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APPLICATION NOTE 5
NOISE TEMPERATURE, FIGURE and FACTOR CALCULATIONS

Basic formulae are:

Noise Temperature (T) = 290 * (10^(Noise Figure/10)-1) K

Noise Figure (NF) = 10 * log (Noise factor) dB

Notes:

log must be to base 10. When using calculators and spreadsheets make sure that base 10 is selected. As a test, 10 * log(2) should give an answer of +3 dB.

Noise temperature is measured in units called Kelvin (K) and these are like Celsius (C) temperature degrees but start at zero for absolute zero temperature so

0 K = -273 deg C

273 K = 0 deg C (ice melts)

290 K = 17 deg C (ambient temperature of a cable, for example)

Table to convert Noise Figure (NF) to Noise Temperature (T). This is useful for working out LNA or LNB noise temperatures from advertised Noise Figures.

NF(dB)	T (K)	NF(dB)	T (K)	NF(dB)	T (K)	NF(dB)	T (K)
0.1	7	1.1	84	2.1	180	3.1	302
0.2	14	1.2	92	2.2	191	3.2	316
0.3	21	1.3	101	2.3	202	3.3	330
0.4	28	1.4	110	2.4	214	3.4	344
0.5	35	1.5	120	2.5	226	3.5	359
0.6	43	1.6	129	2.6	238	3.6	374
0.7	51	1.7	139	2.7	250	3.7	390
0.8	59	1.8	149	2.8	263	3.8	406
0.9	67	1.9	159	2.9	275	3.9	422
1.0	75	2.0	170	3.0	289	4.0	438

Procedure for adding up noise temperatures for antenna, waveguide, LNA, cable and receiver in series:

Notes: T system is referred to the input of the LNA.

You need to convert gains in dB to numbers. Number = 10 ^(dB/10)

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T system = Noise contribution from antenna = Tantenna * waveguide gain

+ noise contribution of the waveguide = 290 * (1-waveguide gain)

+ noise contribution of the LNA = the LNA noise temp

+ noise contribution of the cable = 290 / LNA gain

+ noise contribution of the receiver

= receiver noise temp / (LNA gain * cable gain)

Example: Antenna noise temperature = 35 K (mainly ground pick up noise)

Waveguide feeder gain = -0.25 dB (0.944), temperature = 290K

LNA gain = 50 dB (100000), noise temperature = 75 K

Cable gain = -20 dB (0.001), temperature = 290K

Receiver noise temperature = 2000 K

Tsystem = 35 * 0.944 = 33 Noise contribution of the antenna

+ 290 (1 - 0.944) = 16 Noise contribution of the waveguide

+ 75 Noise contribution of the LNA

+ 290 /100000 = 0.003 Noise contribution of the cable

+ 2000/(100000 * 0.001) = 2 Noise contribution of the receiver

= 126 K

Note that LNA noise temperature, the antenna noise temperature and waveguide loss are the main factors.

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