28 Jul 2006 09:16:22 −0700

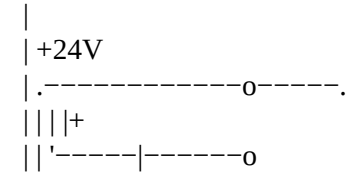
Chris wrote:

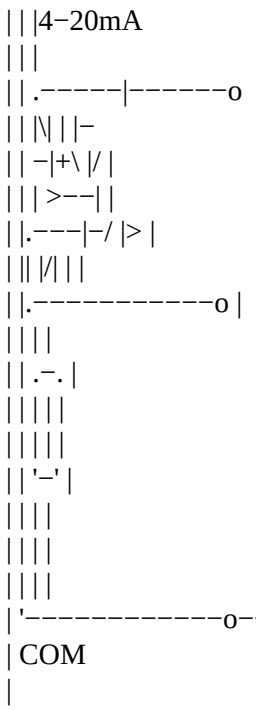
> ewilliams2@xxxxxxxxx wrote:
>
> > thank you so much John, I will try that and post my success message soon....
> >
> > Eric Williams
> > (left the name off last time...thanks again)
> >
> > John O'Flaherty wrote:
> >
> > > ewilliams2@xxxxxxxxx wrote:
> > >
> > > > Hello Everyone,
> > > >
> > > > I have an application that uses 3 displacement sensors with analog current output from 0 to 20mA. I have a real time DAQ system that only measures voltage from 0 to 10V. I have read the previous response to Pradheep's question and it seems like the current values are too high to get the kind of precision that I need. I was wondering if I could use the resistor in series method and if there was some trick that could help me develop this setup? Any help at all would be appreciated, because I've never had to measure currents like this before so I'm a little beside myself trying to figure this one out...Also if the resistor "shunt" is placed in series what kind of accuracy can be achieved?

> If you put the current into an opamp inverting input, with a 500 ohm
> feedback resistor, and the non−inverting input grounded, it will
> convert 0−20mA to 0 to −10V, and the output will be stiff even if it's
> loaded a little. You'd have to invert the output to +10 V. If the opamp
> needs to be protected from voltages, you can use a series resistor with
> diodes to plus and minus supply on the opamp input to limit voltage
> excursion, but you'd have to make sure the current source has enough
> compliance to handle the extra resistance. The source will only need
> enough voltage compliance to handle the drop across that protective
> resistance.You could also just use a 500 ohm resistor, if the DAQ
> system has high input impedance. Using just a 500 ohm resistor, the
> current source would have to have the compliance to produce the 10V.
> −−
> john

> Look before you leap, John −− there are a few potential gotchas here.
>
> First, not all op amps are capable of sourcing/sinking 20mA (and that
> has to be a min., not typ. on the data sheet).

That's a good point.You could put a transistor buffer on the opamp output, or, in a one−direction application like this, you could hang a resistor to the minus supply, pulling 10mA out. Then the opamp could switch between sinking and sourcing 10 mA.

> Second, you really have to look carefully at your system before you
> just plug it in. Many sensors that output a 4−20mA (or 0−20mA) current
> operate on another supply voltage, and have a simplified internal
> circuit like thios (view in fixed font or M$ Notepad):
>
> 
>



(created by AACircuit v1.28.6 beta 04/19/05 www.tech−chat.de)

If your sensor common is connected to DAC GND, you may have an issue connecting the external power supply (which may exceed the DAC power supply or the input common mode voltage) to the DAC input. And if you connect the negative sides of more than one sensor together, it won't work.
Another difficulty is power−up sequencing. If your sensor supply comes up before the DAC's, you may get latchup when the DAC turns on. Not pretty.

Do you think using a series resistor with diodes to prevent excursion more than V+ plus .7 or V− or ground minus 0.7 would prevent that problem? With a hookup like that, wouldn't an early start of the sensor supply at worst just try to power up your circuit?

For current output sensors, you typically place a 250 ohm (0−5V) or 500 ohm (0−10V) load resistor at the receiving end of your signal, and then use a diff amp to get the input voltage to the DAC. That's how it's done.

That seems like the best solution if you have 24V available from the sensors.
−−
john

.