

Help

Effective Number Of Bits Calculator (ENOB Calc) is a program that aids in the design and analysis of data converter application circuits. ENOB calculates the effective number of bits of an ideal data converter. Each parameter can be entered or found.

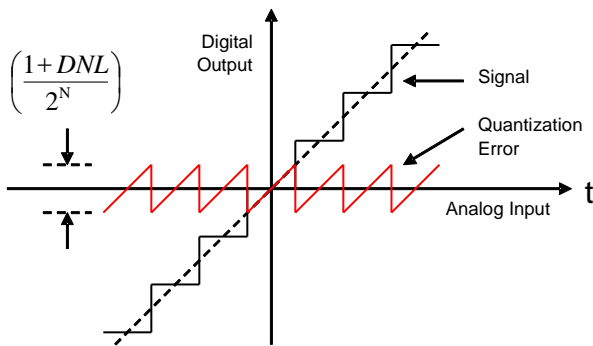
Parameters

1. Effective Number Of Bits, **ENOB**, in bits
2. Signal to Noise and Distortion, **SINAD**, in dB
3. Resolution, **N**, in bits
4. Bandwidth, **BW**, in % of the Nyquist frequency, or, Over Sample Ratio, **OSR**, as a multiple of the sample frequency
5. Average Differential Nonlinearity, **DNL**, in LSB
6. Clock Jitter, **Tj**, in PPMrms of the clock period
7. Analog Referred Noise, **Vn**, in LSBrms
8. Total Harmonic Distortion, **THD**, in % or dB.

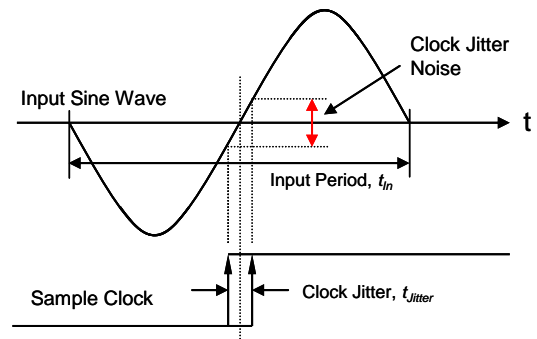
Parameter Descriptions

$$ENOB = \frac{SINAD - 10 \cdot \log\left(\frac{3}{2}\right)}{20 \cdot \log(2)}$$

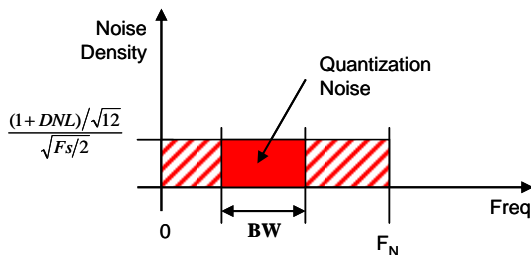
$$SINAD = -20 \log \sqrt{\underbrace{\frac{2}{3} \left(\frac{\sqrt{BW} (1 + DNL)}{2^N} \right)^2}_{\text{Quantization Noise}} + \underbrace{\left(2\pi \frac{Tj}{10^6} \right)^2}_{\text{Clock Jitter Noise}} + \underbrace{\left(\frac{2 \cdot \sqrt{2} \cdot Vn}{2^N} \right)^2}_{\text{Analog Noise}} + \underbrace{\left(\frac{THD\%}{100} \right)^2}_{\text{THD}}}$$



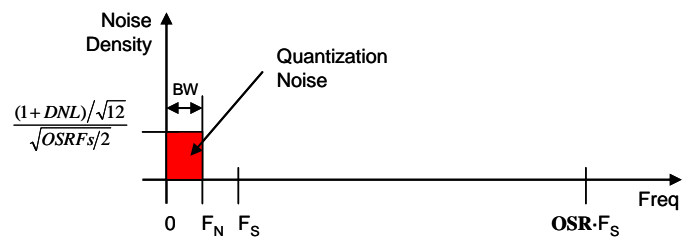
Quantization Noise (Res and DNL)



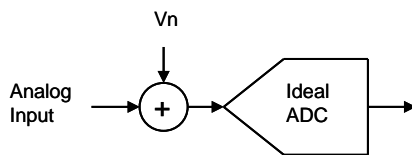
Clock Jitter Noise (Tj)



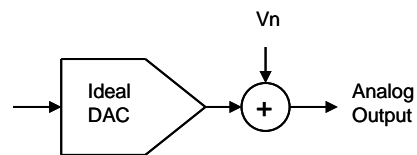
Quantization Noise (BW)



Quantization Noise (OSR)



ADC Input Referred Noise (Vn)



DAC Output Referred Noise (Vn)

Calculator Window

	Description	Name	Value	Unit
Parameters	Effective Number of Bits	ENOB	14.0	bit
	Signal to Noise and Distortion	SINAD	86.0	dB
	Resolution	N	14.0	bit
	Bandwidth	BW	100.0	%Fn
	Over Sample Ratio	OSR	1.0	xFs
	Differential Non Linearity	DNL	0.00	LSB
	Clock Jitter	Tj	0.00	PPMrms
	Analog Referred Noise	Vn	0.00	LSBrms
	Total Harmonic Distortion	THD	0.0000	%
	Total Harmonic Distortion	THD	-inf	dB
Message Line	Consistent			
Command Buttons	<input type="button" value="Defaults"/> <input type="button" value="Import"/> <input type="button" value="Set X"/> <input type="button" value="Find"/>			
	<input type="button" value="Help"/> <input type="button" value="Export"/> <input type="button" value="Plot Y vs X"/> <input type="button" value="Pie Graph"/> <input type="button" value="Close"/>			

← Consistent Indicator

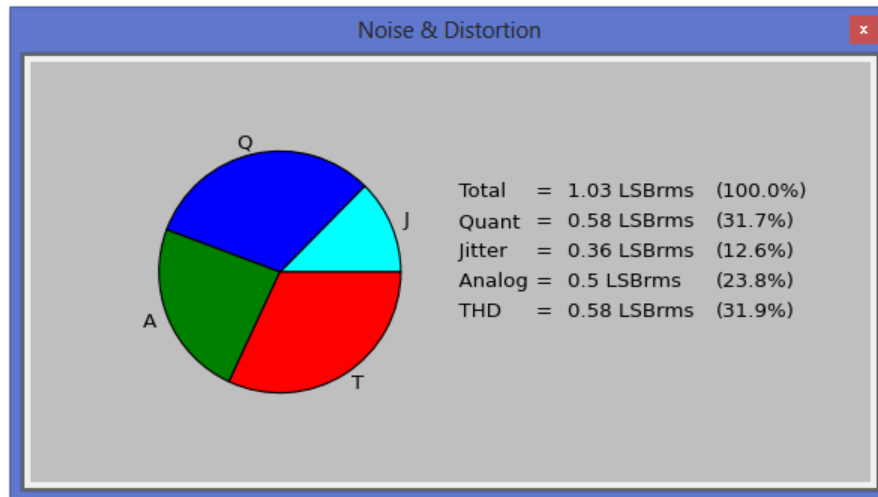
Commands

<input type="button" value="Find"/>	Alt + F	Find the selected parameter
<input type="button" value="Pie Graph"/>	Alt + G	Graph the noise spectral density curve specified by the parameters
<input type="button" value="Set X"/>	Alt + X	Select the x-axis parameter to plot
<input type="button" value="Plot Y vs X"/>	Alt + Y	Select and plot the y-axis parameter with respect to the x-axis parameter
<input type="button" value="Export"/>	Alt + E	Export all parameters to a .cvs file
<input type="button" value="Import"/>	Alt + I	Import all parameters from a .cvs file
<input type="button" value="Defaults"/>	Alt + D	Load the default parameter values
<input type="button" value="Help"/>	Alt + H	Display the help page
<input type="button" value="Close"/>	Alt + C	Close the calculator

“Consistent” indicates that all parameters are consistent. It appears following a Find (Alt + F) command. “Inconsistent” indicates that all parameters may not be consistent. It appears following an entry or import command.

Pie Graph

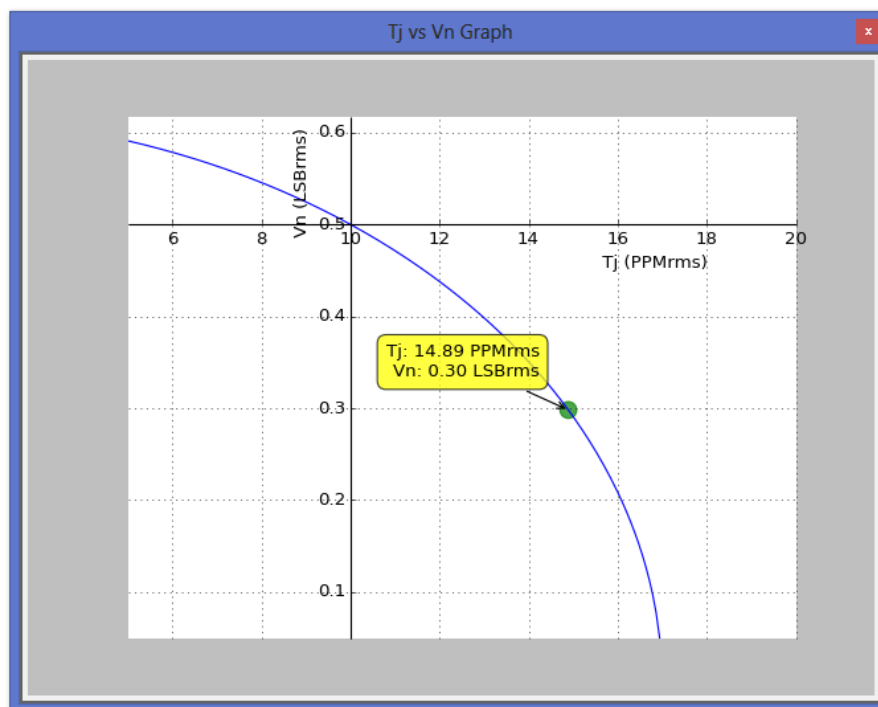
The pie graph command (Alt + G) displays a pie chart showing the contribution of each noise source in the data convertor or signal chain.



The noise and distortion components are plotted as a percentage their contributions to total noise when summed in RSS fashion. The amplitude of each component is given in LSBrms.

Parametric Plot

The "Plot X vs Y" command (Alt + Y) displays the following graph.



Moving the mouse over the plot window will reposition the green cursor showing the trade-offs that can be made between the two selected parameters and the remaining parameters values.

About

Version 1.1.0

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Ported to Python by Matthew Fortin