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Finding the LSB Clarifications Needed

Hari T 00 — Genius 3820 points — Community Member

Other Parts Discussed in Thread: ADS1248, ADS124S08

Hi,

We know that ADC's LSB =(Vref/2^N) where N is the resolution

In the data sheet ENOB is always less than N.

When finding the LSB Which one I need to Consider "N" or "ENOB"

Regards

Hari

over 6 years ago

Joseph Wu *over 6 years ago* — TI__Guru* 92945 points

Hari,

For choosing a converter, you really need to consider both the N for number of bits for resolution and the ENOB for the noise. In most cases however, most customers should care more about the ENOB for the noise.

While the data converter reports back N number of bits, the noise performance may vary depending on a variety of factors. In the case of many of our precision ADCs, the noise will depend on the data rate, digital filtering, PGA selection, and reference voltage. If you look at the ADS124S08 or ADS1248 datasheets, we will give tables that show an approximate noise performance depending on the previously mentioned factors.

In the end, most will want a certain level of noise performance so that they can guaranteed a certain level of accuracy.

Joseph Wu

Hari T 00 *over 6 years ago in reply to Joseph Wu* — Genius 3820 points

Hi Joseph,

Thank you very much.
What I understood from your post is for finding 1LSB we nee to consider "N" not ENOB.(Correct me If I am wrong)
ENOB will affect in the o/p side that is how many noise free bits are coming at the output

Regards
hari

Joseph Wu *over 6 years ago in reply to Hari T O0*

TI__Guru* 92945 points

Hari,

Now I understand your question. For the LSB (least significant bit), you consider only N. For a 24 bit converter, the LSB would be 1/(2^24) of the full scale. This is also 1/2^23 of the positive full scale.

The ENOB comes from the peak to peak noise found when making measurements. This LSB size is not calculated from the ENOB.

Joseph Wu

Hari T O0 *over 6 years ago in reply to Joseph Wu*

Genius 3820 points

Hi Joseph,
That is what I need.I was actully confused with it.Thank you for your calrification.
regards
Hari

Hari T O0 *over 6 years ago in reply to Hari T O0*

Genius 3820 points

Hi Joseph,

Could you please explain this little bit "The ENOB comes from the peak to peak noise found when making measurements. "So that I can make person to understant LSB is not calculated from ENOB

Regards
hari

Joseph Wu *over 6 years ago in reply to Hari T O0*

TI__Guru* 92945 points

Hari,

The ENOB is a measurement of the noise with respect to the full scale measurement. It is a measure of the dynamic range of the ADC. It is calculated from the noise seen in the ADC measurement. One way we measure the noise is to short the inputs together to see the offset voltage and see the noise with a series of measurements. The noise can be quantified with a the standard deviation or the peak-to-peak value with a sufficent number of samples.

To calculate the ENOB, we usually start with the peak-to-peak value. For example, let's say that we have a 24-bit ADC, and the offset measurement shows a peak-to-peak measurement of 70 codes. The equivalent ENOB would be:

ENOB = log[(2^24)/(70)]/log(2) = log(239674.5)/log(2) = (5.380)/(0.301) = 17.87 bits

This is the measurement we use for precision data converters. In other data converters, particularly in audio or higher

speed converters, this metric is based on the signal power instead of the full scale signal, and includes measurement of distortion.

Joseph Wu

Hari T O0 *over 6 years ago in reply to Joseph Wu*

Genius 3820 points

Hi Joseph,
Thank you very much.

embedded-lab.com/.../

May I know in the above article the current resolution calculated is correct or not.
In the last section you can see the calculations.Do we need to multiply with 1LSB or need to divide.

Regards
Hari

Joseph Wu *over 6 years ago in reply to Hari T O0*

TI__Guru* 92945 points

Hari,

I'm not sure I understand the question. I did go through a quick calculation and it seems correct. Starting with the ADC resolution, I get:

ADC LSB = 5V/1024 = 4.9mV

With the op-amp gain of 8.7 V/V, the measurement input (at the resistor) will have an LSB size of:

Measurement LSB = 4.9mV/8.7 = 0.56mV

With a sense resistor of 0.286 Ω, this means that the LSB in current is:

LSB in current = 0.56mV/0.286Ω = 0.00196A

Joseph Wu

Hari T O0 *over 6 years ago in reply to Joseph Wu*

Genius 3820 points

Hi Joseph,

Thank you.

Regards
Hari