The decibel

The bel was named in honour of Alexander Graham Bell. It is defined as the common logarithm of the ratio of two power levels P_1 and P_2. Hence the number of bells B is:

$$B = \text{Log}\left(\frac{P_2}{P_1}\right)$$

A positive value of B represents power gain, a negative value for power loss and zero for no change.

The bel is a rather large unit for use in electrical engineering. A smaller and more convenient unit is the decibel with a magnitude of $^1/_{10}$ B. So

$$dB = 10\,\text{Log}\left(\frac{P_2}{P_1}\right)$$

Or conversely

$$\frac{P_2}{P_1} = 10^{\left(\frac{dB}{10}\right)}$$

Power is often a difficult quantity to measure directly and is commonly calculated from the equations $P = I^2R$ or $P = V^2/R$ where current or voltage is more easily measured. So the change in power level becomes:

$$dB = 20\,\text{Log}\left(\frac{V_2}{V_1}\right) - 10\,\text{Log}\left(\frac{R_2}{R_1}\right)$$

and

$$dB = 20\,\text{Log}\left(\frac{I_2}{I_1}\right) + 10\,\text{Log}\left(\frac{R_2}{R_1}\right)$$

Where this is measured in a system of consistent impedance ($R_1 = R_2$) these equations can be simplified to:

$$dB = 20\,\text{Log}\left(\frac{V_2}{V_1}\right)$$

and

$$dB = 20\,\text{Log}\left(\frac{I_2}{I_1}\right)$$

Or conversely

$$\frac{V_2}{V_1} = 10^{\left(\frac{dB}{20}\right)}$$

and

$$\frac{I_2}{I_1} = 10^{\left(\frac{dB}{20}\right)}$$

dB	$\frac{I_2}{I_1}$ or $\frac{V_2}{V_1}$	$\frac{P_2}{P_1}$
+100	1.0×10^{5}	1.0×10^{10}
+90	3.2×10^{4}	1.0×10^{9}
+80	1.0×10^{4}	1.0×10^{8}
+70	3200	1.0×10^{7}
+60	1000	1.0×10^{6}
+50	320	1.0×10^{5}
+40	100	1.0×10^{4}
+35	56.2	3165
+30	31.6	1000
+25	17.78	316
+20	10.00	100
+15	5.62	31.6
+10	3.16	10.00
+9.5	2.98	8.91
+9.0	2.82	7.94
+8.5	2.66	7.08
+8.0	2.51	6.31
+7.5	2.37	5.62
+7.0	2.24	5.01
+6.5	2.11	4.47
+6.0	1.995	3.98
+5.5	1.884	3.55
+5.0	1.778	3.16
+4.5	1.679	2.82
+4.0	1.585	2.51
+3.5	1.496	2.24
+3.0	1.413	1.995
+2.5	1.334	1.778
+2.0	1.259	1.585
+1.8	1.230	1.514
+1.6	1.202	1.445
+1.4	1.175	1.380
+1.2	1.148	1.318
+1.0	1.122	1.259
+0.9	1.109	1.230
+0.8	1.096	1.202
+0.7	1.084	1.175
+0.6	1.072	1.148
+0.5	1.059	1.122
+0.4	1.047	1.096
+0.3	1.035	1.072
+0.2	1.023	1.047
+0.1	1.012	1.023
0	**1**	**1**

dB	$\frac{I_2}{I_1}$ or $\frac{V_2}{V_1}$	$\frac{P_2}{P_1}$
0	**1**	**1**
-0.1	0.989	0.977
-0.2	0.977	0.955
-0.3	0.966	0.933
-0.4	0.955	0.912
-0.5	0.944	0.891
-0.6	0.933	0.871
-0.7	0.923	0.851
-0.8	0.912	0.832
-0.9	0.902	0.813
-1.0	0.891	0.794
-1.2	0.871	0.759
-1.4	0.851	0.724
-1.6	0.832	0.692
-1.8	0.813	0.661
-2.0	0.794	0.631
-2.5	0.750	0.562
-3.0	0.708	0.501
-3.5	0.668	0.447
-4.0	0.631	0.398
-4.5	0.596	0.355
-5.0	0.562	0.316
-5.5	0.531	0.282
-6.0	0.501	0.251
-6.5	0.473	0.224
-7.0	0.447	0.200
-7.5	0.422	0.178
-8.0	0.398	0.158
-8.5	0.376	0.141
-9.0	0.355	0.126
-9.5	0.335	0.112
-10.0	0.316	0.100
-15	0.178	0.0316
-20	0.100	0.0100
-25	0.0562	0.00316
-30	0.0316	1.0×10^{-3}
-35	0.0178	3.16×10^{-4}
-40	0.01	1.0×10^{-4}
-50	0.00316	1.0×10^{-5}
-60	0.001	1.0×10^{-6}
-70	0.000316	1.0×10^{-7}
-80	1.0×10^{-4}	1.0×10^{-8}
-90	3.2×10^{-5}	1.0×10^{-9}
-100	1.0×10^{-5}	1.0×10^{-10}

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