ADC and DAC Resolution, LSB and Ideal SNR

Smallest step (LSB) of an analogue-to-digital converter in volts and in engineering units, the counts for a value, and the ideal quantisation SNR and ENOB.

Method: Ideal quantisation of an N-bit converter; SNR = 6.02 N + 1.76 dB for a full-scale sine (IEEE 1241)

Input parameters

Unit system: SI

Parameter	Value	Unit
Resolution in bits	12.000	
Full-scale input range	10.000	V
Engineering span represented by full scale For example 200 °C or 16 bar; the LSB is shown in the same unit.	200.00	
Input voltage to convert to counts	3.3000	V
Measured SINAD for ENOB (dB)	68.000	

Calculated results

Parameter	Value	Unit
LSB in volts V_FS / 2^N	2.4414	mV
LSB in engineering units	0.048828	
Counts for the input voltage (rounded down)	1,351.0	
Ideal quantisation SNR 6.02 N + 1.76 (dB)	74.000	
Effective number of bits for the SINAD	11.003	

Formula and method

$$q = \frac{V_{FS}}{2^N}, \quad SNR = 6.02N + 1.76 \text{ dB}, \quad ENOB = \frac{SINAD - 1.76}{6.02}$$

Variables

N	Resolution in bits	-
V_{FS}	Full-scale input range	V
S	Engineering span represented by full scale	-
V	Input voltage to convert to counts	V
$SINAD$	Measured SINAD for ENOB (dB)	-
q	LSB in volts V_FS / 2^N	V
q_{EU}	LSB in engineering units	-
n	Counts for the input voltage (rounded down)	-
SNR	Ideal quantisation SNR 6.02 N + 1.76 (dB)	-
$ENOB$	Effective number of bits for the SINAD	-

Method and standards

Uniform quantisation.

Assumptions and limits

- Uniform, unipolar converter.

References

- Ideal quantisation of an N-bit converter; SNR = 6.02 N + 1.76 dB for a full-scale sine (IEEE 1241)

Report details

Report reference	FCC-VTVP-9EE3 (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/instrumentation/signals-calibration/adc-resolution

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.