

Re: Questions about optimizing Sensor outputs to dsp/microcontroller A/D inputs

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steve wrote:

- > *Ok, when hooking up a sensor output to a/d input we want to minimize*
- > *the ratio of RMS noise to the LSB value. I would think we want a*
- > *sensor with a high voltage output and a A/D with a high voltage input*
- > *so that the LSB is well above the noise floor. Stand alone a/d's*
- > *usually have nice high input ranges (e.g., Maxim 1271 with a +/- 10*
- > *Volt input), but many modern DSP and microcontroller A/D inputs are*
- > *usually +5 volts and the really modern and attractive ones are in the*
- > *+2.5 Volts range (Analog device ADUC7X series, Cypress PSoC), which*
- > *initially look unattractive as far as the A/D is concerned.*
- >
- > *However, when looking at the Maxim datasheet, although its take +/- 10*
- > *Volt input the internal reference is only 2.5 Volts, which is then*
- > *scaled up internally to 4.096V. Secondly, many sensors with high*
- > *voltage outputs simply have an internal final stage amp that scales*
- > *the output voltage. So my questions are*
- >
- > *1) Are those 2.5 Volt A/D's really at a disadvantage compared to the*
- > *wide range stand alone Maxim type A/D's since they really work off 2.5*
- > *volt references? I think the only purpose of the wide range inputs is*
- > *to eliminate the need to externally rescale large inputs, not to*
- > *decrease the RMS noise to LSB ratio. (which is what I thought at first*
- > *glance)*

Somehow your opinion seems possible, but it is important to consider the amount of each individual component in your accuracy Start with the A/D itself. It has a specified accuracy included the effect of the reference voltage scaler and other factors (temp. range) which is expressed in for example +/-1LSB, which in your case would be 2mV.

Now also your sensor has a certain noise level which is amplified by the signal conditioning. Lets say the voltage noise be $500\text{nV}/\text{Hz}^{-2}$ at the 0..4.096V output. With a bandwidth of 10kHz this would be $50\mu\text{V}_{\text{rms}}$, the peaks might be 6 times higher, which is still only 0.3 LSB . So up- and downscaling is not of much impact because the converter and sensor noise is dominant.

- > 2) *When Maxim scales up the 2.5 volts reference to 4.096 volts, what*
- > *the purpose of that? I would think that the amp would amplify the*
- > *noise too (unless its a differential amp). Or maybe they just want 1*
- > *count = 1 mV?*
- > 3) *Sensors with 5V outputs typically are just scaled up to 5 Volts*
- > *internally, and, with external parts, can be rescaled to 2.5 volts. If*
- > *I do that am I hurting the noise/lsb ratio? I would think that if they*
- > *are scaling up the output they are also scaling up the noise too*
- > *(again unless they are using differential amps).*
- >
- > *If there is a application note somewhere about this let me know*
- > *please!*
- > *thanks*
- > *steve*

If you do not use standard exchangeable sensors with +/-5 or 10V range, you can better get an unconditioned sensor and build a dedicated amp + filter to drive the 0...+2.5V analog input. This can be done from a 3.3V supply which has become standard by now. You can use modern low voltage CMOS parts, needs some input protection as shown in the data-sheet.

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ciao Ban
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