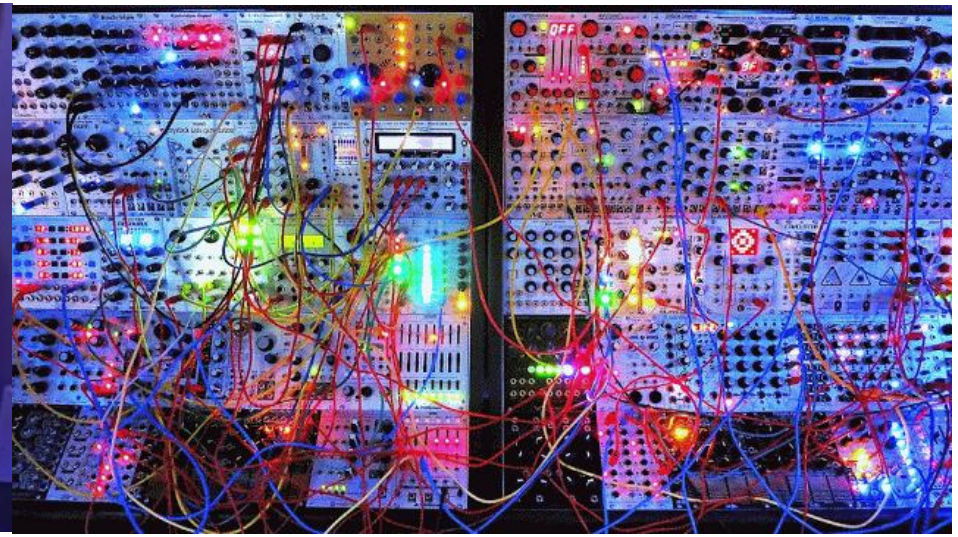
MUSC 4820/5820 Digital Music Techniques 001

Week 6: Control Voltage Sources & Modifiers (Part2: Envelopes, LFOs, and VCAs)
Audio Modifier (Part1: VCAs VCFs, Waveshapers, and Mixers)



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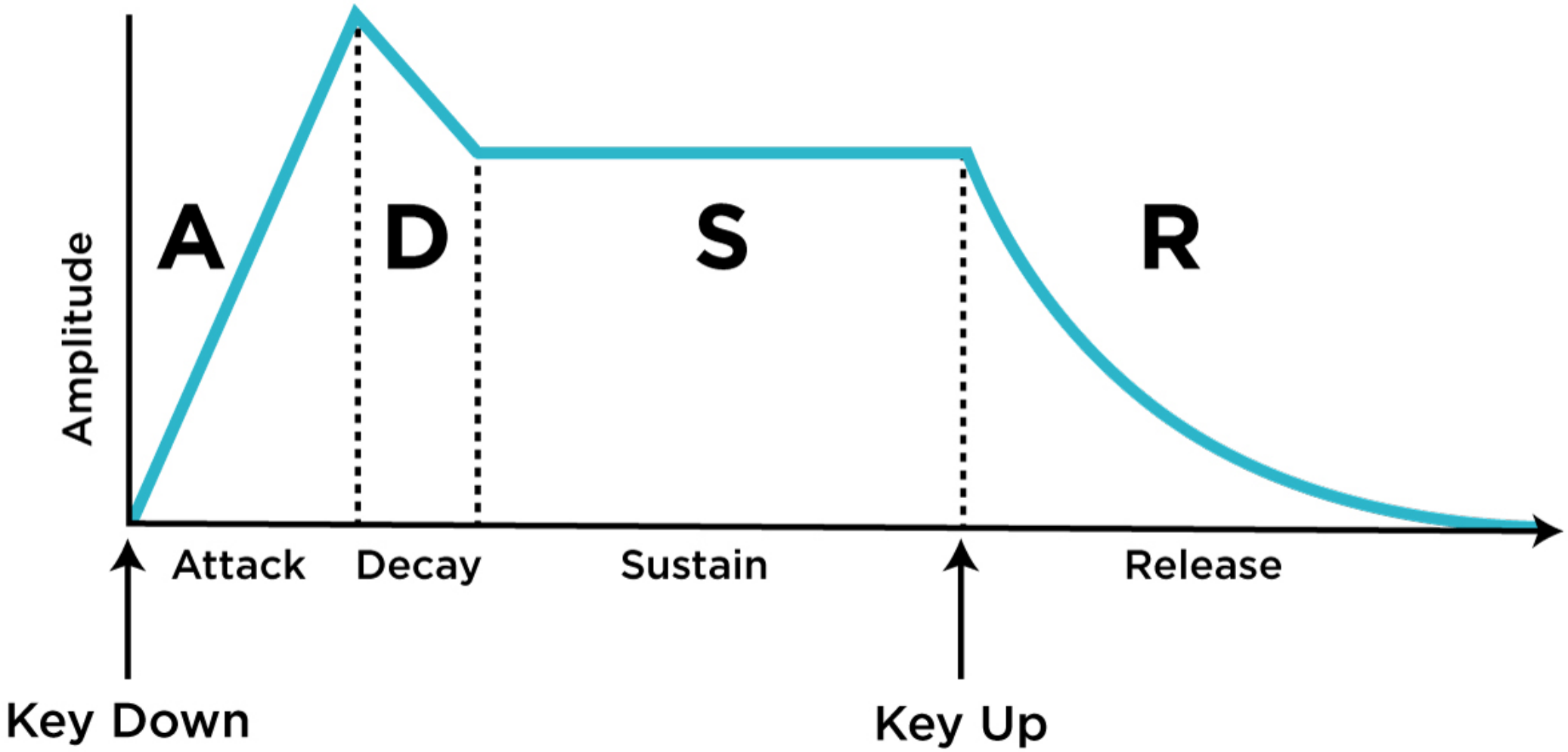
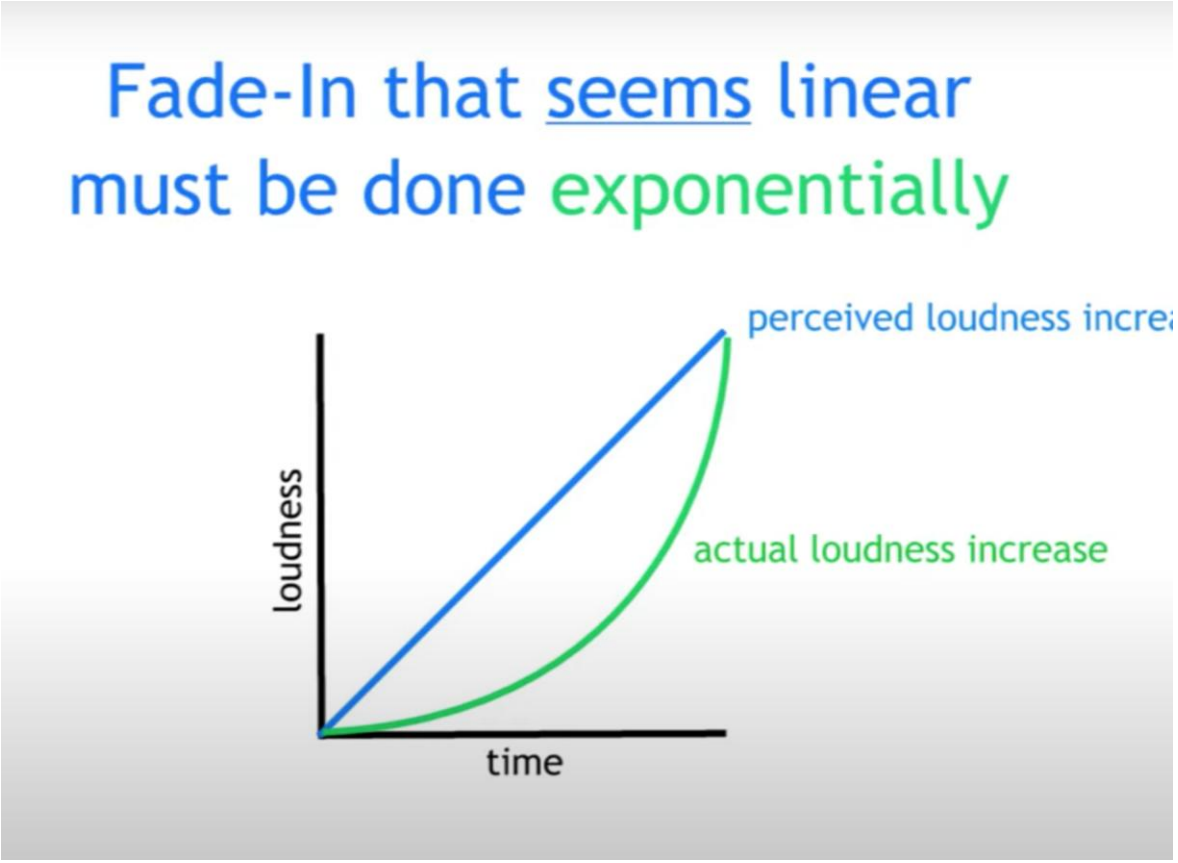
CV sources

Envelope Slope Shapes (Exponential Vs. Linear)

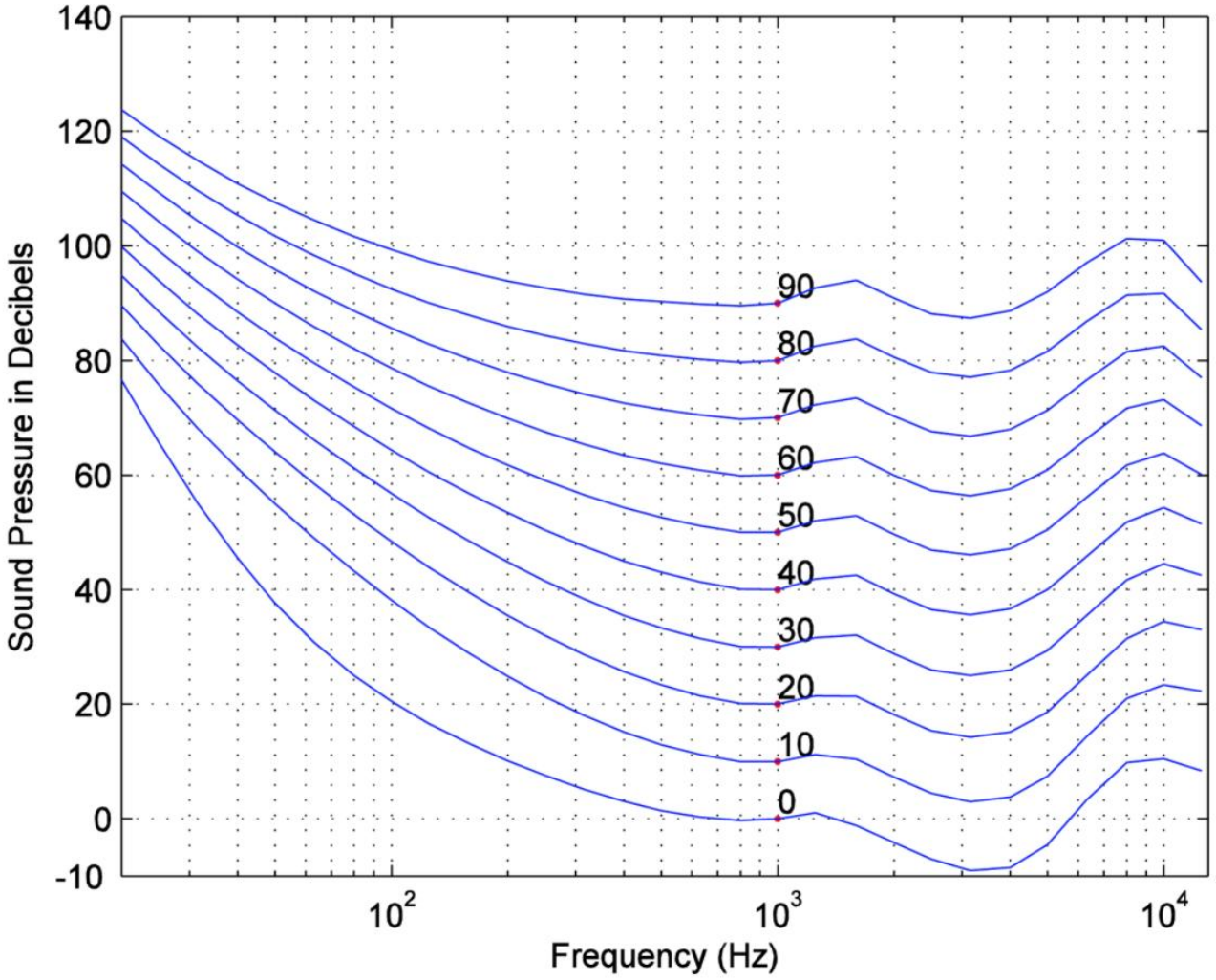
Linear Envelope shape:



Envelope Slope Shapes (Exponential Vs. Linear)



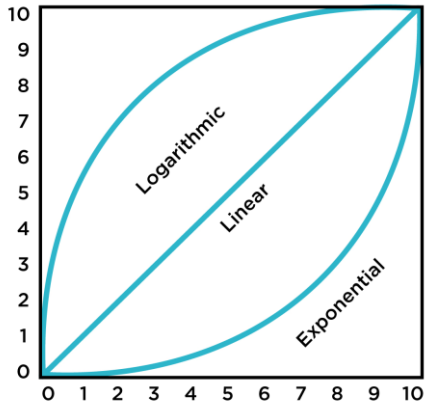
Envelope Slope Shapes (Exponential Vs. Linear)

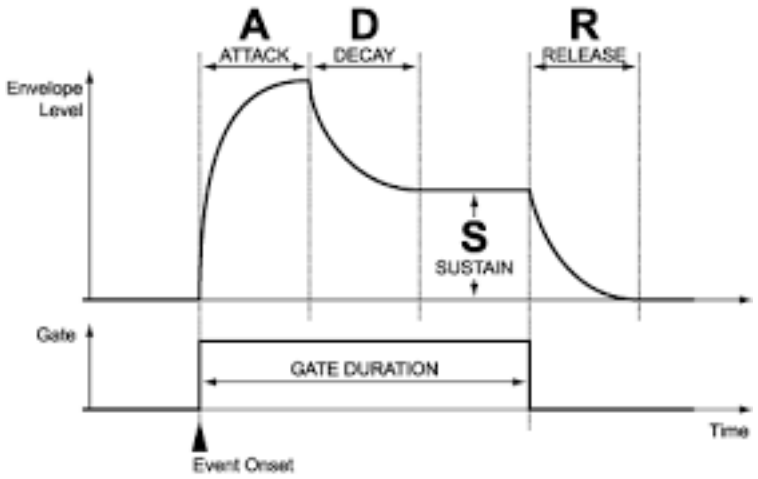


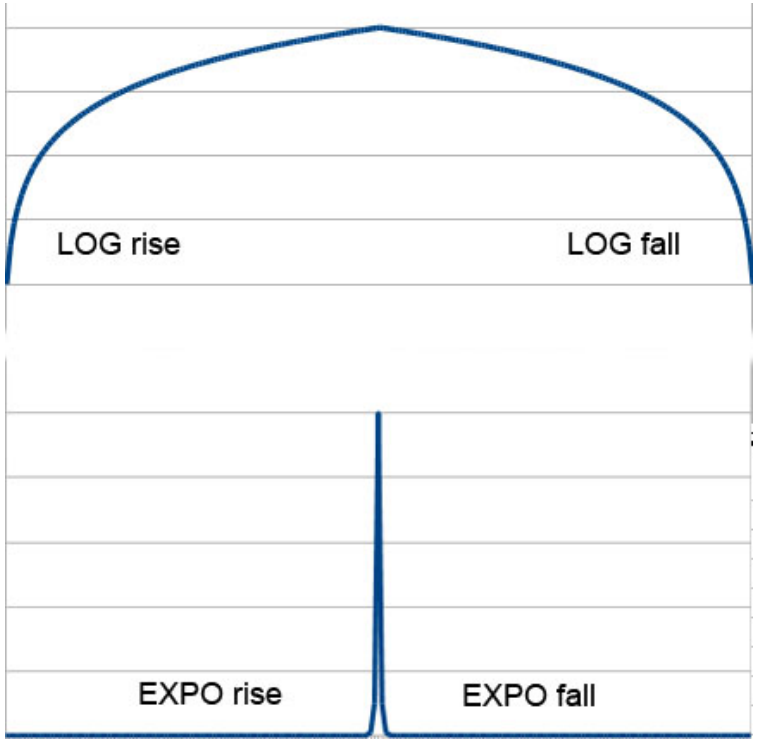
Equal loudness contours

Envelope Slope Shapes (Exponential Vs. Linear)

Classical Exponential Shape



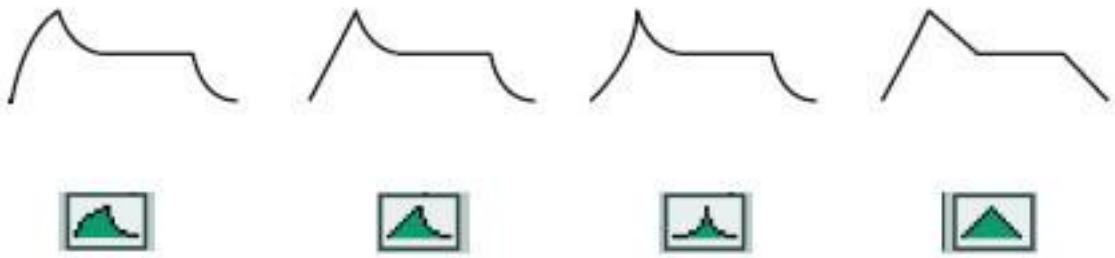




Logarithmic Exponential Shape

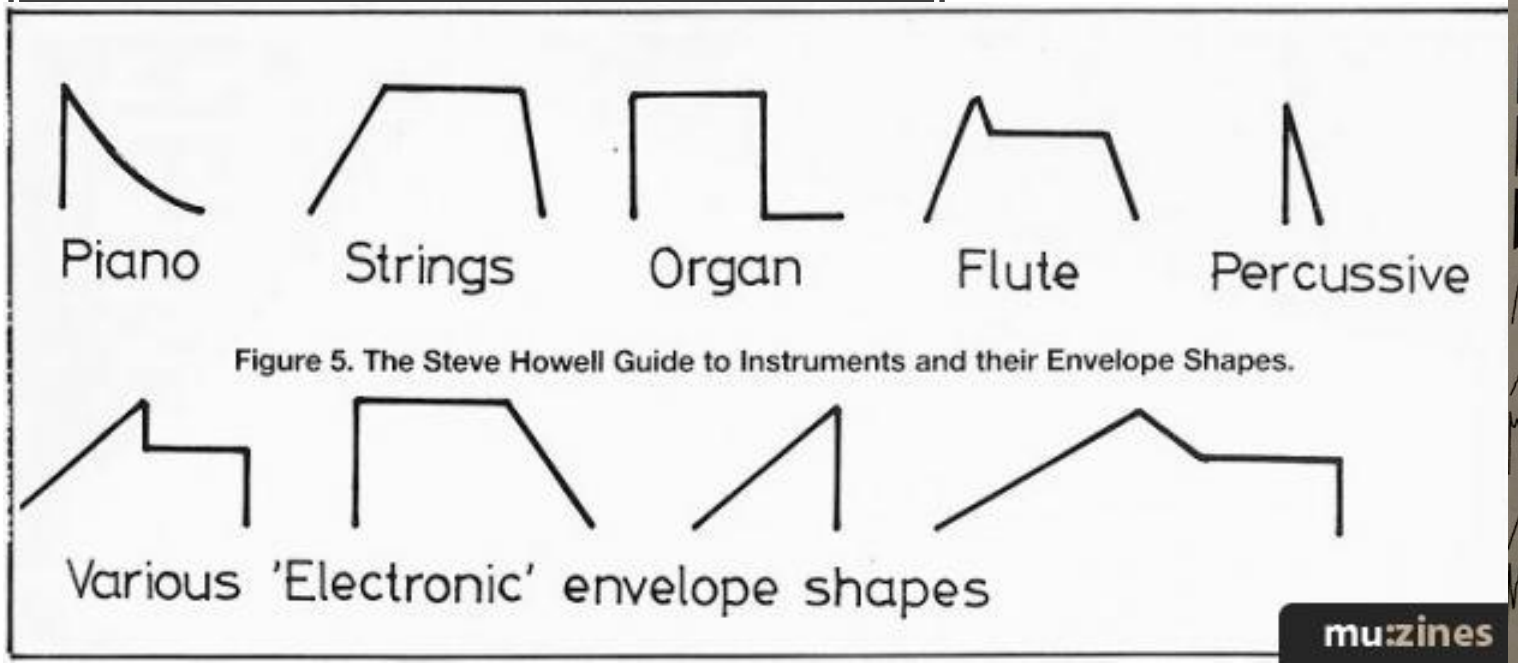
SHAPE SCROLL BUTTON

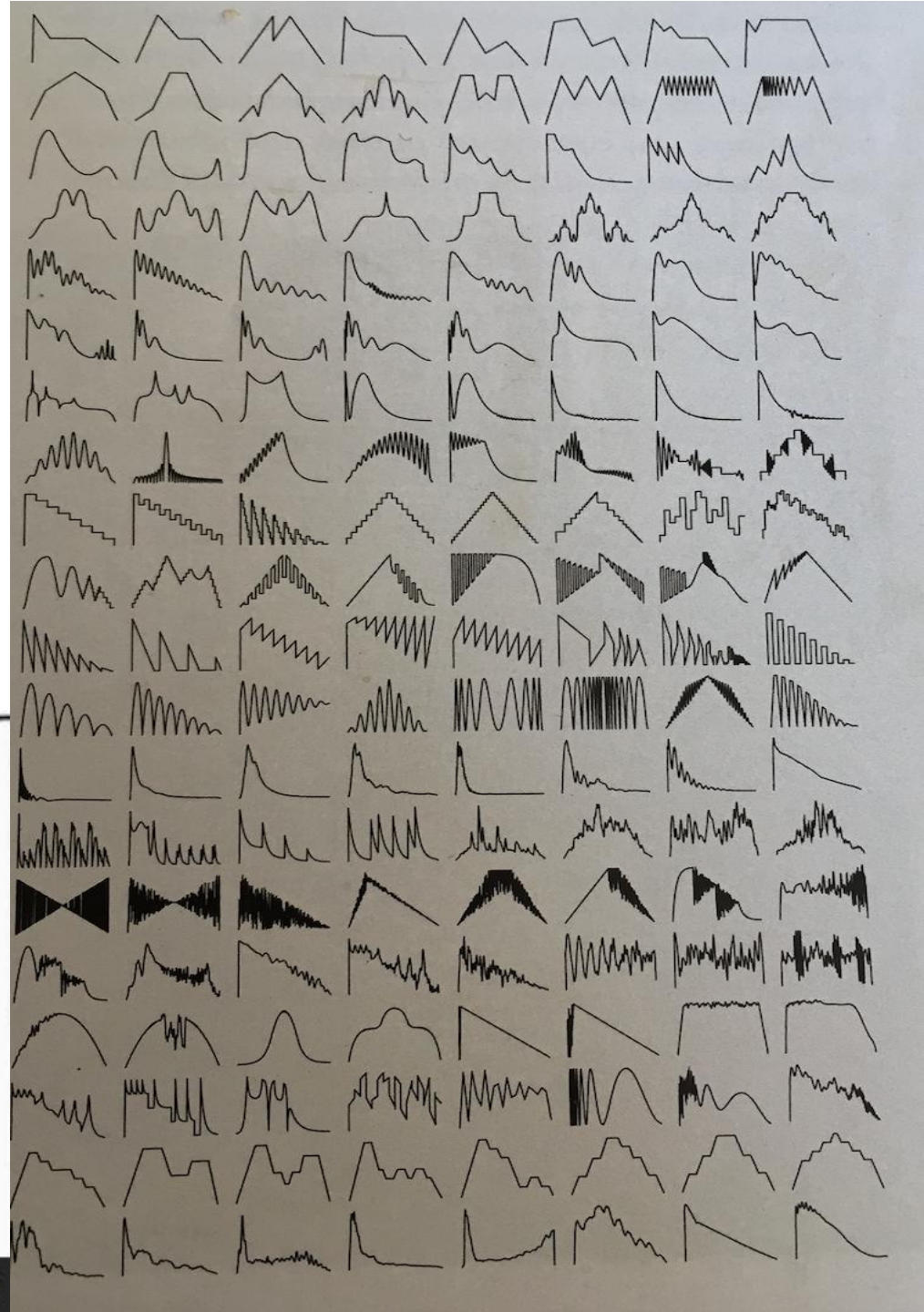
Set the characteristics of the attack and decay/release stage(s) of the envelope by clicking this scroll button. There are four alternatives: Logarithmic Attack & Exponential Decay/Release, Linear Attack & Exponential Decay/Release, Exponential Attack & Decay/Release and Linear Attack & Decay/Release.



Creating instrumental sounds & Compositional structures using Envelopes

Do you know:
Sequencer is ALSO an Envelope when it's used as a VC step/modifier!
Therefore,
Anything that can morph sounds'/voltages' amplitude over time can be considered as an envelope ☺





Control Voltage sources: shaping/modulating the voltage

- **Low Frequency Oscillators:**

- Oscillates ***below*** the human audible frequency range (below 20Hz, some LFOs can be up to 200Hz depending on the design so it's interchangeable with VCOs in some cases)
- Creates a ***rhythmic*** pulse, sweep, or basic waveshapes such as sawtooth, square, and sine
- This ***waveshape*** is used to modulate (a) audio rate oscillator(s) to create audio effects such as vibrato, tremolo and phasing (***modulation sources***). The voltage ranges could be bi-polar (mostly) from -5V–5V or unipolar; Sometimes you would need to ***offset or invert the output of an LFO*** to get the desired result. (Reading assign).
- Using a VCA to adjust the voltage of a LFO can ***change the modulation depth***!! (FUN :D)
- ***Using audio-range CVOs to serve as modulation parameters*** such as a filter cutoff can create additional sidebands, thus enriching the timbre. (Audio-rate modulation)
- Sometimes it is useful to have LFO outputs that are fixed offsets or so-called "phases" – this is useful to achieve ***stereo panning effect*** (Reading assign).
- Syncing LFO or VCOs: in general, it is a practice that a leading edge of a waveform from one oscillator can reset the waveform of the second, so it ***adjusts the phases***. Since LFOs run at a lower speed, the reason to sync them is to allow you to restart at the modulation from the same point for every note by using the note's gate signal – resulting in ***creating a repeatable modulation pattern***. (Reading Assign)
- **Voltage controlled LFOs**: voltage controls the speed (FM), amplitude (AM), or even waveshape. This allows

Control Voltage Modifiers: shaping/modulating the Voltage

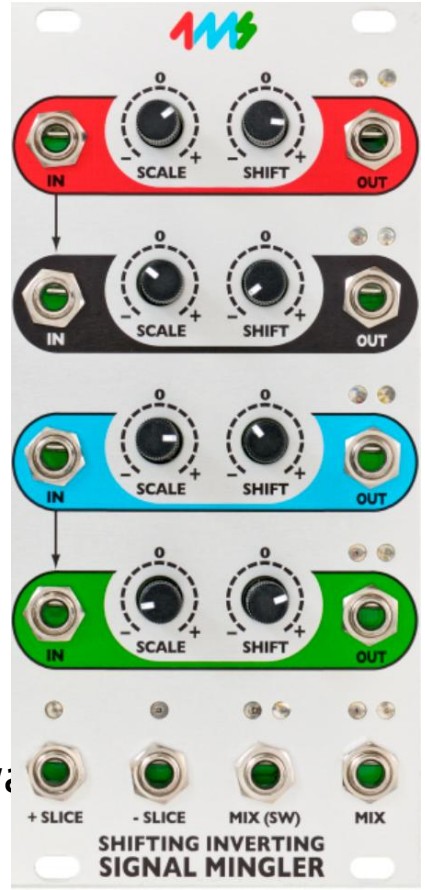
- **Attenuators/Attenuverters/VCAs**

- Attenuators ***reduces*** the level of a signal – think of it as a volume control for control voltages
- Attenuverters combine an optional ***inverter with an attenuator*** (8vert)
- Using VCAs for Audio vs. Control Voltage: When using ***for audio, it changes the dynamics*** (volume) of the sound; When using ***for control voltage, it controls the level of the modulation voltages as a CV modifiers*** – this is why people say "YOU CAN NEVER HAVE TOO MANY VCAs" ☺
- When controlling modulation depth, set your VCA's initial level minimum to start with and adjust it accordingly

- **Inverters (polarizer), Offsets (bias), & Adders (4MS)**

- Inverters multiples an incoming voltage by -1, causing it to move in the opposite direction, mirroring it around a 0 V centerline
- Patching an offset or bias voltage into one's CV inputs can help you ***lower down a VCO's or VCF's original frequency controls***
- Bias offset voltage are often paired with attenuators in modules.
- Adders – think of it as ***a mixer of control voltage*** ☺ that's why they sometimes are called "unity mixers"; it can also be used to tune an oscillator (precision adders)

- **Multiples** (8vert) – splits, in real world you might need an ***active/"buffered" multiple***!
- **Minimum/maximum –** also a split but will send the max signal and min signal separately
- **Rectifiers –** ***waveshapers for control voltage***. It often uses to make sure a bipolar LFO or random voltage source does not shut off a VCA by sending it negative voltages. It causes side effect to double the frequency of triangle wave LFOs or other symmetrical wa
- Utility mixers and CVPs (***Control Voltage Processors)*** and Matrix mixers!



Control Voltage Modifiers: shaping/modulating the Voltage

AND MANY MORE matrix patchers, such as switchers, triggers, quantizes, Slew limiters , comparators, slope detectors…

Audio Modifiers: Sculpturing sound

- **VCAs:** Alter the strength of the signal. Has “voltage control” (VC) part and “amplifier” (A) part – but actually an attenuator

  - Different VCAs ***are designed differently to handle voltages***
  - The Eurorack format uses a +- 12 V power supply so the practical limit is around +- 10 V and then the signal will clip
  - If you hear ***distortion*** at the peaks of your envelopes, you are probably hitting the limit

  - ***Linear vs. Exponential***: Linear for control voltage manipulations; exponential for audio signal manipulations (tube VCAs)
  - ***Flexibility of paring envelopes with VCAs***: some envelopes already have a logarithmic (reverse exponential) attack
    shape paired with exponential decay and release shapes, when paired with a linear VCA, the resulting sounds more
    natural than an exponential option (Use the week6_demo.vcv patch to test)

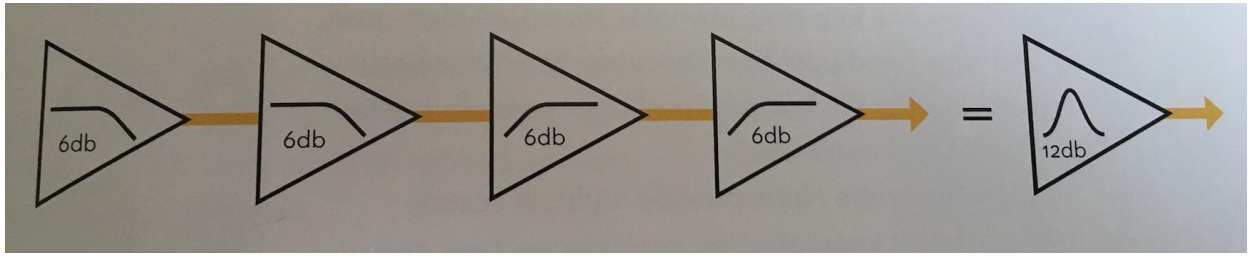
  - ***DC coupled and AC coupled VCAs*** – DC coupled VCAs can pass DC signal through – this would introduce DC offset (0Hz)
    and thus creating audio distortion– so AC coupled VCAs would eliminate this DC signal from the audio signal chain.
    However, sometimes passing a DC signal is necessary for passing control voltage or modulation, you might need the DC

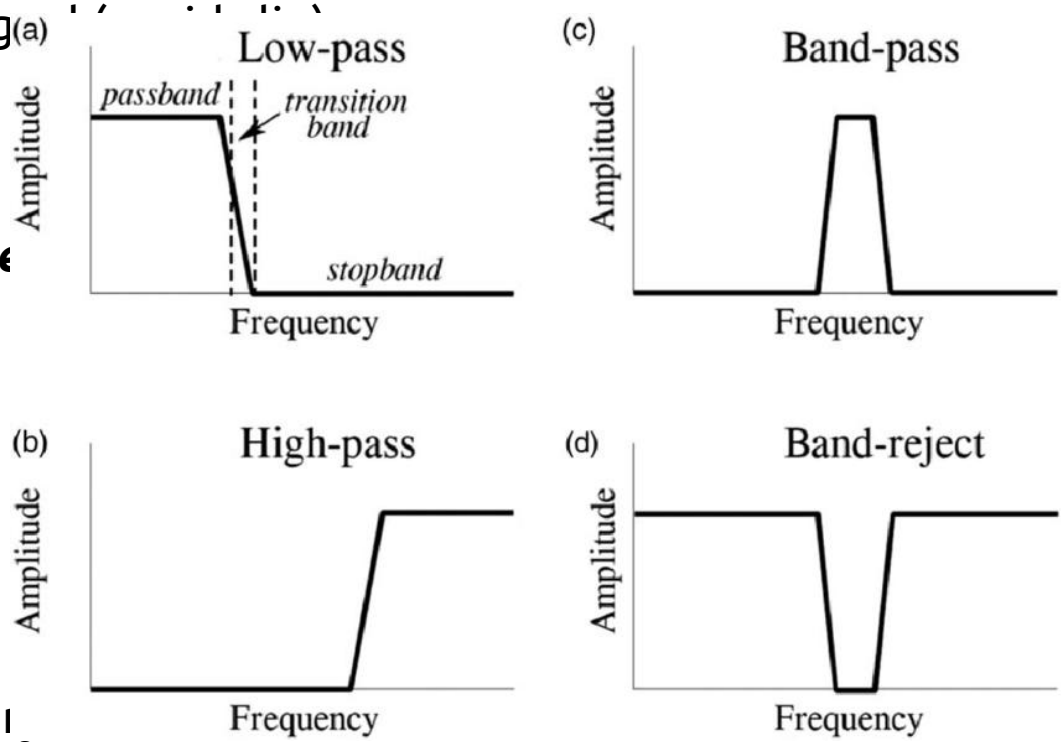
Audio Modifiers: Sculpturing sound

- **Filters**: These modules weakens or removes some of the sonic harmonics. In modular synth, they are called Voltage Controlled filter, aka. “VCF”.

Note:

1. Different filters may use different circuit designs which resulting in different tonal shifts even though they have the same specifications.
2. Many filters create internal feedback loop, often referred to as ”***resonance***” of “Q.” This feedback reinforces or strengthened harmonics around the cutoff frequency. This is also known as “***self-oscillation***.”
3. Managing levels: Using VCAs before filter with input gain to add harmonics to the spikes and than filter them down (Overdrive); Same patch but reduce the sig
4. What are “***poles***”?? One pole cuts either low or high freq by 6 dB for every octave. E.g. 4 low-pass poles wired in series make a 24 dB per octave low-pass filter (4X6dB= 24 dB) When low-pass and high-pass poles combine, it creates ***slope***



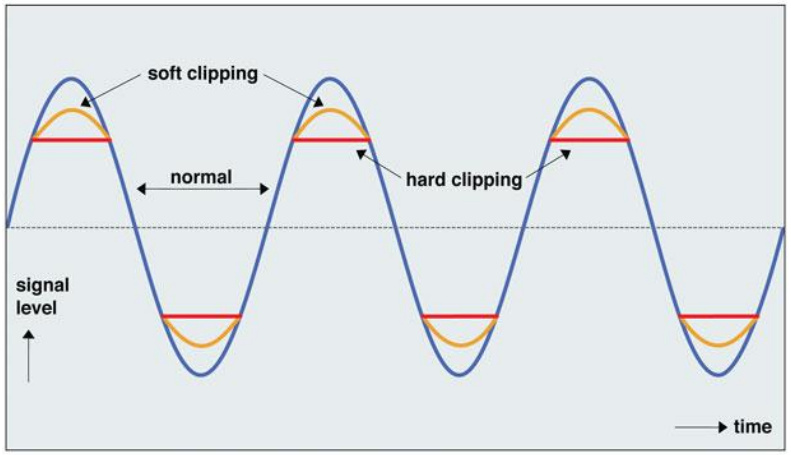


5. Filters can also be used to control voltages when a VCF can pass DC voltages, and with a cutoff freq that can be tuned ver
6. Spectral processers (EQs)

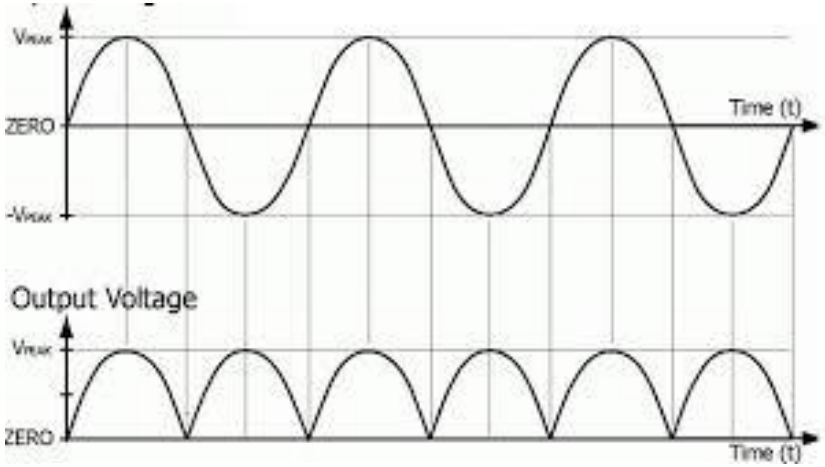
Modulation Sources and Audio Modifiers: Sculpturing sound

- **Waveshapers**: Directly change the waveforms (harmonics); then you can fine-tune the sound to make it musical.

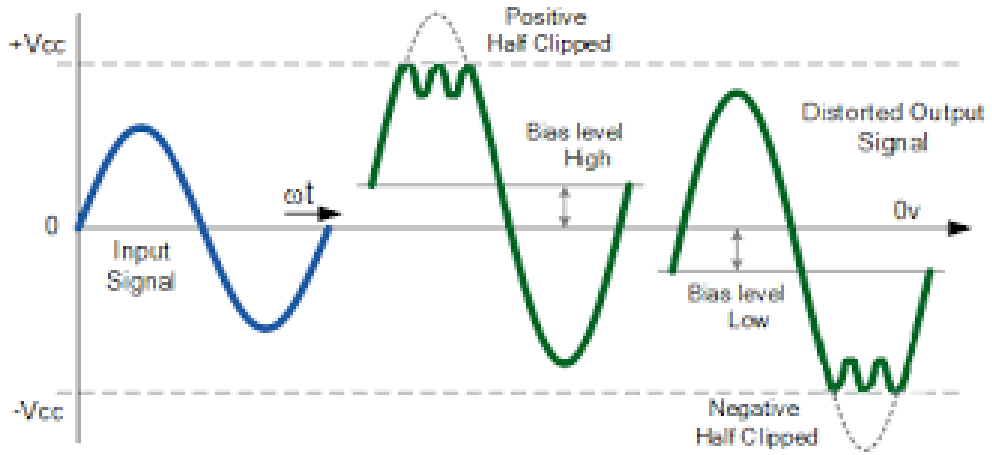
1. Clipping, distortions, or saturation circuits.

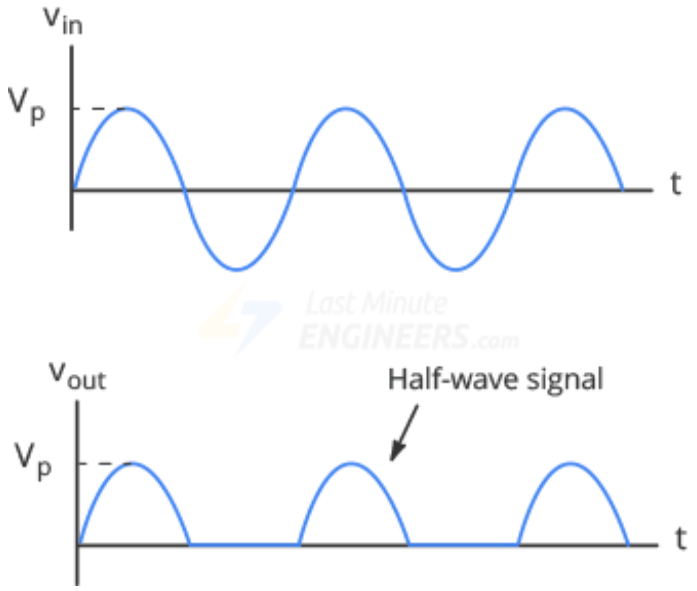


2. Full-wave and half-wave rectifiers



3. Wavefolders





Modulation Sources and Audio Modifiers: Sculpturing sound

- **Waveshapers**: Directly change the waveforms (harmonics); then you can fine-tune the sound to make it musical.
- Use a LFO or envelope to control and vary the shape over time can create a dynamically changing timbre
- Sub-octave dividers are a kind of waveshaper – it can be used to divide a complex wave form to several simpler ones to create subharmonics

- **A wave folder adds mostly odd harmonics to a signal.** It works the best with low-harmonic content, such as triangle and sine waves. Too many harmonics outputting noise-like sound when too much is too much ☺

- **Mixers: Audio vs. CV mixers - the combination of both is the best**
- Linear vs. Exponential
- Stereo mixers and multichannel mixers
- Passive and active mixers
- Crossfading and scanning
- Clipping and saturation (Erica's tube mixer)
- Effect: aux sends and returns
- Expandable mixing systems
- Surrounding sound panning (quadraphonics)