



Speaker Power and Distance

When most people consider a speaker to design into their assembly to get the highest output, most are only concerned with, how much space do I have for the speaker, and how much power do I have available. There are many more factors that come into play. A big factor is the sensitivity rating of the speaker. The sensitivity (output SPL) rating of a speaker gives you a rough idea of how loud the speaker will play with a specific amount of power at a specific distance.

Consider a speaker with this sensitivity rating:

85 dB / 1 watt / 1 meter

This speaker will produce sound at 85 dB, 1 meter away, when it is given an input power of 1 watt. Typically the input frequency is 1 kHz or an average of specific frequencies (e.g. 800Hz, 1.0KHz, 1.2KHz, 1.5KHz). Depending on the type of enclosure along with other factors the speaker may not produce 85 dB but it's still a useful spec for comparison with other speakers.

You have to double the input power to produce a 3 dB increase in sound output (assuming the speaker is not reaching its limits). Therefore we can produce a table for how loud the speaker will play with a specific starting power:

Power in watts	Volume in dB
1	85
2	88
4	91
8	94
16	97
32	100
64	103
128	106
256	109
512	112

You can see how it starts to take a lot of power to make a speaker play very loud.

When you ask yourself how much power you need for your system you need to ask yourself how loud you want your system to play and plan accordingly. Going with higher power amps or more sensitive (efficient) speakers will make your system play louder, but you can push your speaker too hard and cause failures later.

Another consideration is the measuring distance. A speaker with the sensitivity rating of 85 dB / 1 watt / 1 meter, is the same as a speaker rated at 91 dB / 1 watt / 50 cm, and or a speaker



rated at 105 dB / 1 watt / 10 cm. This is due to a 6 dB increase with each halving of the measured distance, and a 20 dB increase with decreasing the distance to 1/10 of the original. This gives us a table like this:

SOUND PRESSURE LEVEL Vs DISTANCE			
Sound pressure loss in free space			
Distance (m)	dB drop	Distance (m)	dB drop
1	0	26	28.30
2	6.02	27	28.63
3	9.54	28	28.94
4	12.04	29	29.25
5	13.98	30	29.54
6	15.56	31	29.83
7	16.90	32	30.10
8	18.06	33	30.37
9	19.08	34	30.63
10	20.00	35	30.88
11	20.83	36	31.13
12	21.58	37	31.36
13	22.28	38	31.60
14	22.92	39	31.82
15	23.52	40	32.04
16	24.08	41	32.26
17	24.61	42	32.46
18	25.11	43	32.67
19	25.58	44	32.87
20	26.02	45	33.06
21	26.44	46	33.26
22	26.85	47	33.44
23	27.23	48	33.62
24	27.60	49	33.80
25	27.96	50	33.98

SOUND PRESSURE LEVEL Vs DISTANCE			
Sound pressure loss in free space			
Distance (cm)	dB drop	Distance (cm)	dB drop
10	0	260	28.30
20	6.02	270	28.63
30	9.54	280	28.94
40	12.04	290	29.25
50	13.98	300	29.54
60	15.56	310	29.83
70	16.90	320	30.10
80	18.06	330	30.37
90	19.08	340	30.63
100	20.00	350	30.88
110	20.83	360	31.13
120	21.58	370	31.36
130	22.28	380	31.60
140	22.92	390	31.82
150	23.52	400	32.04
160	24.08	410	32.26
170	24.61	420	32.46
180	25.11	430	32.67
190	25.58	440	32.87
200	26.02	450	33.06
210	26.44	460	33.26
220	26.85	470	33.44
230	27.23	480	33.62
240	27.60	490	33.80
250	27.96	500	33.98

Keep in mind that this works in reverse as well. A speaker rated at 95 dB at 10 cm will measure 75 dB at 1 meter and a speaker with a rating of 100 dB at 1 meter will measure 106 dB at 50 cm or 84.44 dB at 6 meters.

Now that we have done the math, let's look at where this leaves us.

If you need a measured sound pressure level of 80 dB at 3 meters, and you have 4 watts available from your amplifier, the needed sensitivity at 1 watt and measured at 1 meter would be:

80 dB / 4 watts / 3 meters -- 3 meters to 1 meter is a 9.54 dB increase to 89.54 dB

89.54 dB / 4 watts / 1 meter -- 4 watts to 2 watts is a 3 dB decrease to 86.54 dB

86.54 dB / 2 watts / 1 meter -- 2 watts to 1 watt is a 3 dB decrease to 83.54 dB

So, to get 80 dB at 4 watts measured at 3 meters requires a speaker with a sensitivity of 83.54 dB at 1 watt measured @ 1 meter.