



THE
BOOK IS
NOW
AVAILABLE!

SOUND3 AMPLITUDE

TOMMASO ROSATI
SOUND ART

PLAY WITH SOUND

MANUAL FOR ELECTRONIC
MUSICIANS AND OTHER SOUND
EXPLORERS



TOMMASO ROSATI
TIMOTHY HSU

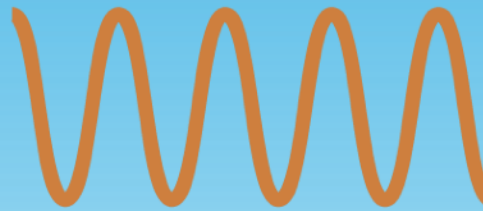
A Focal Press Book



SOURCE

WAVE

AUDITORY
SYSTEM



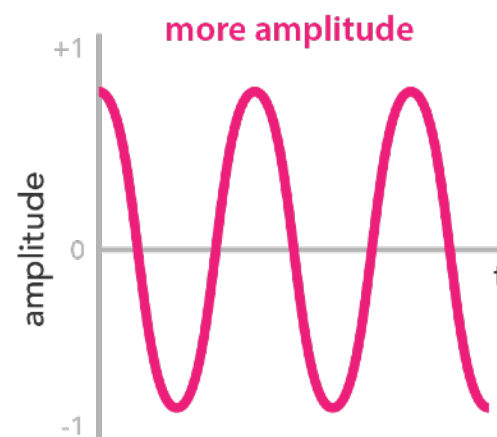
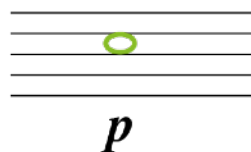
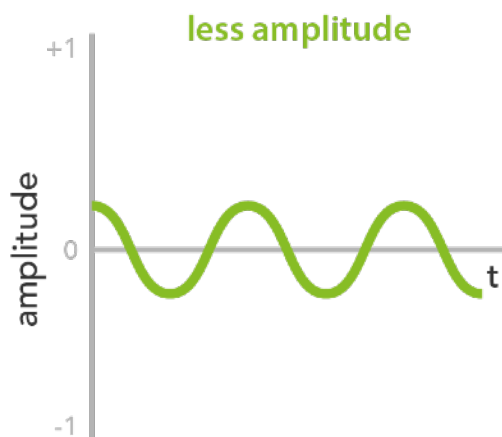
ELASTIC MEDIUM

Amplitude - Dynamics - Loudness

Amplitude is the acoustical term for the maximum pressure deviation from zero pressure. Remember that zero pressure is a simplistic way to describe the equilibrium, or atmospheric pressure. In other words, the amplitude represents the largest magnitude of the compression or rarefaction in the elastic medium that my vibrating body produces.

Dynamics, on the other hand, is the musical term for how loudly we should play. Unlike amplitude, dynamics are relative to context.

Loudness refers to our perceived (psychoacoustic) sensation of amplitude, or the amount of air compression-rarefaction. While loudness depends mostly on amplitude, our auditory system also takes cues from pitch and duration to determine how loudly we perceive sound.



Analog

dB SPL

Sound Pressure Level

dB SIL

Sound Intensity Level

dBW

Sound Power Level

dB



```
graph LR; dB --> Analog; dB --> Digital;
```

FS

Full Scale

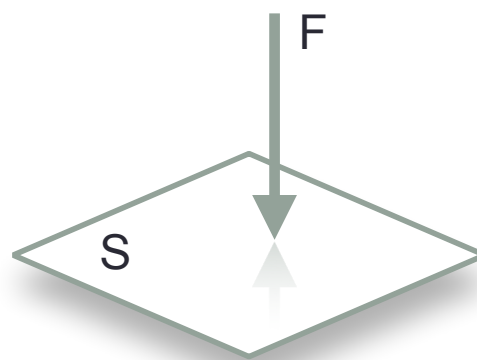
Digital

ANALOG

SPL Sound Pressure Level

A logarithmic measure of the air **pressure** deviation between the equilibrium line and the maximum peak, whether taken in the positive part (compression) or in the negative part (rarefaction).

Pressure = the force applied to a surface = F/S = Newton/m²



one of the weakest audible sounds: 0.000025 N/m^2 →



one of the loudest sounds: 30 N/m^2 →



This huge range becomes a bit complex to handle in everyday measurements:

$$\frac{30 \text{ N/m}^2}{0,000025 \text{ N/m}^2}$$

A logarithm allows us to “squash” these values and make them easier to use.

I relate the measured pressure to the minimum audible pressure:

$$\text{SPL} = 20 \log \left(\frac{p}{p_0} \right) \text{ dB}$$

measured pressure

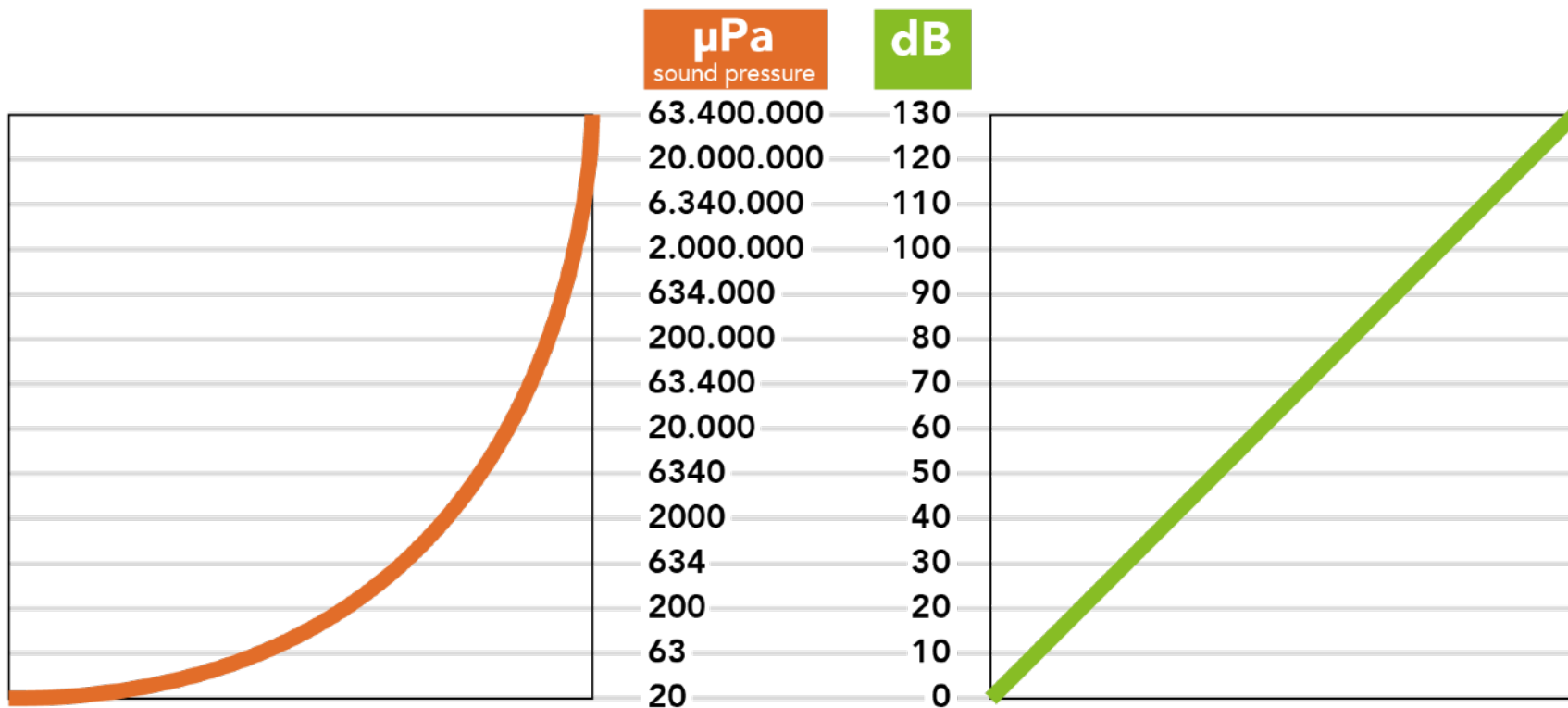


reference pressure



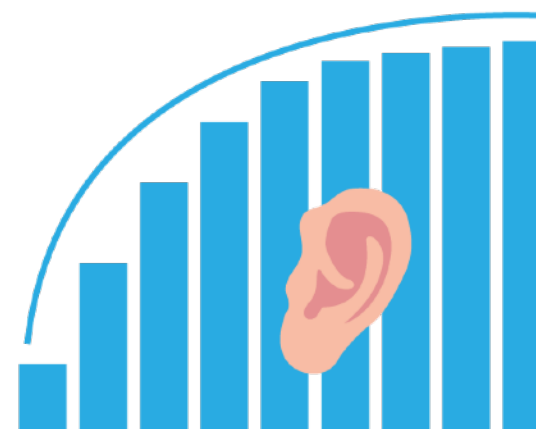
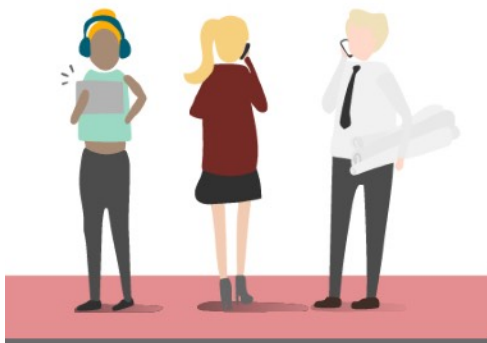
1st advantage on using logarithms

A **smaller numerical scale** which is more agile to use



2nd advantage on using logarithms

Using decibels acts as a form of **compensation** for the way our auditory system generally responds in logarithmic way to both amplitudes and frequencies.



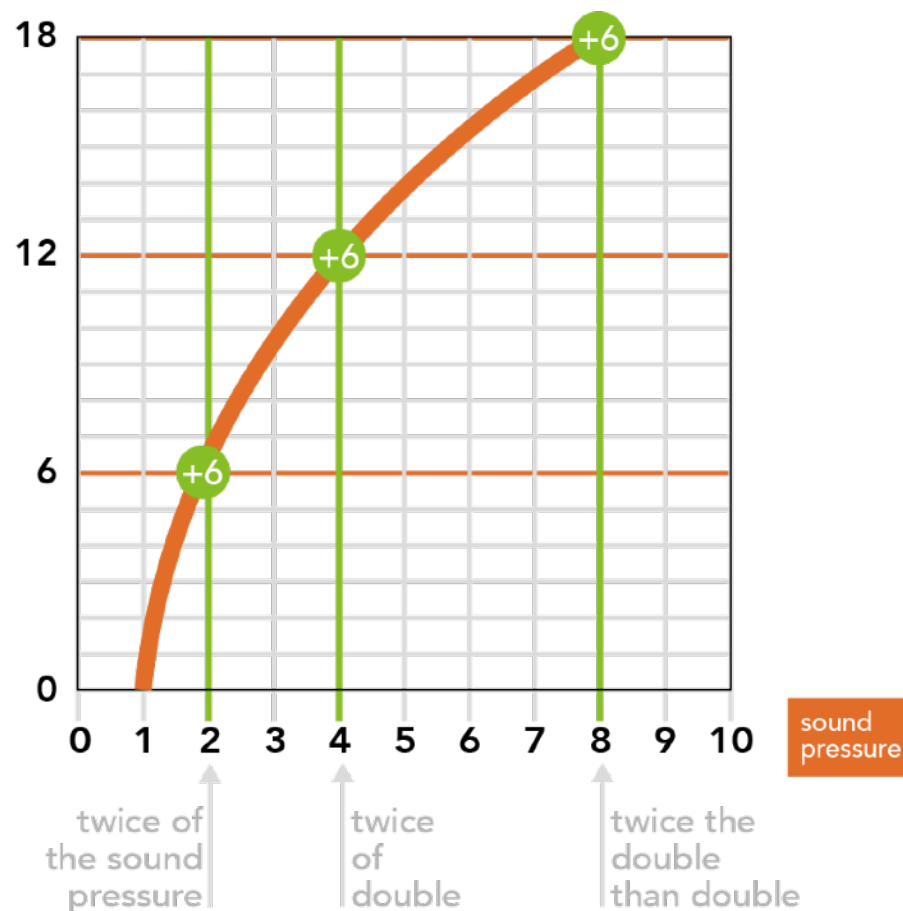
Logarithmic

ANALOG

A significant practical consideration of using a logarithmic scale is when you want to increase the amplitude of your signal using a fader.

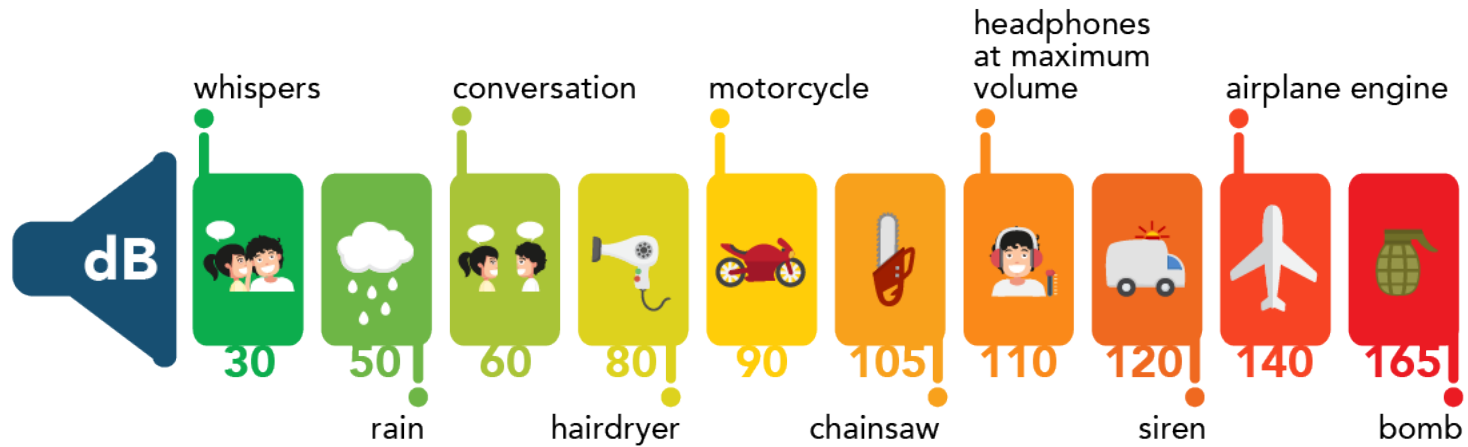
If we want to double the amplitude of the sound, we do not double the position of the fader, but rather we would push up the fader by **+6 dB**. When we adjust the fader by **-6 dB** (down), then the amplitude is halved.

dB SPL



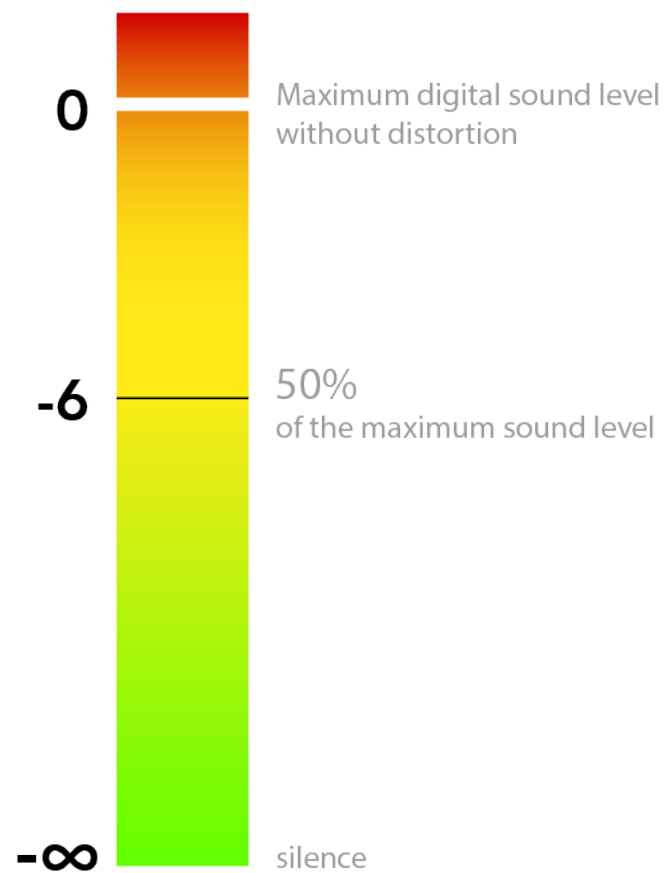
ANALOG

dB SPL



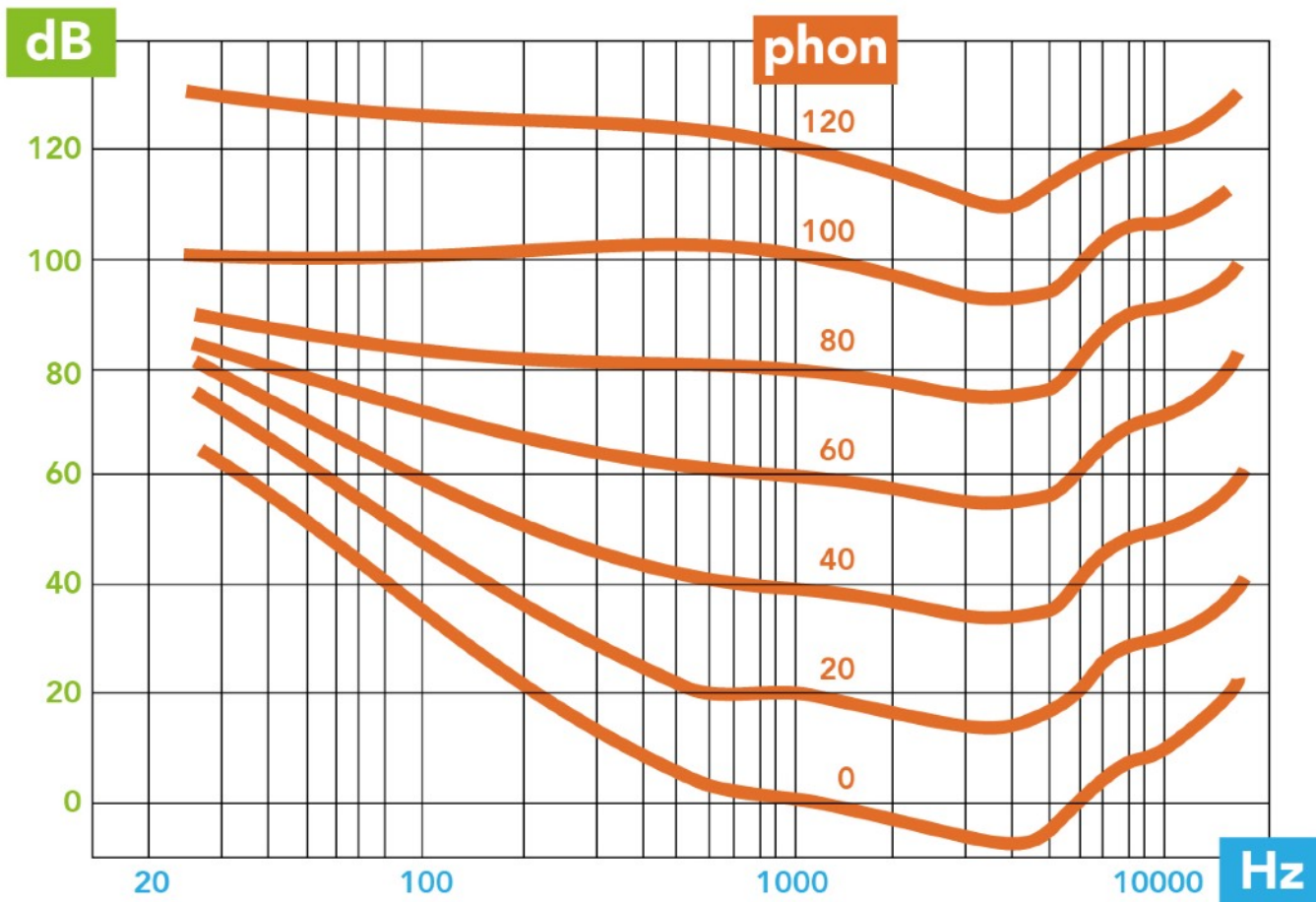
DIGITAL

dB FS (Full Scale)



Our ears are not equally sensitive to all frequencies.

The graph illustrates how many decibels, at a given frequency, is equivalent to that loudness level. In other words, if I pick an **orange phon curve** and follow it from the lowest to the highest frequencies on the graph, the perceived loudness will appear to be constant throughout.



Fletcher-Munson
diagram

Dynamics is the musical term for how loudly we should play. It is expressed on a qualitative scale using words, ranging from pianissimo to fortissimo, and, unlike amplitude, dynamics are relative to context.

ppp più piano possibile

pp pianissimo

p piano

mp mezzo piano

mf mezzo forte

f forte

ff fortissimo

fff più forte possibile

< crescendo

> diminuendo

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ROUTLEDGE

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