Thermal (Johnson–Nyquist) Noise Power, Voltage and SNR

Thermal noise power and RMS noise voltage of a resistor or receiver over a bandwidth, the noise floor with the noise figure, and the signal-to-noise ratio.

Method: Johnson–Nyquist thermal noise

Input parameters

Unit system: SI

Parameter	Value	Unit
Temperature	290.00	K
Bandwidth	125.00	kHz
Resistance (for the noise voltage)	50.000	Ω
Receiver noise figure (dB)	6.0000	
Signal power at the input (dBm)	-110.00	

Calculated results

Parameter	Value	Unit
Thermal noise power (dBm)	-123.01	
Thermal noise power	5.0049e-16	W
Open-circuit RMS noise voltage √(4kTRB)	3.1638e-07	V
Noise floor kTB + NF (dBm)	-117.01	
Signal-to-noise ratio (dB)	7.0061	

Notes for this case

• Johnson–Nyquist noise: available power kTB (−174 dBm/Hz at 290 K), open-circuit voltage √(4kTRB). The receiver adds its noise figure to the floor.

Formula and method

$$P_n = kTB, \quad v_n = \sqrt{4kTRB}, \quad N = 10\log_{10}\frac{kTB}{1\ \mathrm{mW}} + NF, \quad SNR = P_s - N$$

Variables

T	Temperature	K
B	Bandwidth	1/s
R	Resistance (for the noise voltage)	Ω
NF	Receiver noise figure (dB)	-
P_s	Signal power at the input (dBm)	-
kTB	Thermal noise power (dBm)	-
v_n	Open-circuit RMS noise voltage √(4kTRB)	V
N	Noise floor kTB + NF (dBm)	-
SNR	Signal-to-noise ratio (dB)	-

Method and standards

Thermal noise physics.

Assumptions and limits

- Thermal equilibrium, white noise over the band.

References

Johnson–Nyquist thermal noise

Report details

Report reference	FCC-K2A9-5Y5M (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	Thermal (Johnson–Nyquist) Noise Power, Voltage and SNR
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/electrical/electronics/thermal-noise-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.