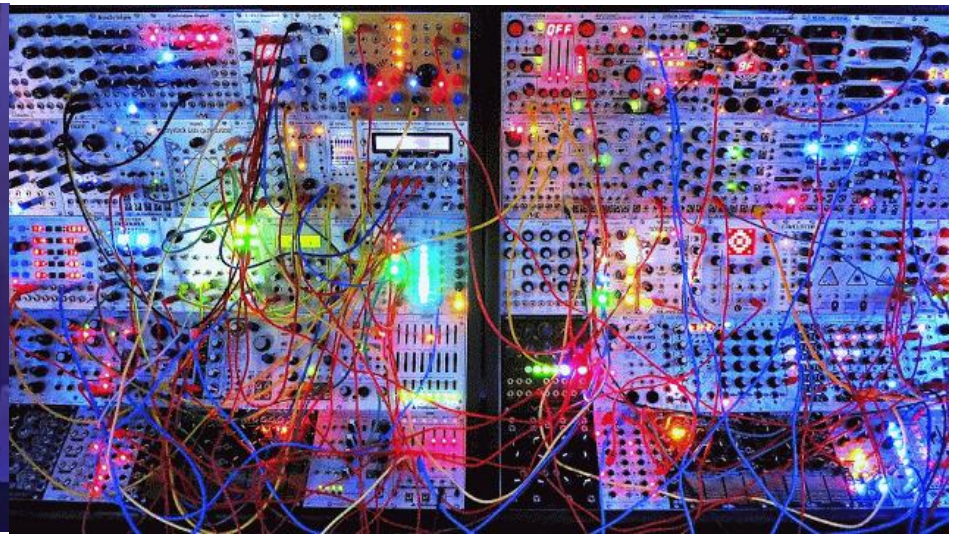
MUSC 4820/5820 Digital Music Techniques 001

Week 5: Audio and Control Voltage Sources/inputs (Part1: VCOs, noises, Envelopes and LFOs)



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The Building Blocks of Modular Synth

Audio Sources: A raw lump of sonic clay

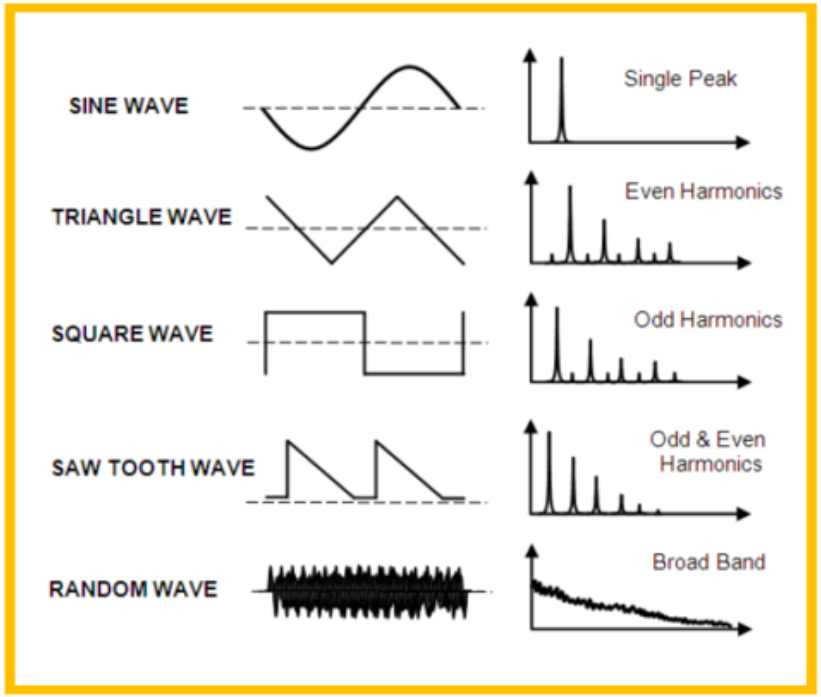
- **Oscillator**: output a voltage that fluctuates between positive and negative values at a speed in the audible range (20hz-20khz). This vibration causes our eardrums to vibrate in a similar way, which our brain interprets as sound.

VCOs –Voltage Controlled Oscillators:

The classic oscillator waveforms:

1. Sine wave (the purest and simplest tone in the world)
2. Triangle wave (bass)
3. Square wave (half full, hallow
4. Sawtooth wave (most full, bra
   & string, etc.
5. Paulse wave (A variation on a
   square, but the % of positive
   negative portion can be varic
   so it sounds buzzy or reedy)

- All of them can be used as a control signal, audio shaper, c modulation parameters.



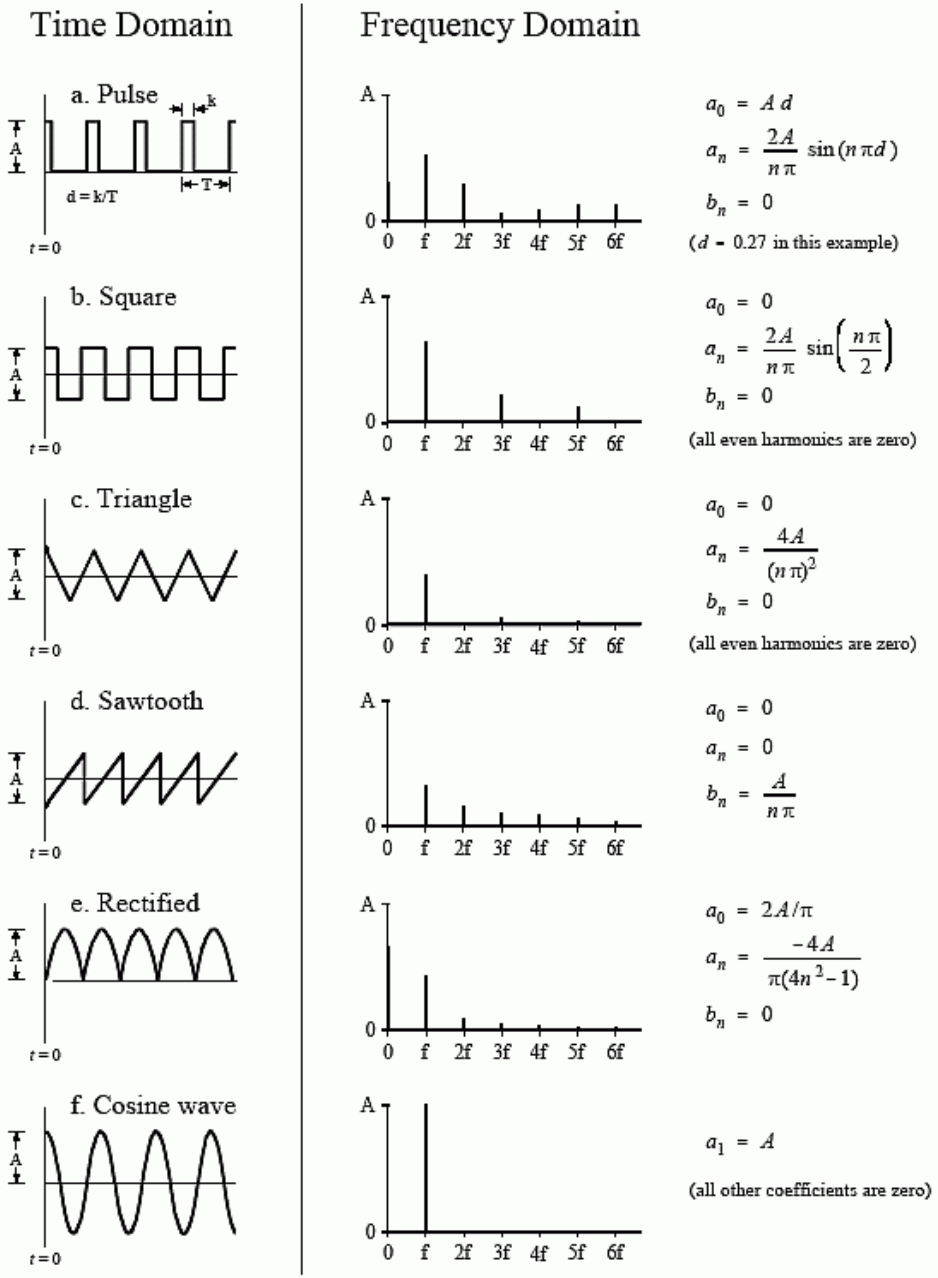


FIGURE 13-10
Examples of the Fourier series. Six common time domain waveforms are shown, along with the equations to calculate their "*a*" and "*b*" coefficients.

The Building Blocks of Modular Synth

- **Audio –ranged Sources (VCOs –Voltage Controlled Oscillators)**:
  - Sine wave (the purest and simplest tone in the world): The sine wave has energy at only one frequency.
  - Sawtooth wave (most full, brass & string, etc.): The sawtooth wave has energy at all harmonics of the fundamental frequency, and the relative amplitude of each harmonic is proportional to the inverse of the harmonic number, e.g., 1/1, 1/2, 1/3, 1/4, etc.
  - Square wave (half full, hallower): The square wave has energy only at the odd harmonics of the fundamental frequency, and the relative amplitude of each harmonic is proportional to the inverse of the harmonic number, e.g., 1/1, 1/3, 1/5, 1/7, etc.
  - Triangle wave (bass): The triangle wave has energy only at the odd harmonics of the fundamental frequency, and the relative amplitude of each harmonic is proportional to the inverse of the square of the harmonic number, e.g., 1/1, 1/9, 1/25, 1/49, etc.
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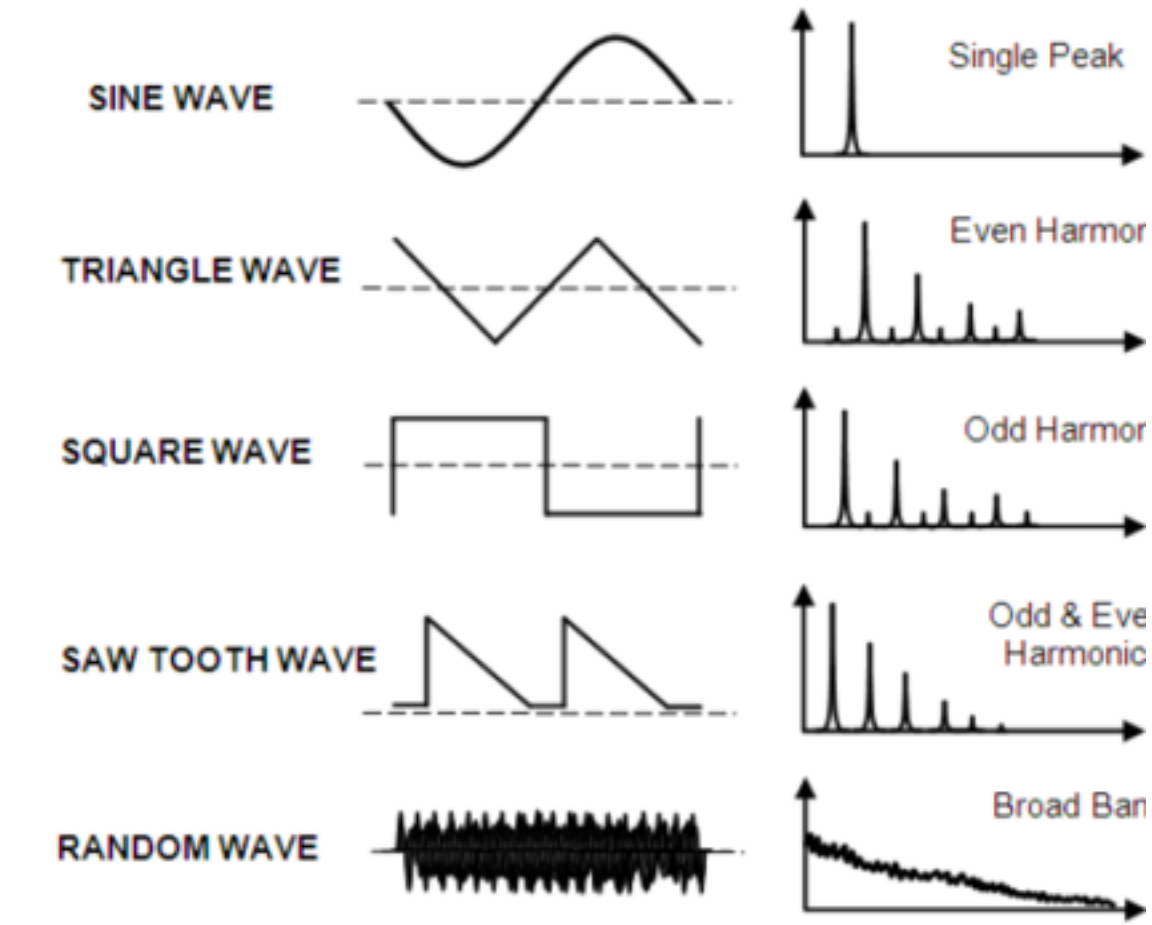
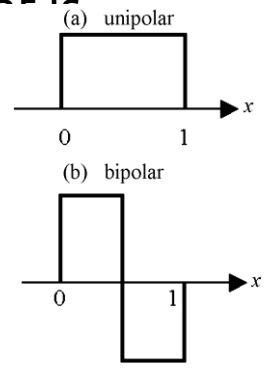


Tuning VCOs

Stability: The pitch of VCOs may drift while they are warming up, or if the temperature changes noticeably – e.g. the sun heating up your case on a live gig, etc. (give it at least a few min - an hour to warm up and stabilize their pitches)

Tracking: You don't want it to go sharp or flat compared to another instrument or oscillator as you play higher or lower notes. In control volage terms, when you send an oscillator a control voltage that is precisely 1.0 volts higher, you want it to play a note that is precisely one octave higher.

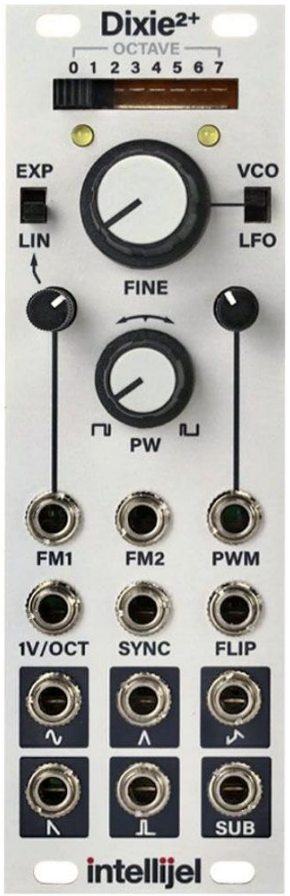


Pitch offset: Different oscillators are designed with different ideas of what voltage should equ what note, so you often need to offset a V O up or down by octaves or finer increments to mat your goal. This is complicated by the fact that some oscillators accept both positive and negati voltages,
while others only accept positive voltages. (-5V-5V; 0-10V, 0-15V Buchla, 0-5V Moog…)

Adding: When you add two voltages together (e.g. a sequencer + a keyboard), make sure the VCO to play a note that precisely matches the combination of their voltages – most ordinary mixers are not accurate enough and introduce slight pitch offsets or tracking errors. (this can be fixed later in the digital world with DAW and plugins too in a hacking fashion; otherwise you would need to purchase a "precision adder" module to do the job $$$;D)

Tuning VCOs

- You can tune your oscillators by ear to reach your esthetics, or use an external tuner like your guitar tuner or a tuner app
- Tuning multiple VCOs: The Argos Bleak module can add and offset voltages, control up to 4 VCOs at once. It also additionally includes a LFO (Low Frequency Oscillator) for vibrato. However, it only output positive pitch voltages.



- Patching a ***trimmer*** between the pitch voltage source and your VCOs, so it can fine-tune and track the stability.
- Have a ***buffered multiple*** for tracking multiple VCOs
- An easy way to adjust the tracking of your VCOs is to use one as a ***reference*** to tune to a C with no control voltage to it, then patch your controller to the second VCO and tweet this to be aligned with your referenced VCO.

The Building Blocks of Modular Synth

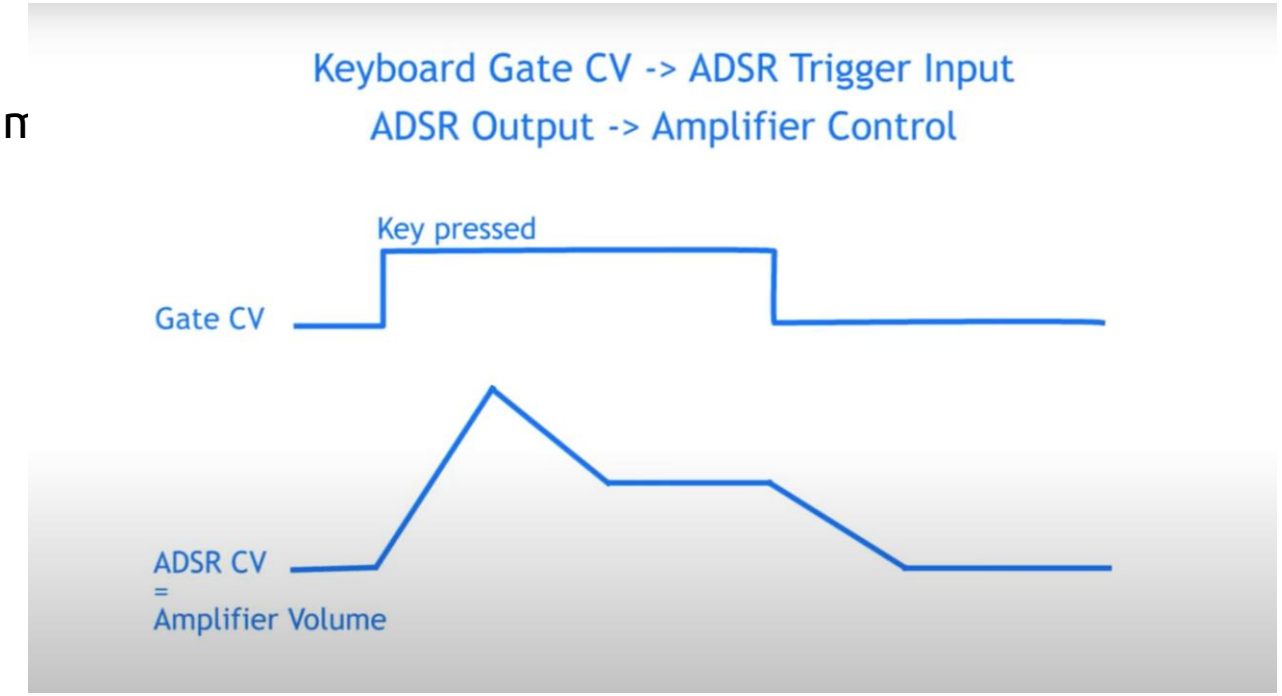
Control Voltage sources: shaping/modulating the sounds

- **Function generators:**

Envelope Generators (EGs): they are your primary tools for shaping the loudness and other qualities of a note or sound events.

The basics:

- When a EG triggers by a *gate signal*, it outputs a voltage that rises from a minimum level (e.g. from 0 v) to a max level
- Then it falls back to where it starts.
- It defines how a note's volume changes over tim



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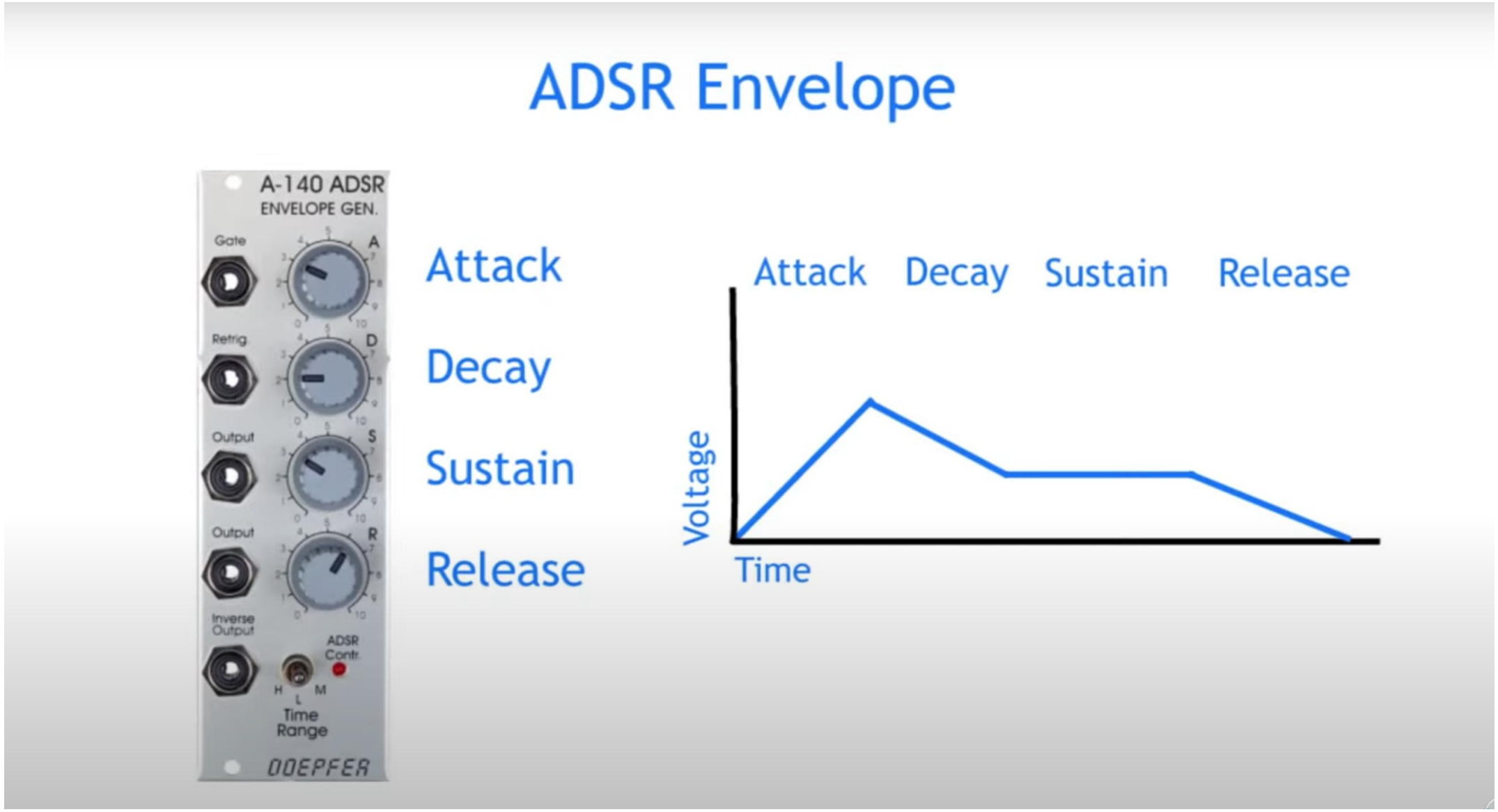

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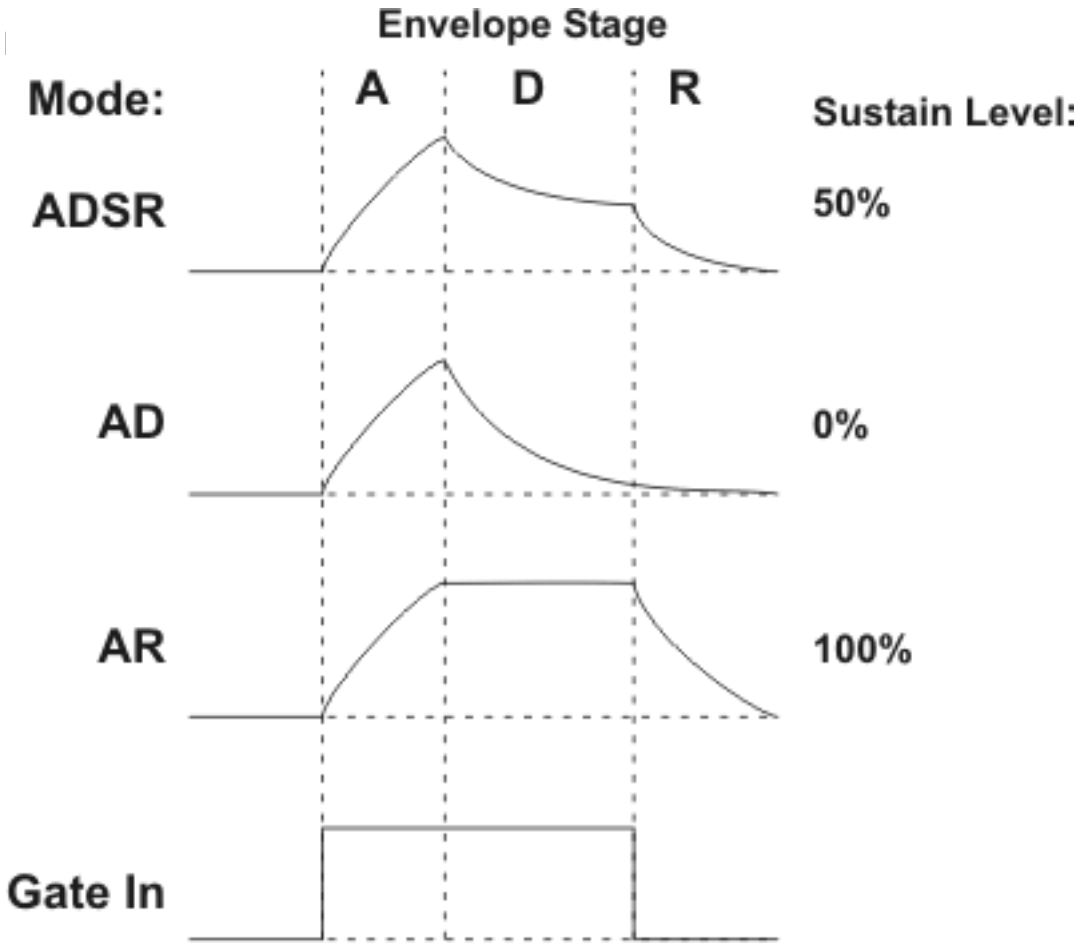
- Two-Stage EGs: ***ADs*** ~ this is sometimes referred to as a transient generator as it is good for synthesizing a pluck or percussive strike that typically decays on its own
- ***ADs*** are also often used to control the FM depth, wave-folde amount, or filter cutoff a s a control shaper to define how the harmonic content of a note changes over time
- ***ARs*** freezes sustains at the point when reaching the attack peak – they're also called (ASRs) or a trapezoid generators
- ARs are handy for controlling VCAs, keeping them open as long as you are holding a note
- It is common to switch between AD and AR in a module



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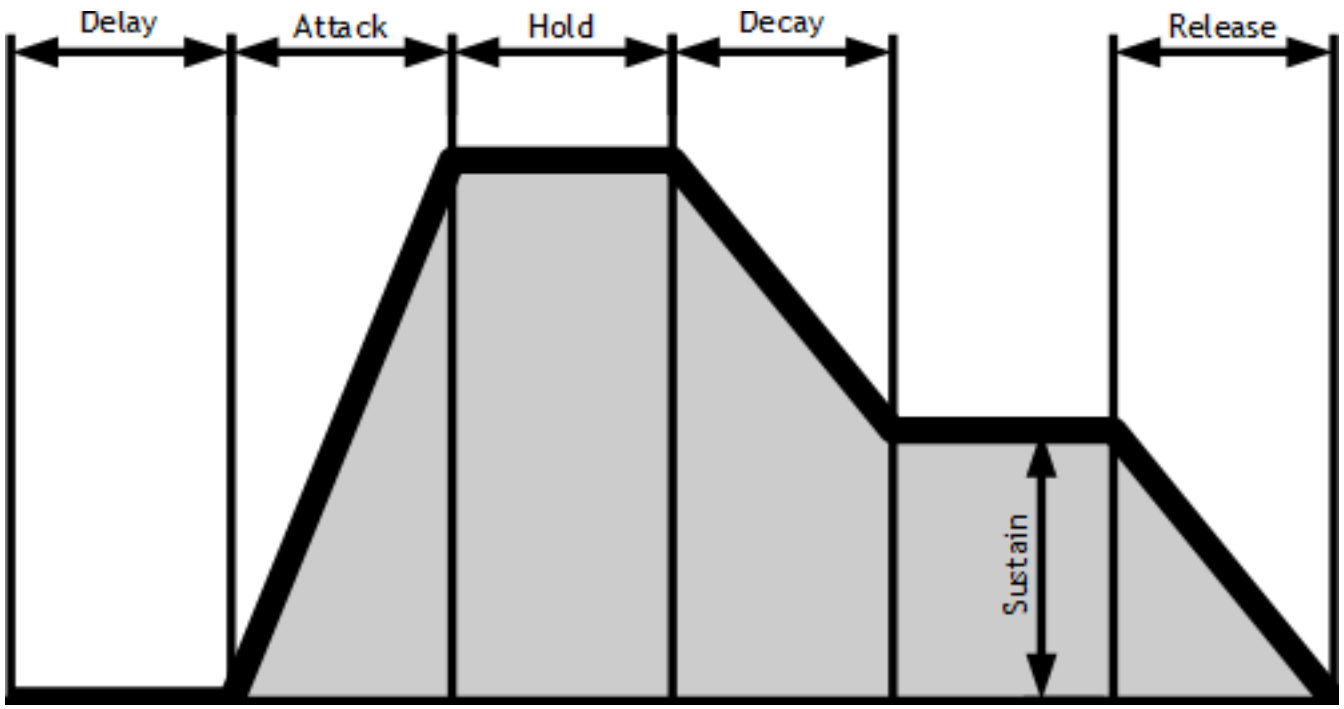

Question: where does the gate start and end?

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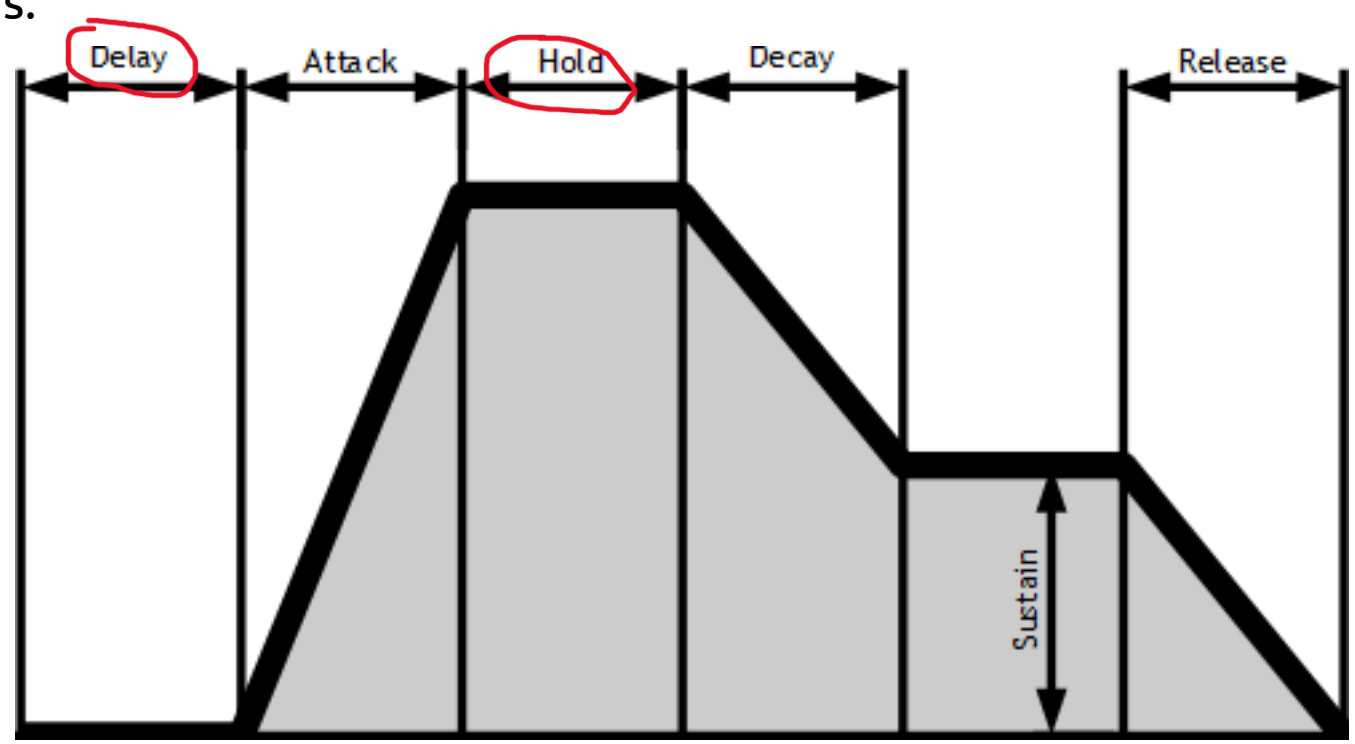
Delay and **Hold** functions:



|Gate starts. -> **Gate Ends|**

Difference between ”Hold” and “Sustain”:

- “Hold” happens after attached and before Decay
- “Sustain” happens after Decay and before Release

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