The DeciBell Concept

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The Deci Bell (dB) Concept

- The Deci Bell (dB) concept is used to represent very large or very small numbers employed in scientific Works.
- The dB version of the number *n* is defined a

$$N\ (dB) = 10 \times \log_{10} n$$

- By definition, ratios or ordinary numbers are represented in small case where the dB values are represented in capital case.
- If the ratio of two numbers is given by *r*, the dB representation of *r* will be given by

$$R\ (dB) = 10 \times \log_{10} r$$

Gain in dB

- If the transmitted power is 100 W and the Received power is 10 W,

$$L\,(dB) = 10 \times \log_{10} \frac{p_{Tx}}{p_{Rx}} = 10 \times \log_{10} \frac{100}{10} = 10 \times \log_{10} 10 = 10\,dB$$

- Similarly, the gain in an amplifier circuit is given by

$$g = \frac{p_{out}}{p_{in}}$$

- In dB

$$G(dB) = 10 \times \log_{10} \frac{p_o}{p_i}$$

- If the input to an amplifier is 1 W and the output is 100 W, the gain, $g = \frac{100}{1} = 100$ times
- In dB

$$G(dB) = 10 \times \left(\frac{p_o}{p_{in}}\right) = 10 \times \log_{10} \frac{100}{1} =$$

$$= 10 \times 100 = 10 \times \log_{10} 10^2 = 20 \times \log_{10} 10 = 20\,dB$$

Loss in dB

- In communication systems, the power loss in a transmission line is defined as the received power divided by the transmitted power

$$l = \frac{p_{Tx}}{p_{Rx}} \quad \text{(no unit)}$$

- If the transmitted power is 100 W and the received power is 10 W,

$$l = \frac{p_{Tx}}{p_{Rx}} = \frac{100}{10} = 10 \text{ times}$$

- In dB,

$$L\ (dB) = 10 \times \log_{10} \frac{p_{Tx}}{p_{Rx}}$$

- If the transmitted power is 100 W and the Received power is 10 W,

$$L\ (dB) = 10 \times \log_{10} \frac{p_{Tx}}{p_{Rx}} = 10 \times \log_{10} \frac{100}{10} = 10 \times \log_{10} 10 = 10\ dB$$

Power Levels w.r.t. a Reference Signal

- When measuring very small powers with respect to a reference power level such as 1 W, we use the definition

$$P(dB_W) = 10\log_{10}\frac{p}{1W}$$

- Power level w.r.t. 1 mW can be written as

$$P(dB_m) = 10\log_{10}\frac{p\ in\ W}{1\ mW} = 10 \times \log_{10} p \times 10^3$$

$$= 10\log_{10} p + 10\log_{10} 10^3 = 30 + 10\log_{10} p$$

- Power w.r.t. μW can be written as

$$P\left(dB_\mu\right) = 10\log_{10}\frac{p}{10^{-6}} = 60 + 10\log_{10} p\ (\mathrm{dB}\mu)$$

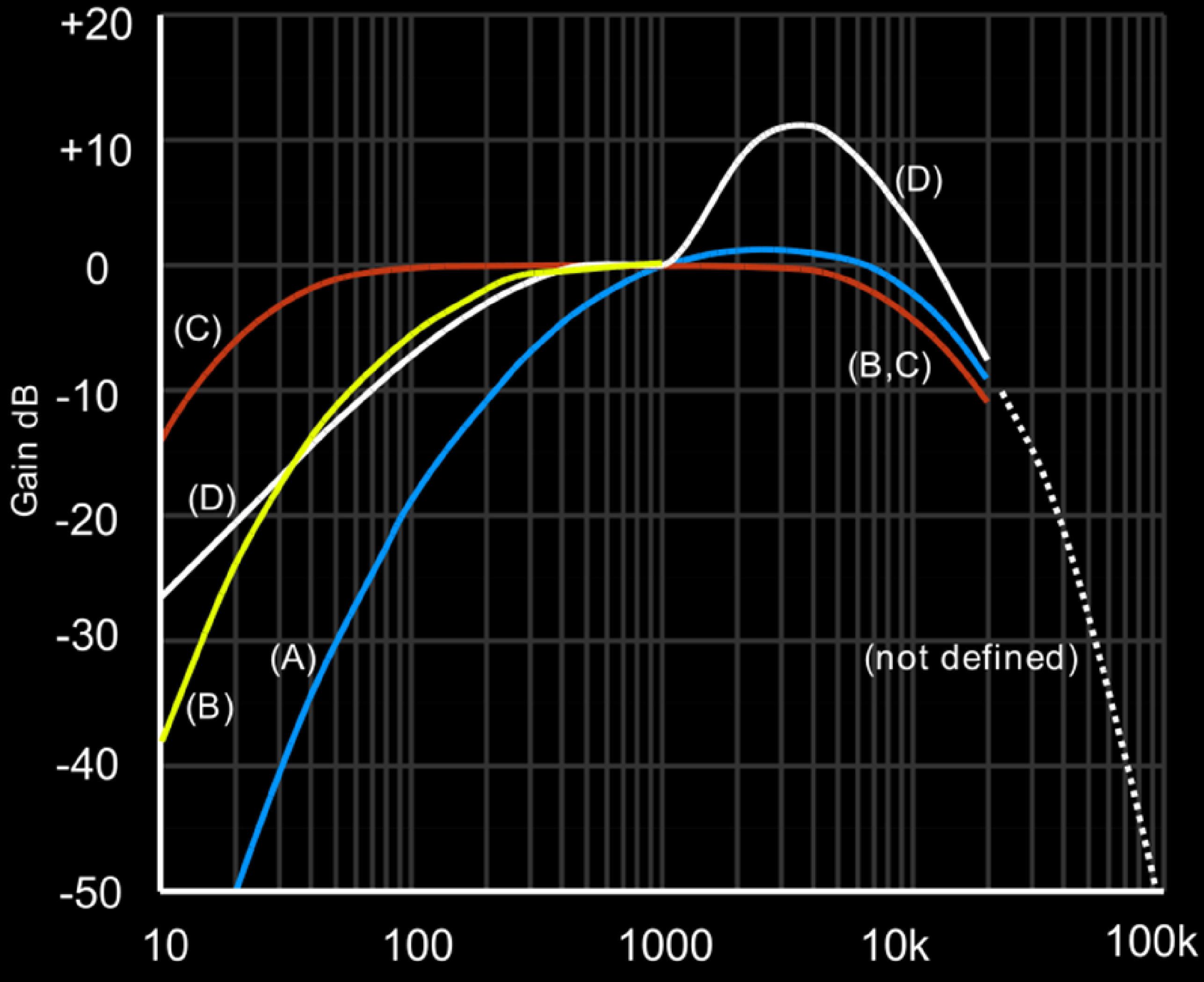
Sound Pressure in dBA

- In acoustics, sound is a change in pressure relative to atmospheric pressure.
- Thus, the reference quantity is the smallest pressure change detectable by the ear (hearing threshold), 20 μPa in air, which corresponds to 0 dB SPL.
- However, the human ear does not perceive all frequencies in the same way.
- Indeed, ear of a healthy person is more sensitive to frequencies between 2 kHz and 5 kHz.
- The reference quantity is 20 μPa and the units are dB SPL, but each value has a different gain depending on the frequency in order to better represent human auditory perception.
- dBA is a weighted scale for judging loudness that corresponds to the hearing threshold of the human ear.

https://www.softdb.com/difference-between-db-dba/#:~:text=What%20is%20a%20dBA%3F,not%20hear%20all%20frequencies%20equally.

Sound Pressure in dBA

- Since humans do not hear all frequencies equally, sound levels in the low frequency end of the spectrum are reduced as the human ear is less sensitive at low audio frequencies than at high audio frequencies.
- You will often see noise levels given in dBA (A-weighted sound levels) instead of dB.
- Measurements in dBA, or dB(A) take into account the varying sensitivity of the human ear to different frequencies of sound.



A-weighting (blue), B (yellow), C (red), and D-weighting (blk)

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