Frequency Response

Definition

- Relationship between input and output
- Regards frequency and amplitude across the acoustic spectrum
- A flat frequency response would have an identical output and input.

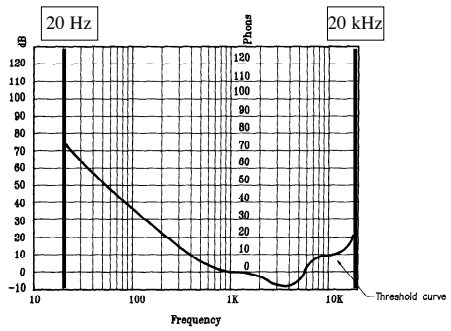
Perception of Loudness

- Page 36 in your Textbook

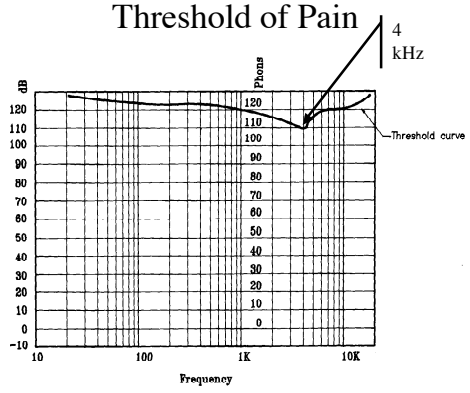
The Phon

- A unit of measurement relating the perception of equal loudness across the frequency spectrum
- 1 kHz is the reference level: phons are equal to the power decibel at this frequency.
- Phons are different from dB at other frequencies.

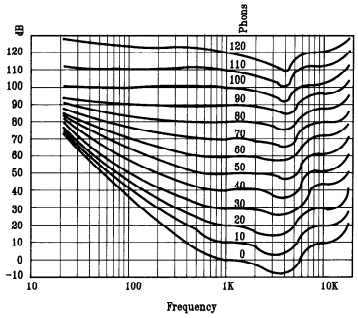
Threshold of perception



Threshold of Pain



Fletcher-Munson Curve



Characteristics of Equal-Loudness

- Optimum sensitivity at 3 kHz
- Best range is 2 kHz to 4 kHz
- The softer the overall sound, the more hearing concentrates in central bandwidth
- This means we hear mainly midrange information in low amplitude sounds
- Low frequencies are much more present relative to mid range frequencies at loud amplitude levels

Peaks have Significantly more effect on perception than valleys

BAD NOISE

- ***Undesired audio elements within a signal***
- ***Undesired acoustical information within the listening environment***

Hiss

- ***Present in all electrical systems***
- ***Random current flow in circuits at very low levels***
- ***Also called "White Noise"***
- ***Equal energy per frequency***
- ***We experience this in our own listening environment***

Hum

- Leakage of AC power into the Audio Circuit
- Power supply problems
- grounding problems

Buzz

- Richer harmonic spectrum than hum, with all higher harmonics present
- SCR noise, dimer racks, active electronic AC power.
- improper shielding

Crosstalk

- Sound travelling across a circuit or channel
- You hear this in radio broadcasts when two different stations are heard simultaneously

Static

- Intermittent random noise events caused by radio frequency interference
- You hear this in AM radio when traveling away from the station
- Distant Lightning

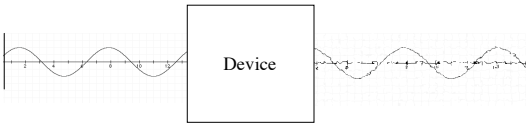
Harmonic Distortion Definition

- The production of harmonic frequencies by an electronic system when a signal is applied at the input.
- When an input signal goes through nonlinear electronic circuitry, the output signal will include some harmonic distortion (or unwanted frequencies).

Why?

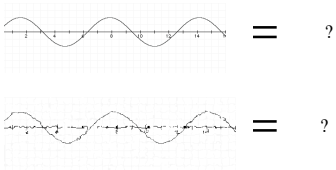
Thought Experiment

- Sine Wave changes from input to output



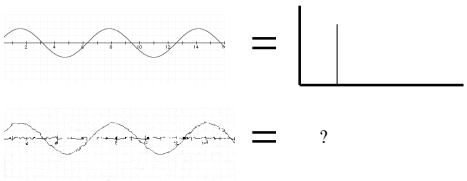
Thought Experiment

- Difference in Frequency/Energy chart will be?



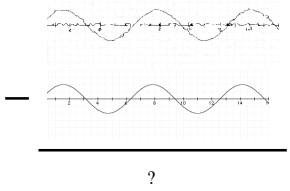
Thought Experiment

- Difference in Frequency/Energy chart will be?



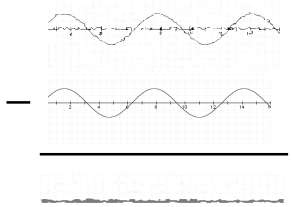
Thought Experiment

- Think about what will remain if the original sine wave is subtracted from the resultant wave.



Thought Experiment

- The result is a final change.



Thought Experiment

- If each cycle has been effected in the same way, then the result will be periodic as well.
- Periodic results indicate a natural harmonic series over the modified cycle.
- If each cycle is effected differently, then the result is non-periodic, and the resulting distortion will be non-harmonic.

Type of "residue" will be determined by the type of harmonic distortion

Harmonic Distortion

- Creation of spurious harmonic frequencies not present in the original signal
  Useful for some types of effects
- Overdriven guitars
- vocal exciters.
- Caused by clipping of the waveform

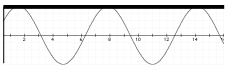
Clipping

- Occurs when nominal signal exceeds peak level.

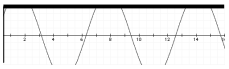
Clipping

6 dB Headroom

0 dB Headroom

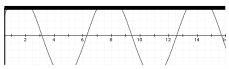


Negative headroom (clipping occurs)



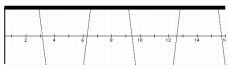
Clipping values (Voltage)

3 dB clipping



6 dB clipping

12 dB clipping



Additional clipping slowly increases the shape of the wave from a sin wave to a square wave.

- Square Wave contains all odd number partials at the amplitude of the inverse of their partial number

Intermodulation Distortion

- Combination of at least two input signals which interact to form new, enharmonic output frequencies.

Masking

- Generally a 10 dB difference in level will produce masking of the softer signal.