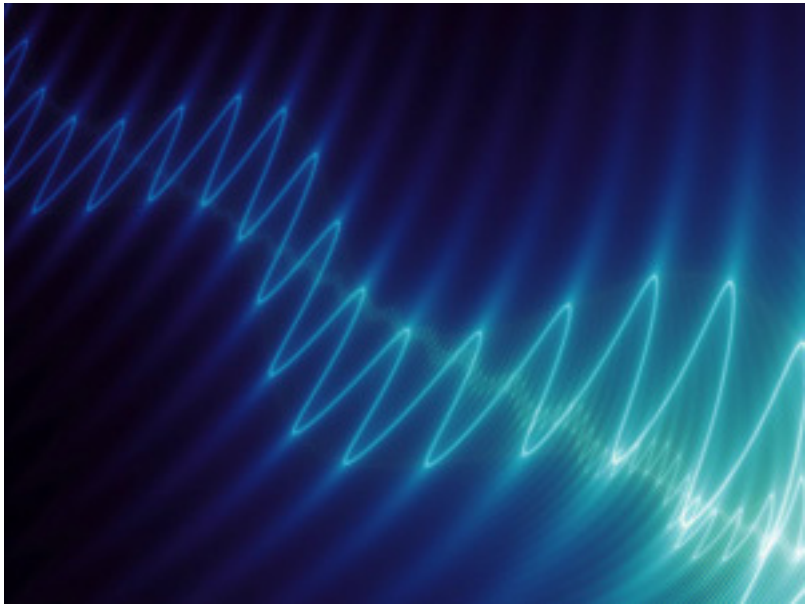


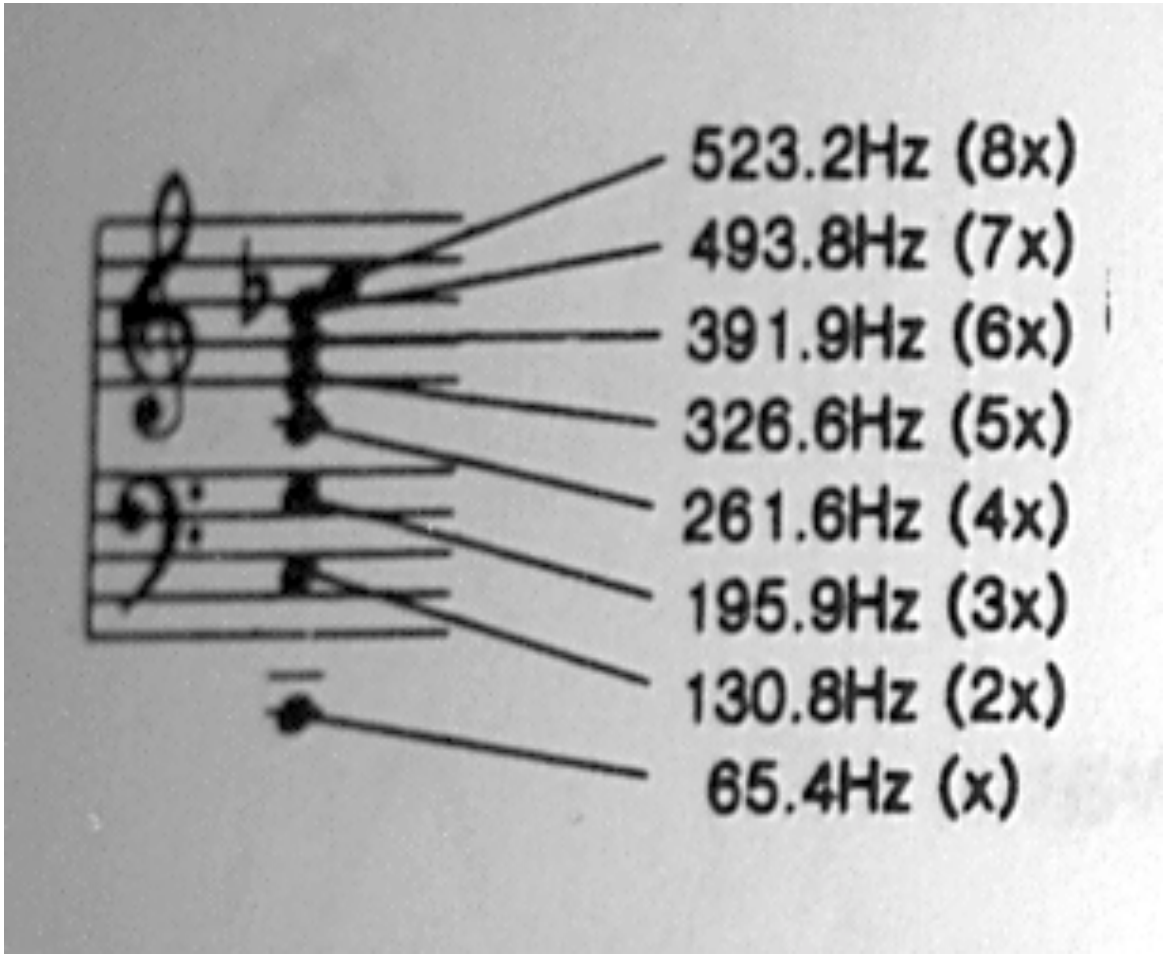
MUS421–571.1
Electroacoustic Music Composition

Kirsten Volness – 26 Feb 2016

Additive Synthesis

- WDR in Cologne
- Oscillators (**V**oltage-**C**ontrolled **O**scillator)
- Record sounds on tape + manipulate with multiple tape machines / further overdubbing

Harmonic Series



Waveforms

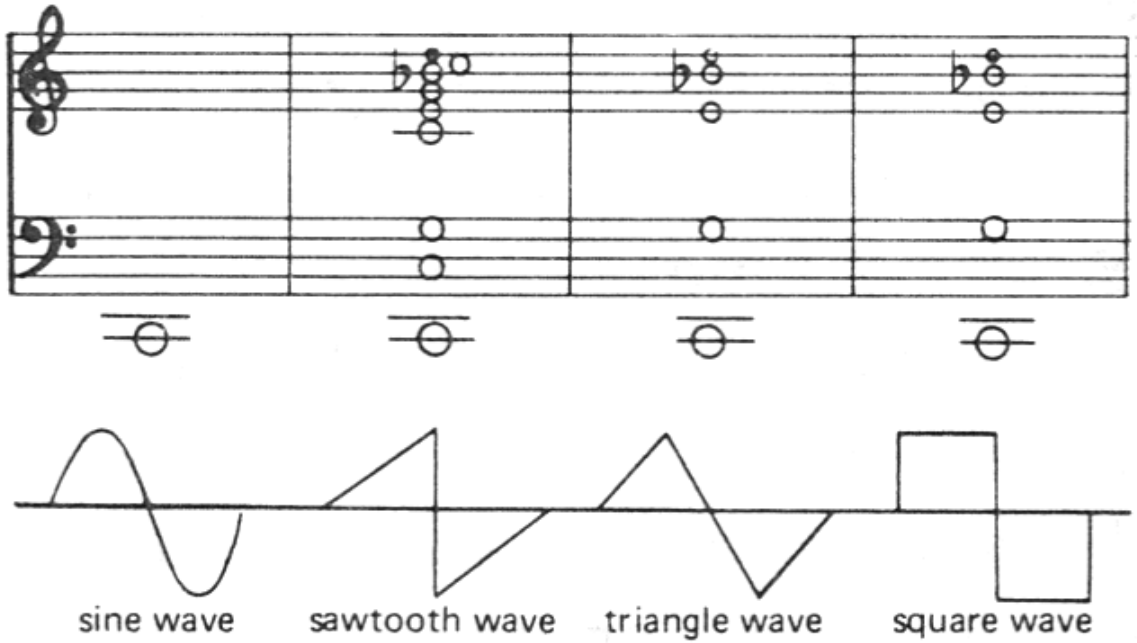


Figure 3.11. The four basic waveshapes and their harmonic content (up to the 9th multiple)

Noise

- White noise – equal, random amplitudes across frequency spectrum
- Pink noise – Amplitude decreases 3 dB per octave from bottom to top of frequency spectrum
- Brown(ian)/red noise – Amplitude decreases 6 dB per octave from bottom to top of frequency spectrum

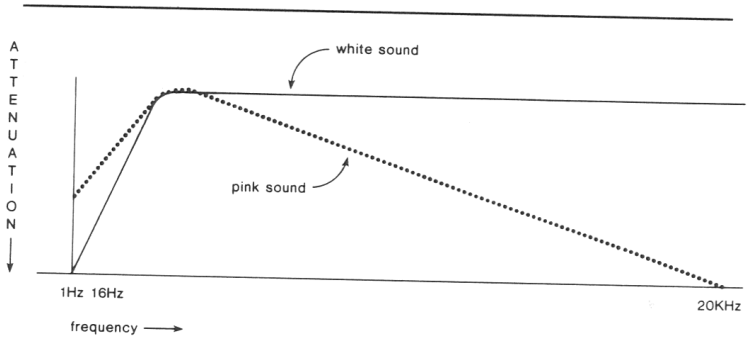
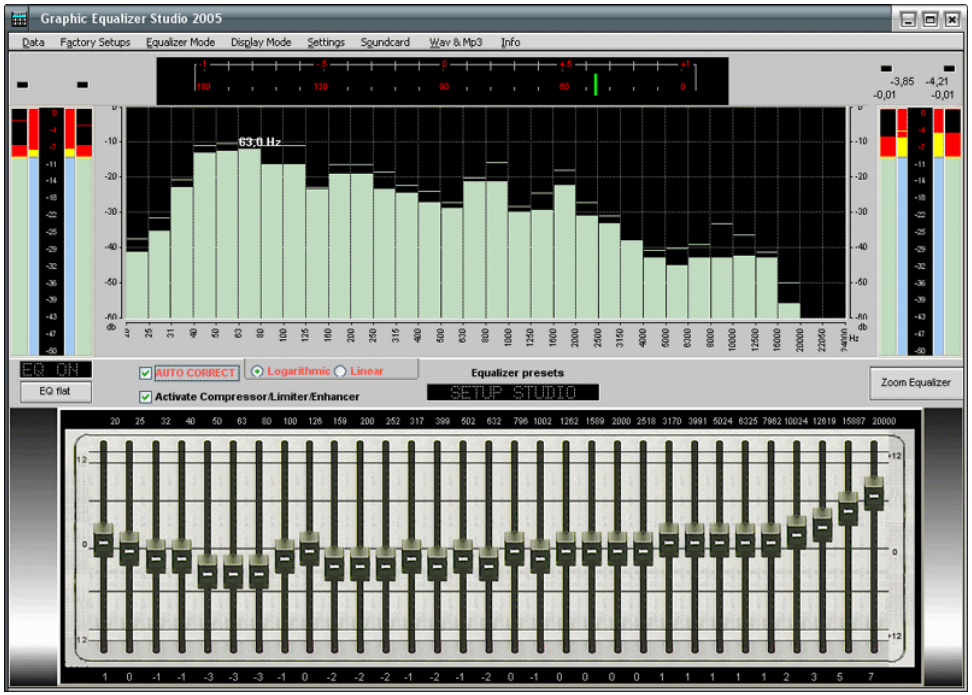


Figure 3.19. White and pink sound

Filtering (Equalization)

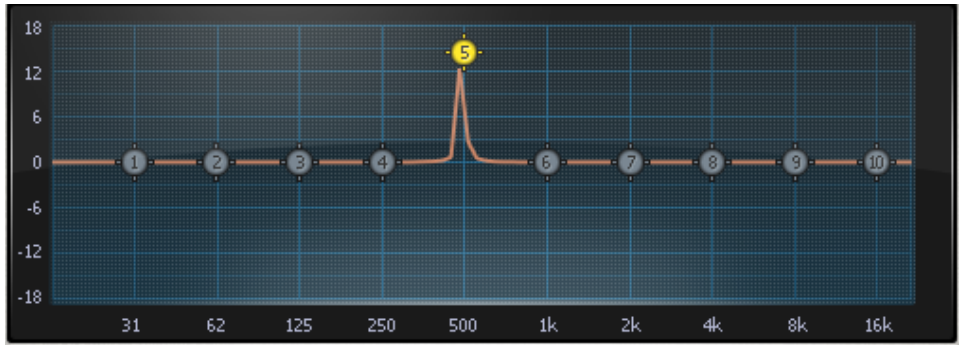
- Graphic EQ
  - Pre-determined bandwidths (frequency ranges)



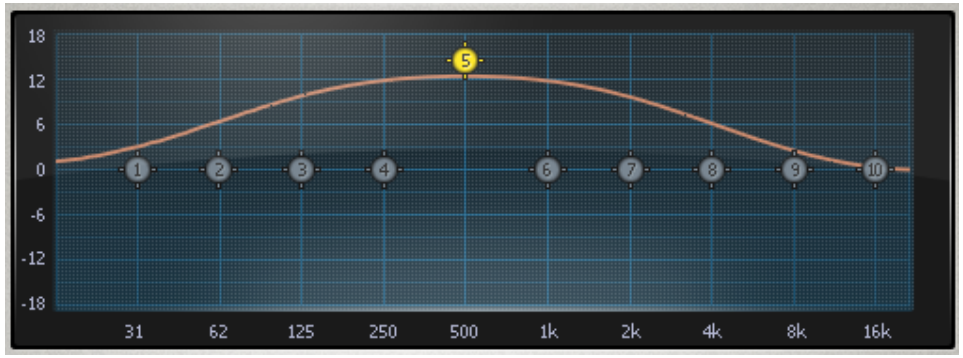
Filtering (Equalization)

- Parametric EQ
  - User can change bandwidths (frequency ranges)
  - Q = how broad or narrow each bandwidth is

Q (bandwidth)



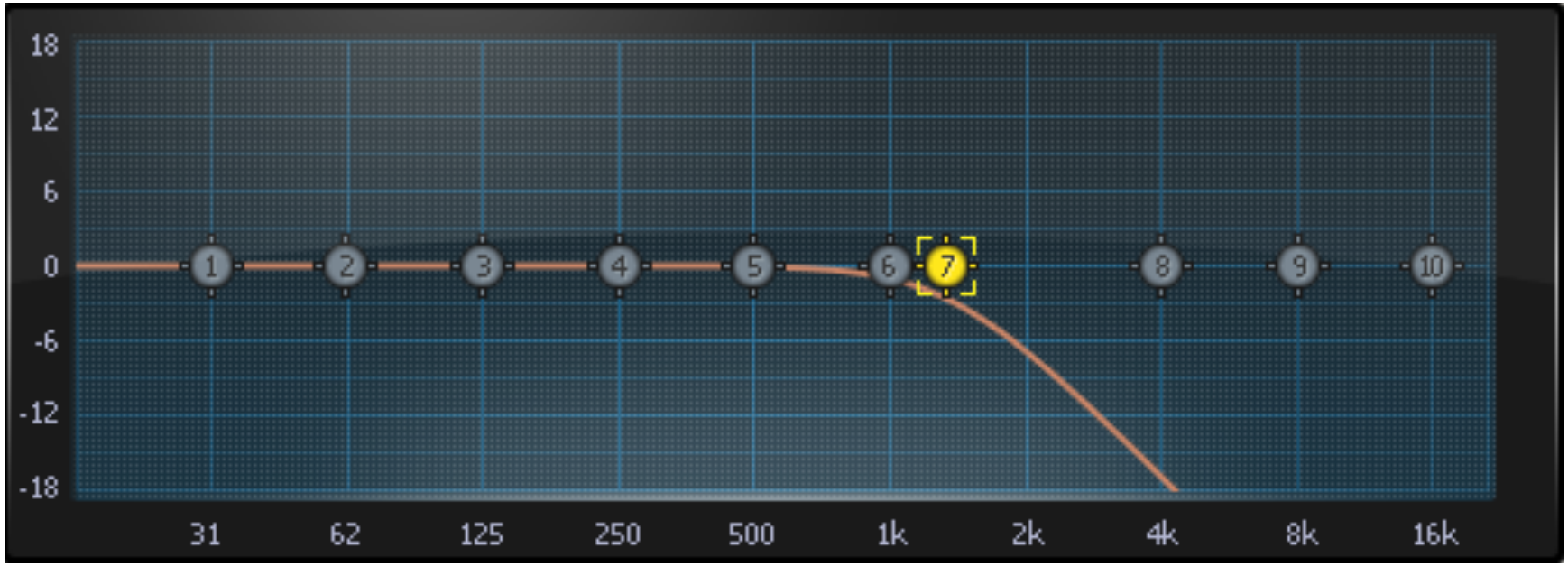
High Q = narrow bandwidth



Low Q = broad bandwidth

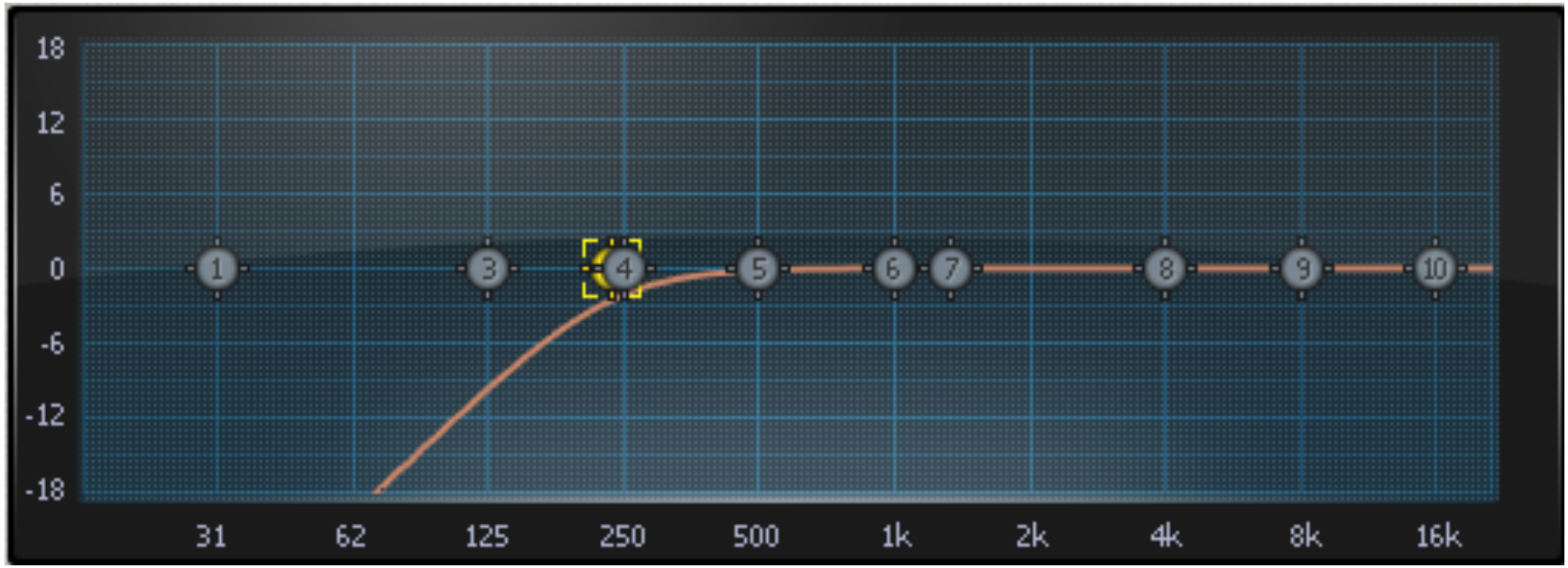
Low Pass Filter

(low frequencies are allowed to pass to the speakers) – aka high cut



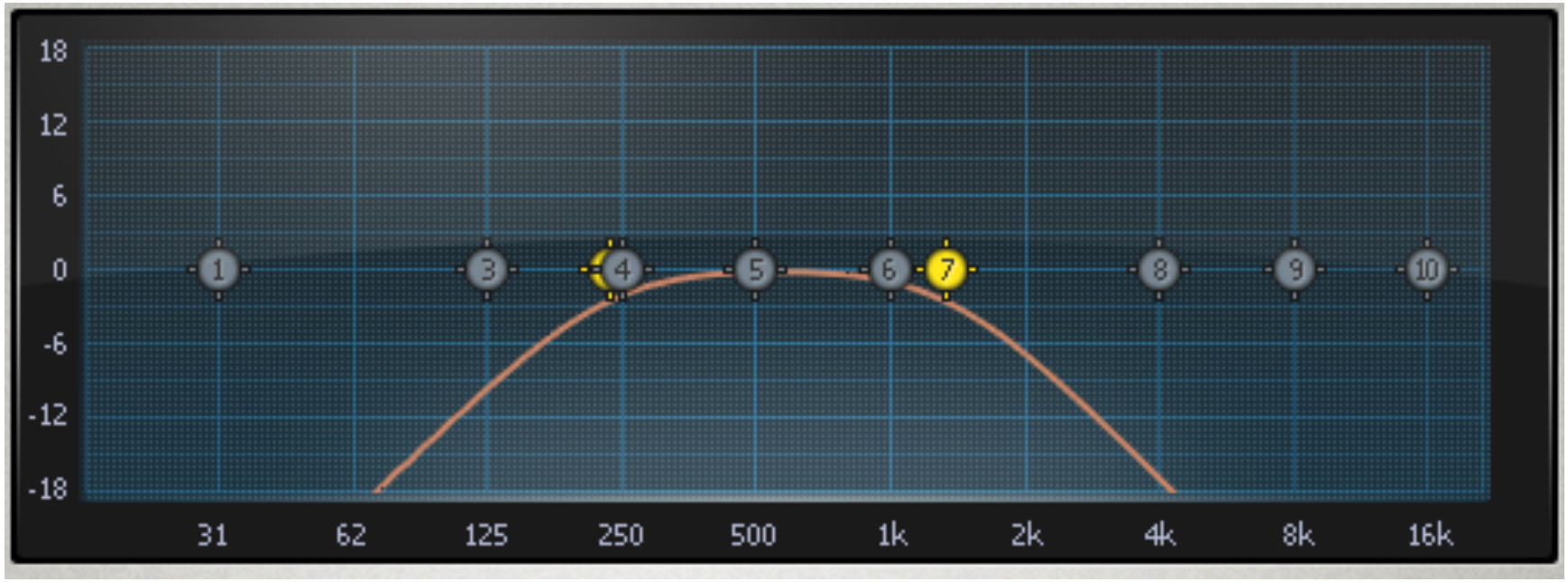
High Pass Filter

(high frequencies are allowed to pass to the speakers) – aka low cut



Band Pass Filter

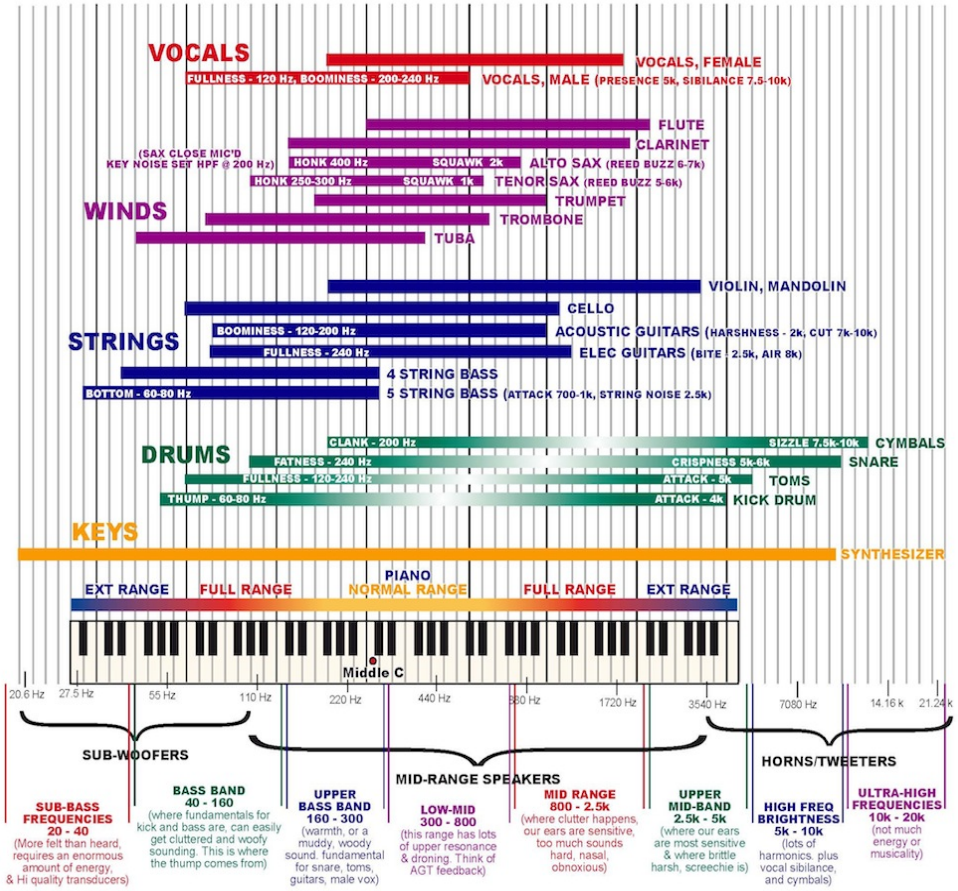
(a set range of frequencies is allowed to pass to the speakers)



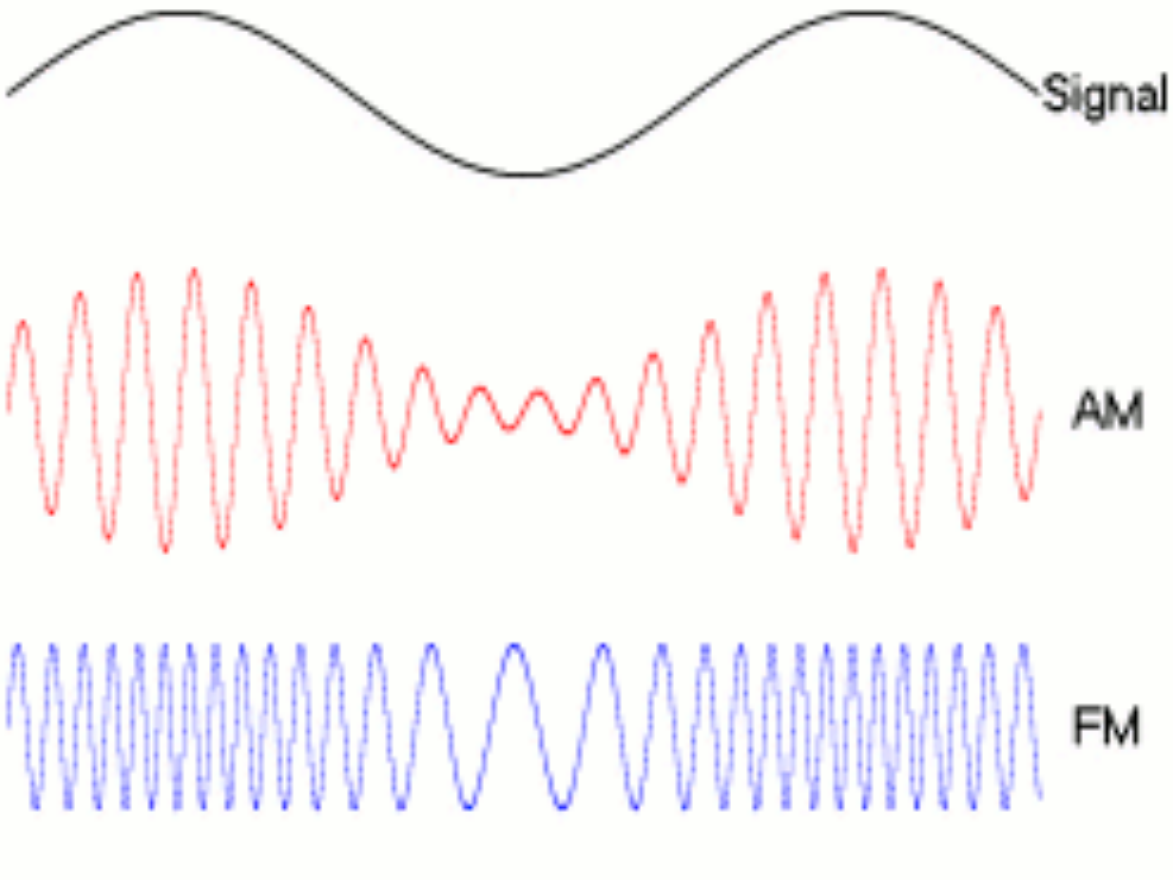
Filtering

- Changes timbre by changing frequency content
- Effective for creating sense of distance / space
- Effective for deconstructing sound (e.g., only highs are captured)
- Effective for tuning sound (clarify various elements / pitches you want to stand out)
- Good mixes control what occupies each range of frequency spectrum

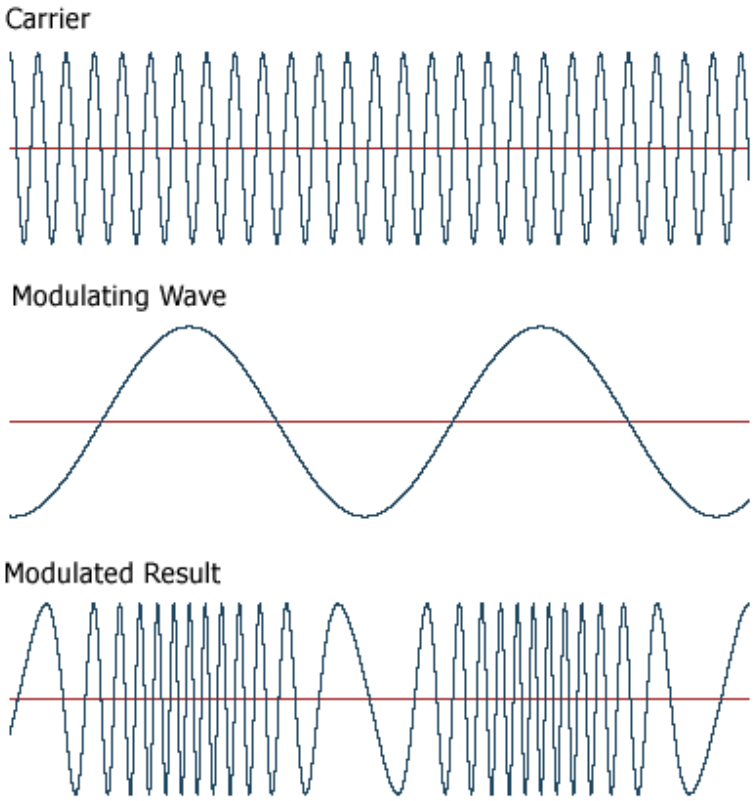
EQ Chart



AM (Amplitude Modulation)
FM (Frequency Modulation)



The Modulating Wave *affects* the Carrier Wave (source)



Parameters of Modulation

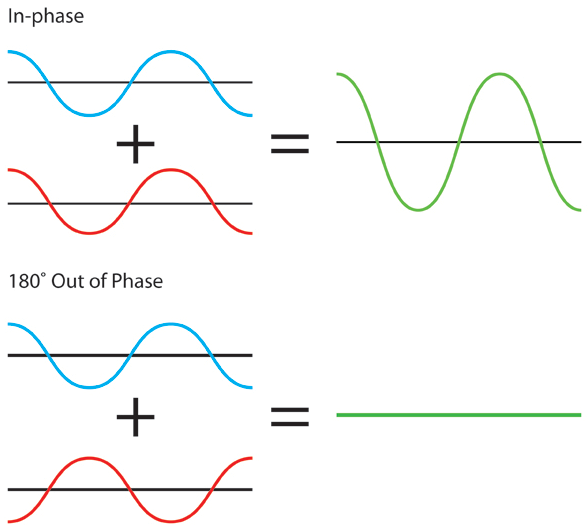
- **Rate** = frequency of modulating waveform (how fast a wobble?)
- **Depth** = amplitude/strength of modulating waveform (how large a wobble?)
- **Feedback** = how much of output is fed back in to process
- **Phase** = crest/trough relationship between carrier and modulating wave
- **LFO** = Low Frequency Oscillator (modulating wave is lower than hearing range)

Phase Relationships

- Two waves in sync (crest+crest) increase resulting amplitude
- Two waves 180° out of sync (inversion–crest+trough) cancel sound completely
- Feedback = amplification

of second signal in phase

with the first.



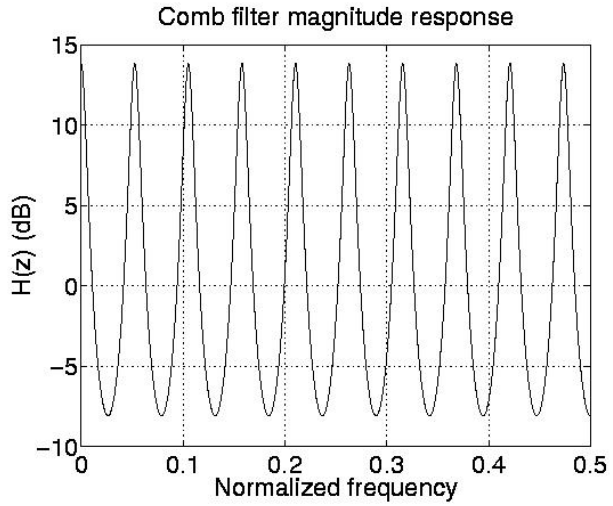
Phaser

- Uses phase relationships to modulate carrier wave – some amplitudes are boosted, others reduced
- Amplitude modulation is achieved by manipulating 180° phase relationships

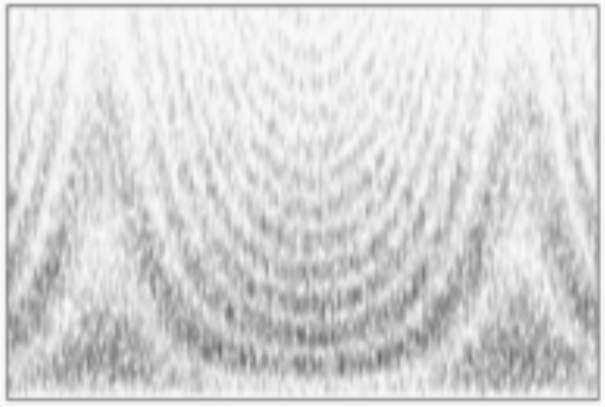
Flanger

(a type of phaser)

- Two identical copies of sound mixed, except one is delayed by a small and gradually changing period
- Creates sweeping comb filter effect



Flanging vs. Phasing



Flanging effect

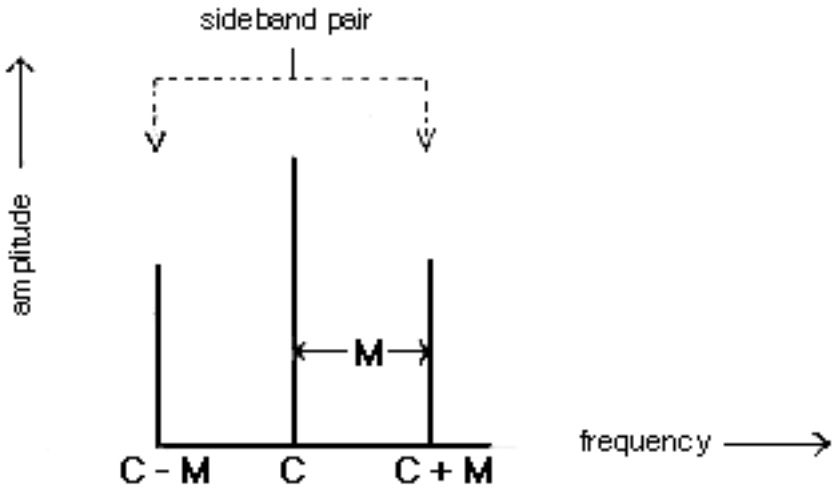
Phasing effect

Chorus

- More than one copy of the same sound
  - Differences in pitch and/or timing cause modulation
  - Automatic double tracking (ADT) is an example of a chorus effect

Ring Modulation

- Mostly sidebands in output



If Carrier wave = 300 Hz
and Modulating wave = 100 Hz

lower sideband = 300-100 = 200 Hz
upper sideband = 300+100 = 400 Hz

Since you can't have -100Hz, at 0 Hz
the lower sideband goes back up
frequency range – absolute value

Lower sideband = 300-400 = 100 Hz
upper sideband = 300+400 = 700 Hz

Listening Examples

- Pink Floyd – *Wish You Were Here*
- Arcade Fire – *My Body Is A Cage*
- Tom Petty – *You Don't Know How It Feels*
- Cocteau Twins – *Carolyn's Fingers*
- Radiohead – *Planet Telex*
- The Cure – *Lullaby*
- The Rolling Stones – *Brown Sugar*