Week 1: Modular Thinking

INTRODUCTION TO MODULAR SYNTHESIS

Signal Flux x Pioneer Works
September 2019

Week 1: Modular Thinking

Modular Thinking: Systems & Signals

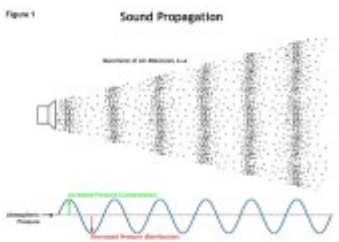
A system is composed of a few things:

- Inputs
- Rules for transformation
- Outputs

Modular Thinking: Patching

- A module is a device that accepts input signals and produces an output based off the input signals according to its own set of rules.
- A rack is a collection of modules all installed into a single case with a shared power source.
- Eurorack is a specific standard for the sizing, power needs, and voltage levels of a module so that manly designers modules can all be used together in the same case.

What is sound?



The Parameterization of Sound

Oscillscopes, Voltage & Signals

Electrical signals are measured in voltage.

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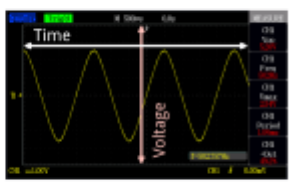

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Agenda

- Introductions
- Course Overview
- Modular Thinking
  - The Parameters of Sound
  - The Electronic Transmission of Sound
  - So What's a Patch?
  - Control Voltage and Modulation
- Modular Building Blocks
  - Oscilloscopes: Visualizing Voltage
  - Oscillators: Frequency and Amplitude
  - Attenuators and Voltage-Controlled Amplifiers: Amplitude Control
- Break
- Lab: Introduction to VCV Rack

Course Overview: Topics

- Week 1: Introduction to Modular Thinking – VCOs, VCAs
- Week 2: Creating Events – Gates, Triggers, EGs, V/Oct, Sequencers, Mixers
- Week 3: Sculpting Timbre & Time – VCFs, Pattern Generators, Chance, FX
- Week 4:The Real World – Interfacing, Planning a Case, Creative Practice

Course Overview: Learning Goals

- Understanding discrete modular building blocks
- Understanding control voltage and modulation
- Ability to build and analyze relationships in a patch from scratch
- Ability to think on the micro-, meso-, and macro-timescales of composition
- Self-sufficiently be able to continue your learning and modular practice

Course Overview: Class Structure

Each class we will:

- Review homework
- Lecture & demo of new concepts using hardware modular synthesizers
- Explore new concepts in guided labs within VCV Rack
- Opportunities for hands-on practice with 4MS Pods

Modular Thinking: Systems & Signals

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Modular Thinking: Systems & Signals

Case Study: Radio

Modular Thinking: Systems & Signals

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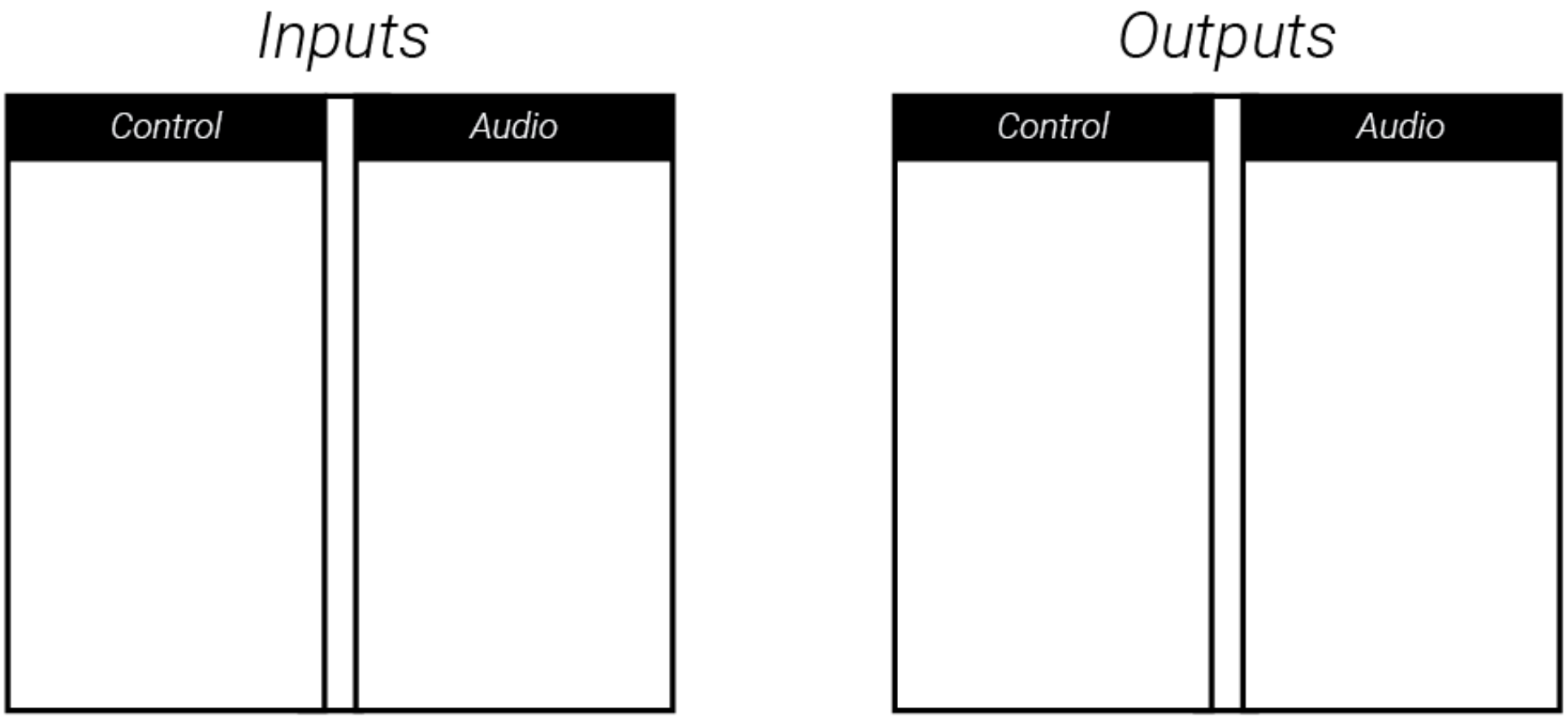
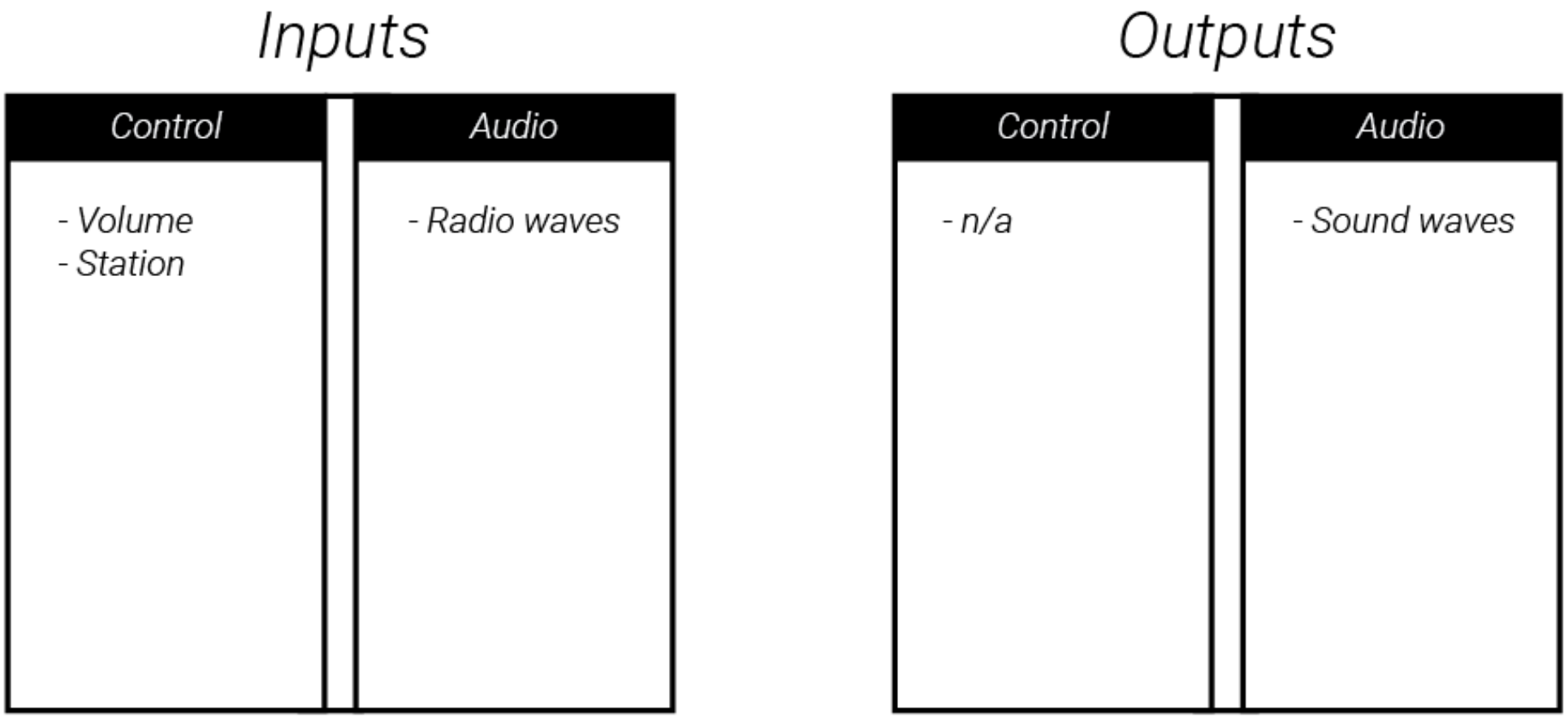


Modular Thinking: Systems & Signals

Case Study: Radio



Modular Thinking: Systems & Signals

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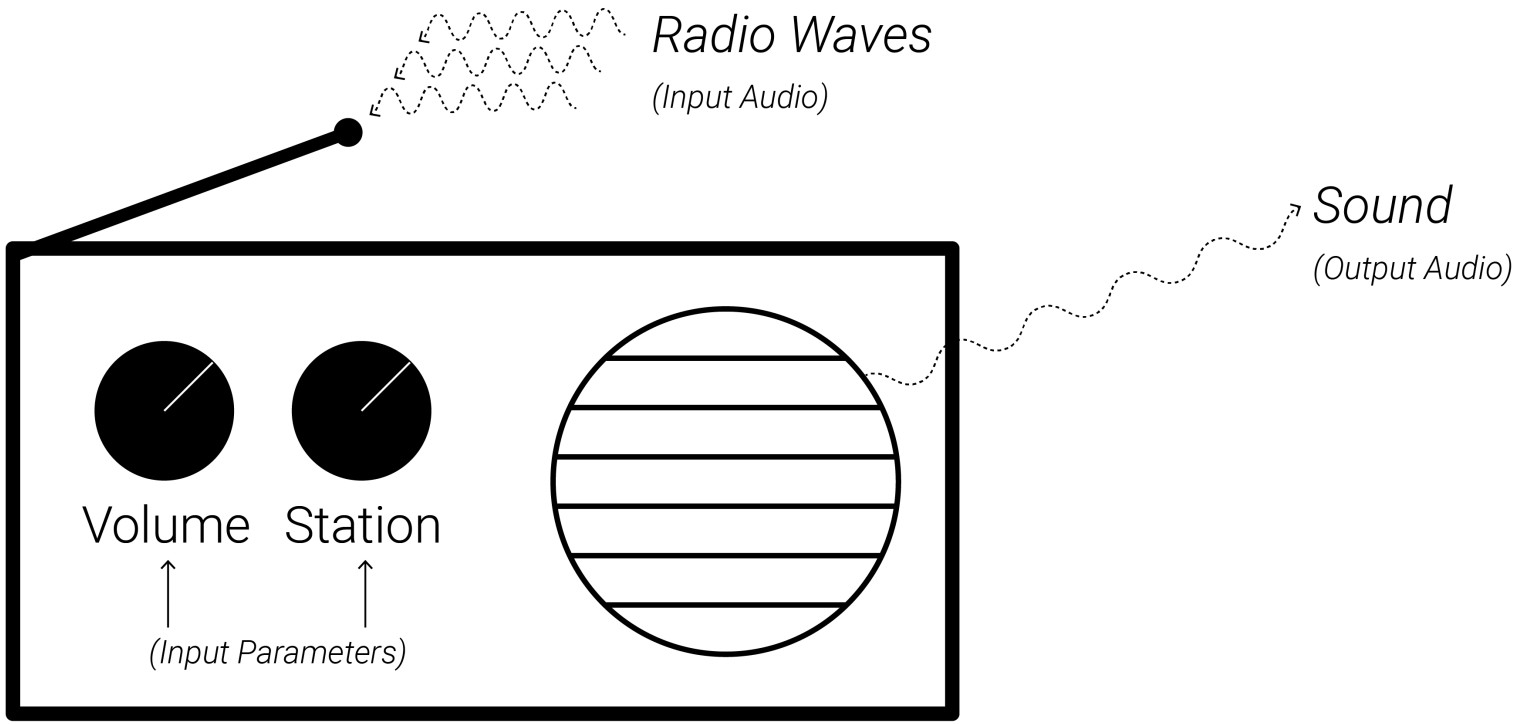

Modular Thinking: Systems & Signals

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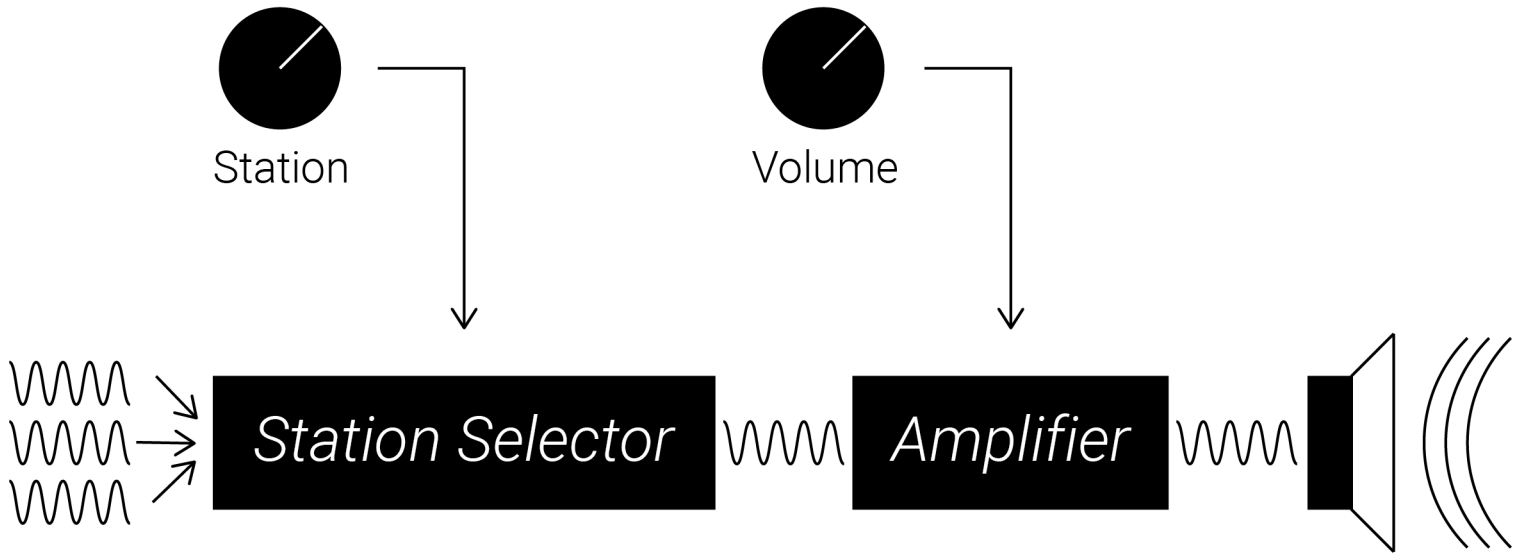

Modular Thinking: Patching

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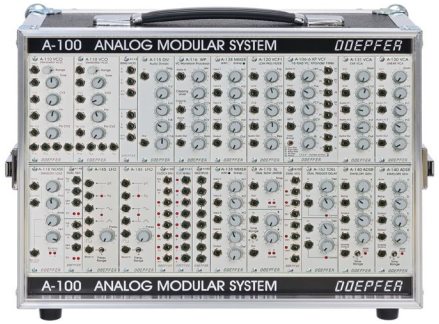
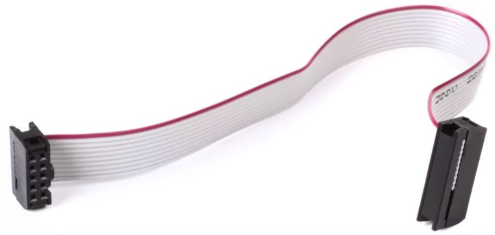
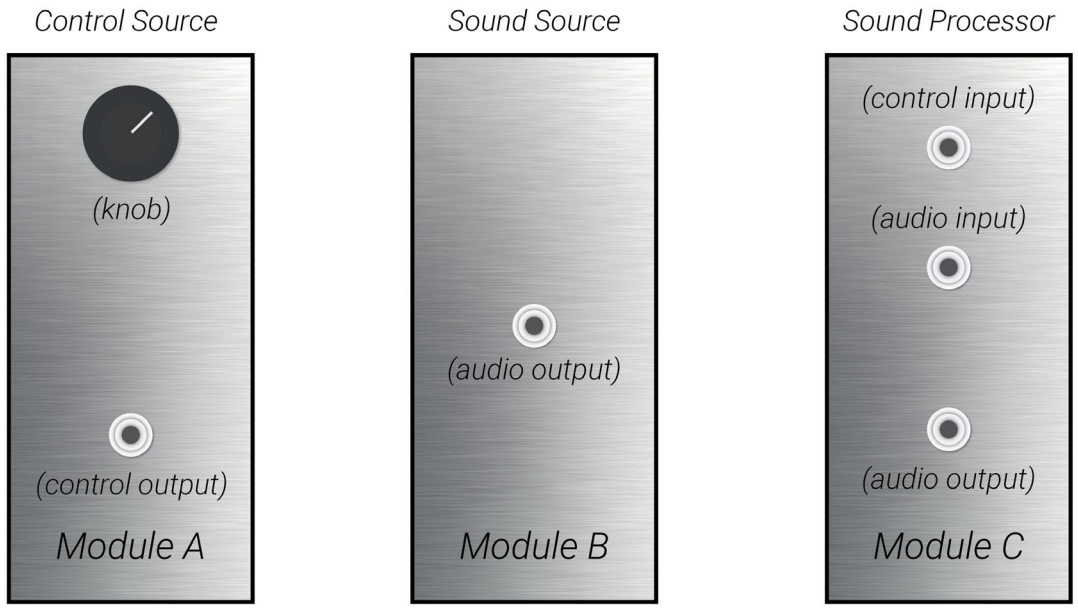




Modular Thinking: Patching

Generic Types of Modules:

- Sound Generators
- Sound Processors
- Control Voltage Generators
- Control Voltage Processors



Modular Thinking: Patching

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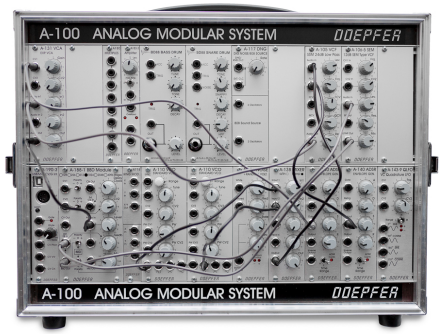
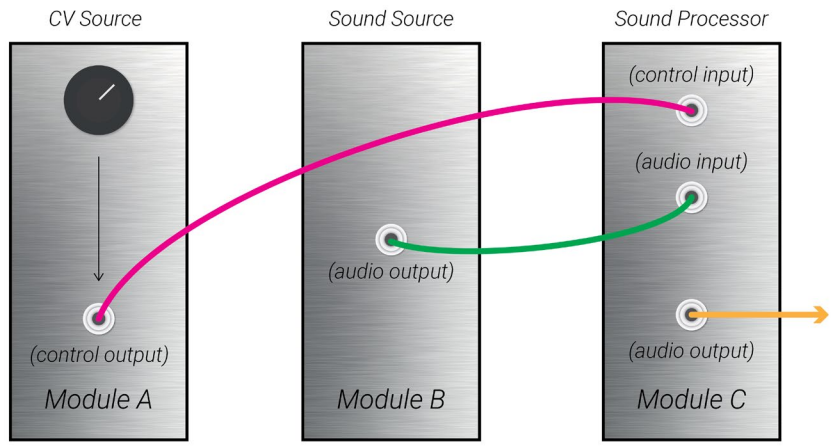
Interface:

- Interactive Objects (Knobs, Sliders, Buttons, Switches, etc)
- Information Feedback: LEDs, Screens, Text/Graphics
- Signal Inputs
- Signal Outputs

Modular Thinking: Patching

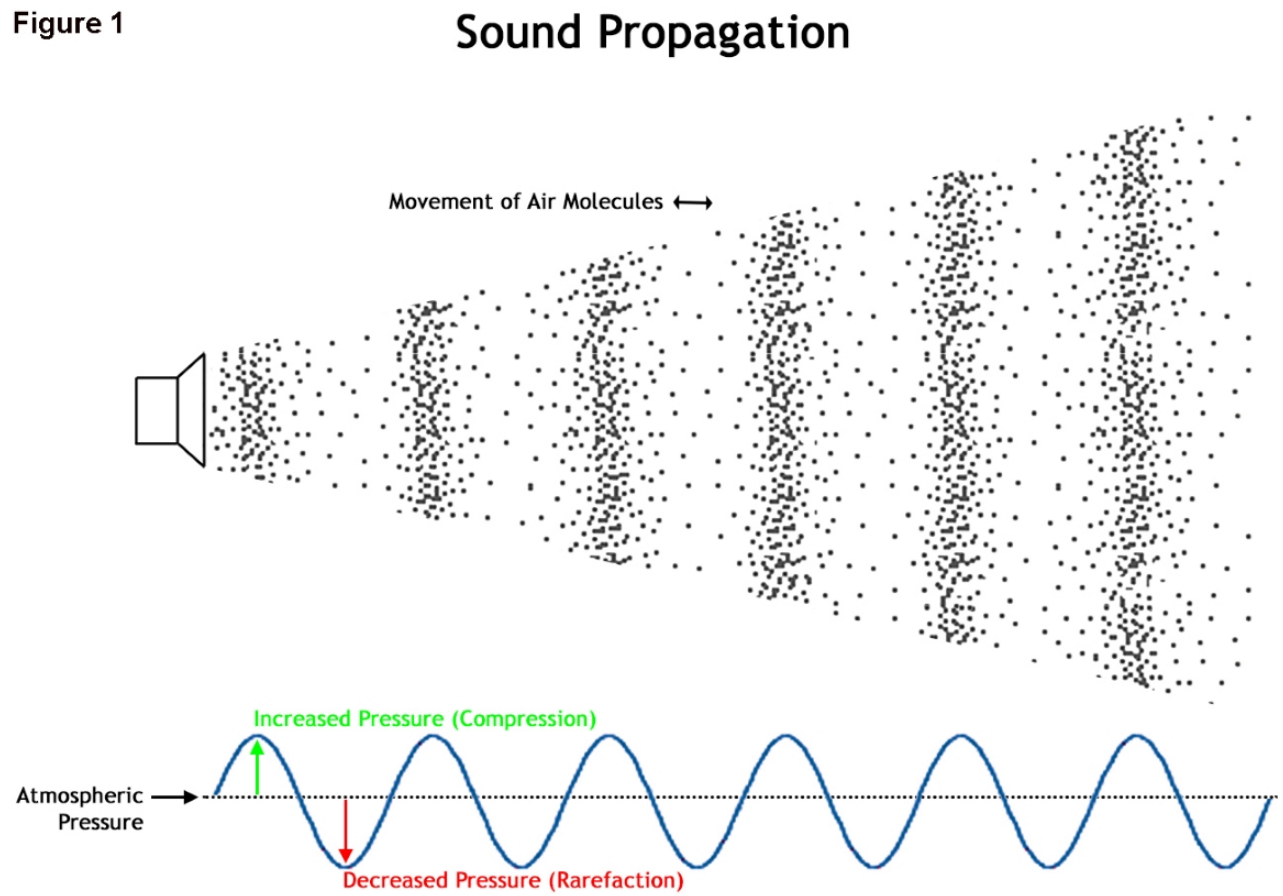
- Cables carry signals from the *output* of one module to the *input* of another module
- Signals may be audio for processing
- Signals may be control voltage used to modify parameters on another module
- Composing or improvising with a modular synthesizer is the act of creating and interacting with patches





What is sound?

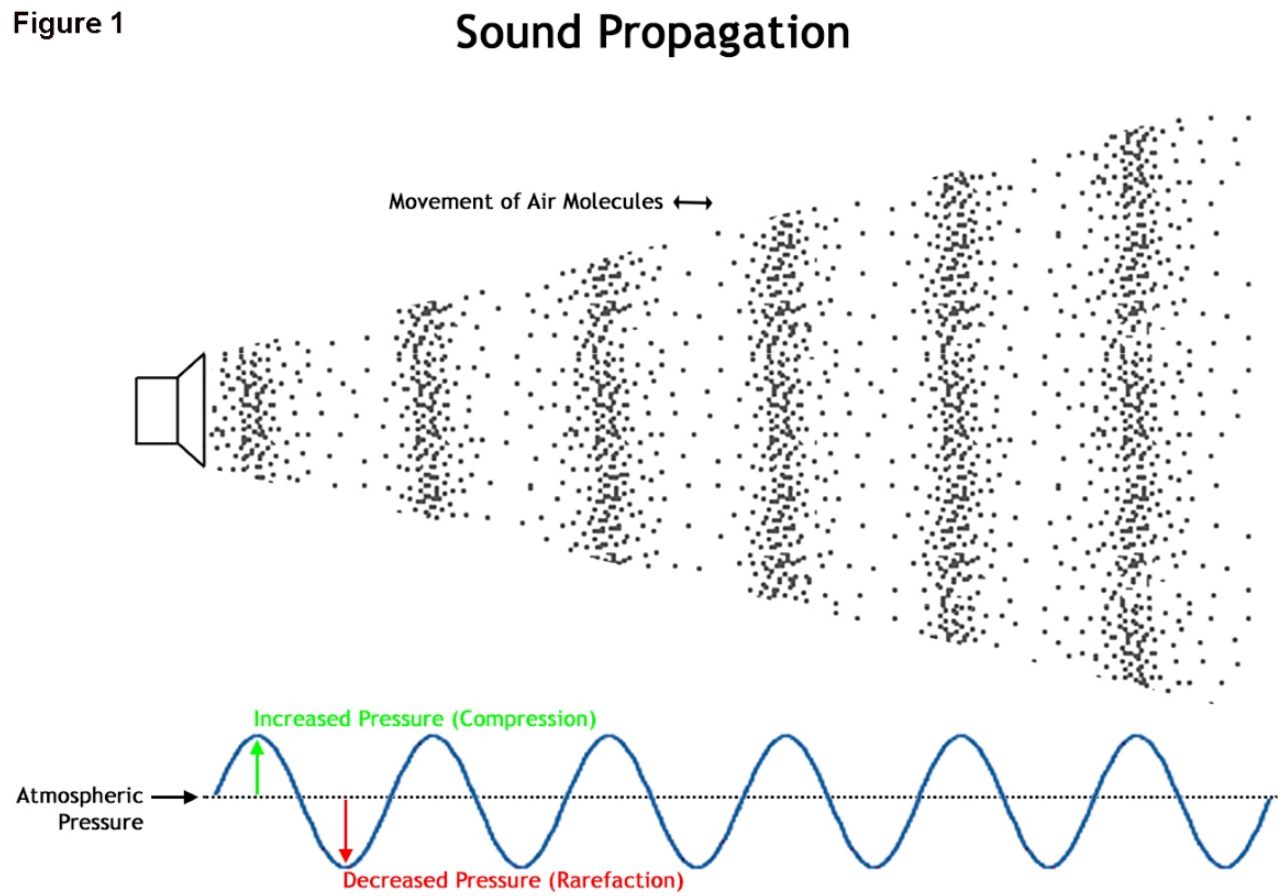
Figure 1



What is sound?

The phenomenon of *Sound* is created by air pressure waves reaching our ears.

Figure 1



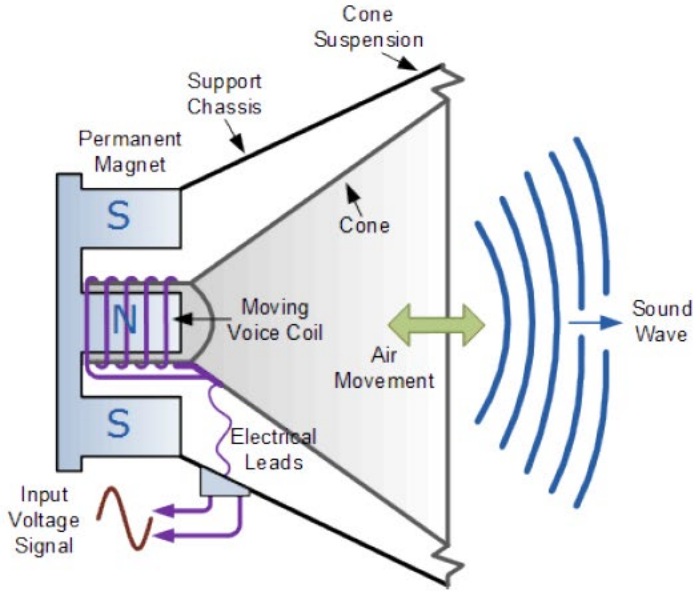
The Physics of Sound

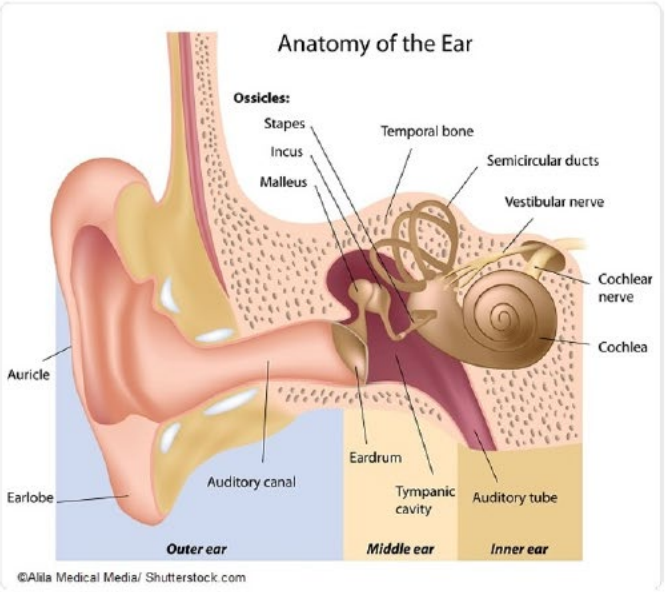
Synthesizers generate the voltage to push the speaker cone, and thus create sound!

Electrical voltages are used to push the speaker cone back and forth.

Speaker cones push air back and forth, creating air pressure waves.

Air pressure waves reach the ear and are heard as sound.





The Parameterization of Sound

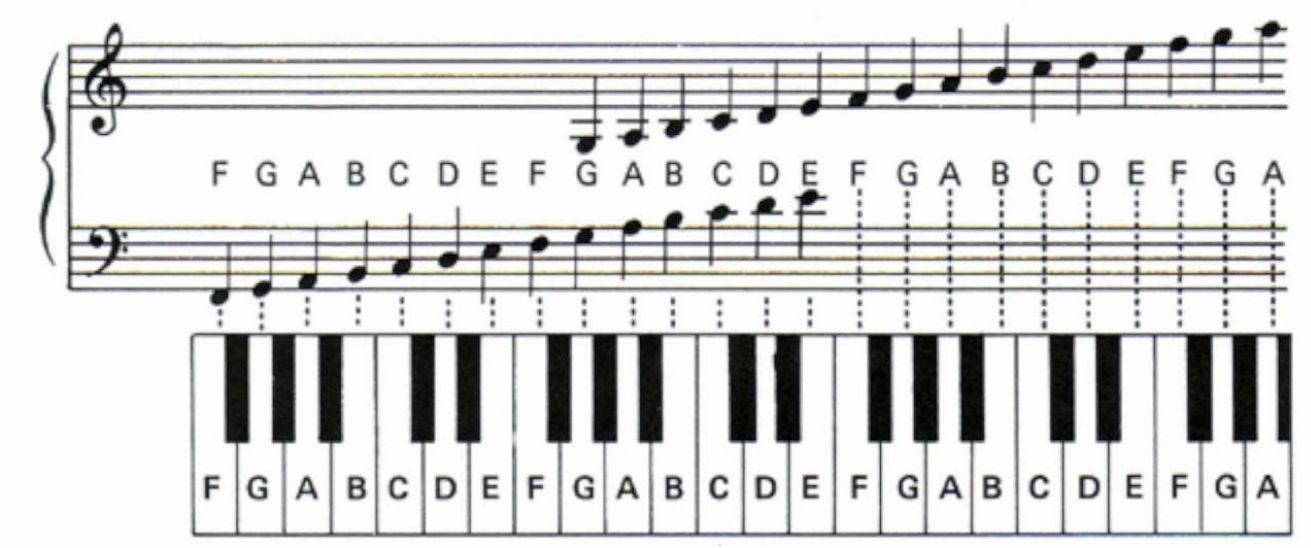
The Parameterization of Sound

Pitch:

How high or low a sound is

Melodies are made out of sequences of different pitches

Harmonies and chords are composed of multiple voices producing different pitches that sound pleasing together



The Parameterization of Sound

Timbre:

The “character” of a sound;

The difference between the same pitch played by two different instruments is their timbre

The Parameterization of Sound

Loudness:

The “intensity” of a sound

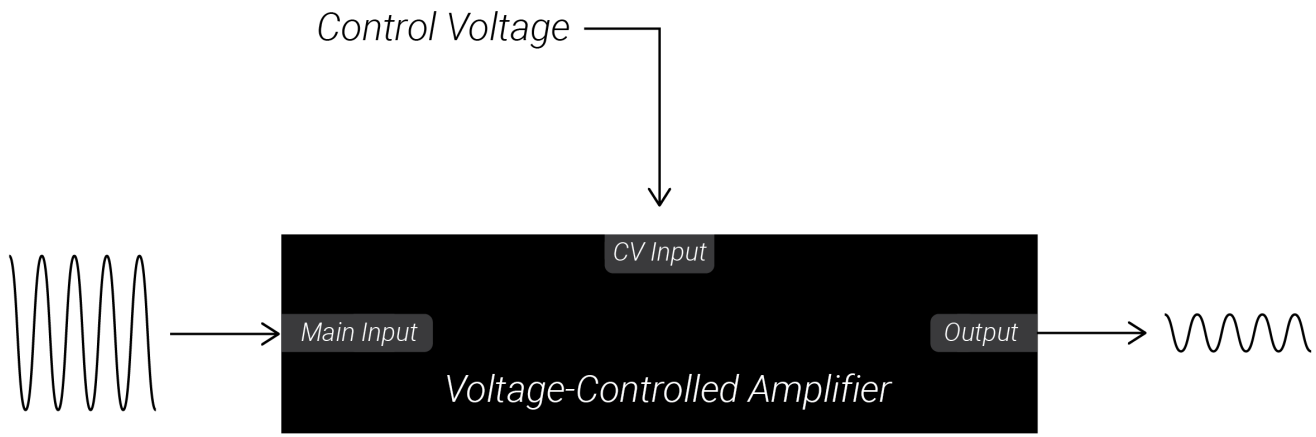
Greater sound pressure waves creates more intense ear drum movement, and a “louder” sound

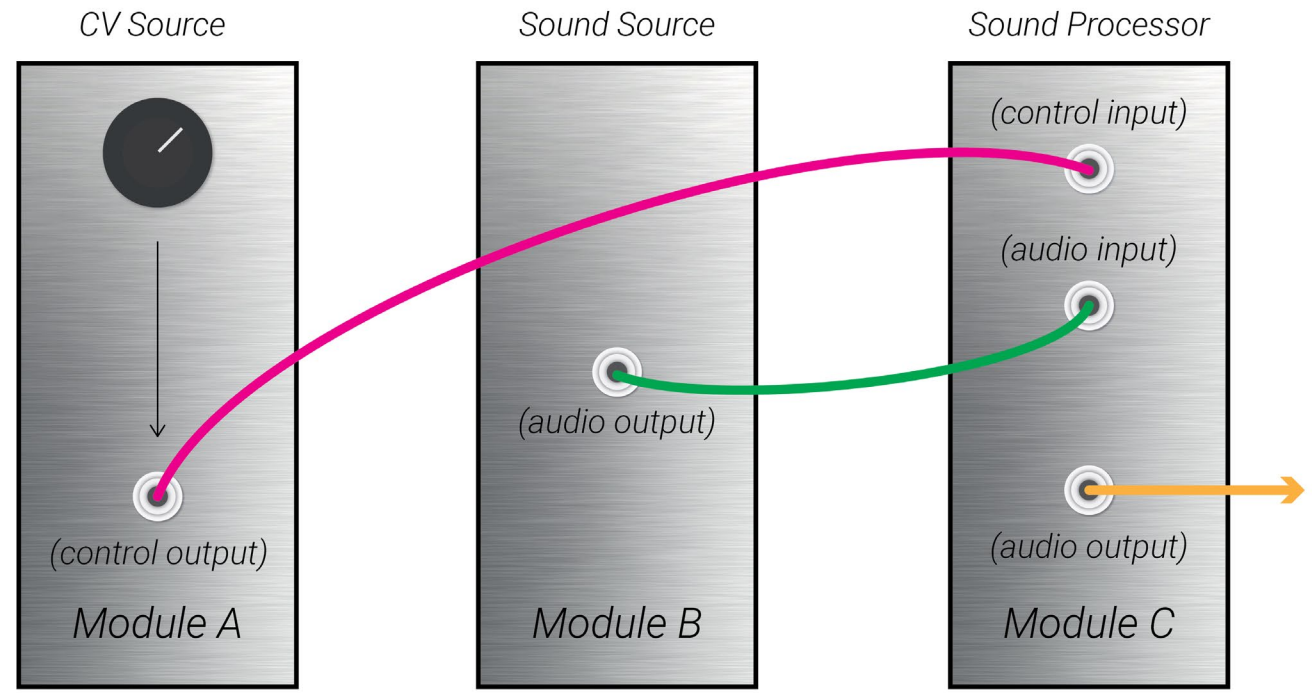
Earbuds can produce sound waves only at a very quiet level, while a line array can play back the same sounds at an enormously louder level

The Parameterization of Sound

Control Voltage/Modulation:

Using a slowly changing or constant signal from one module to change the parameters of another module





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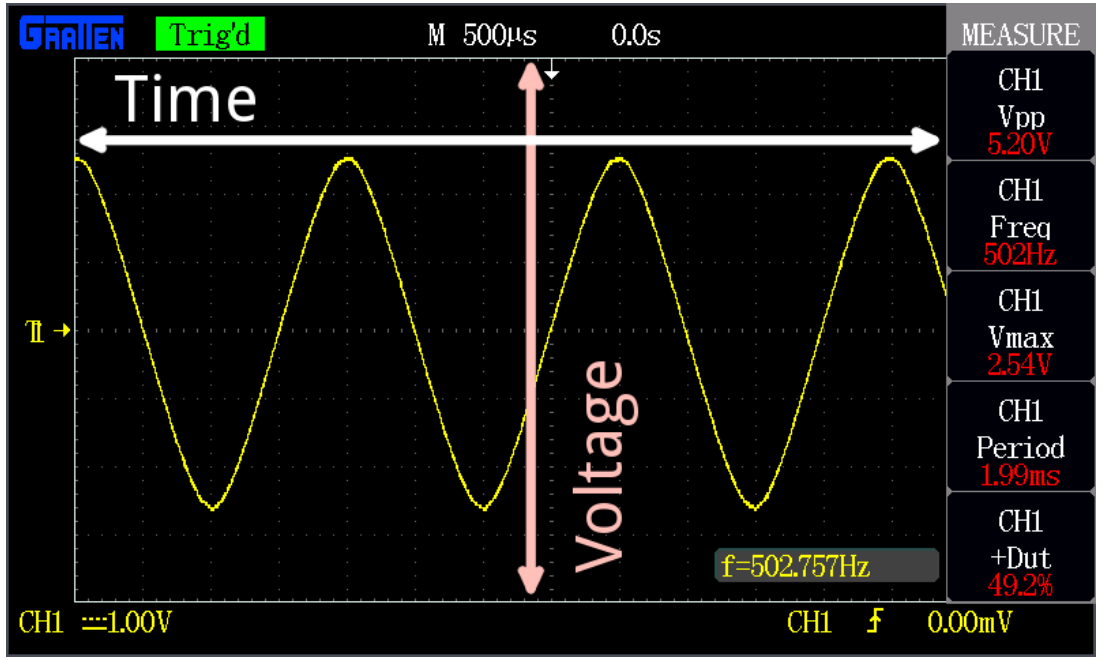
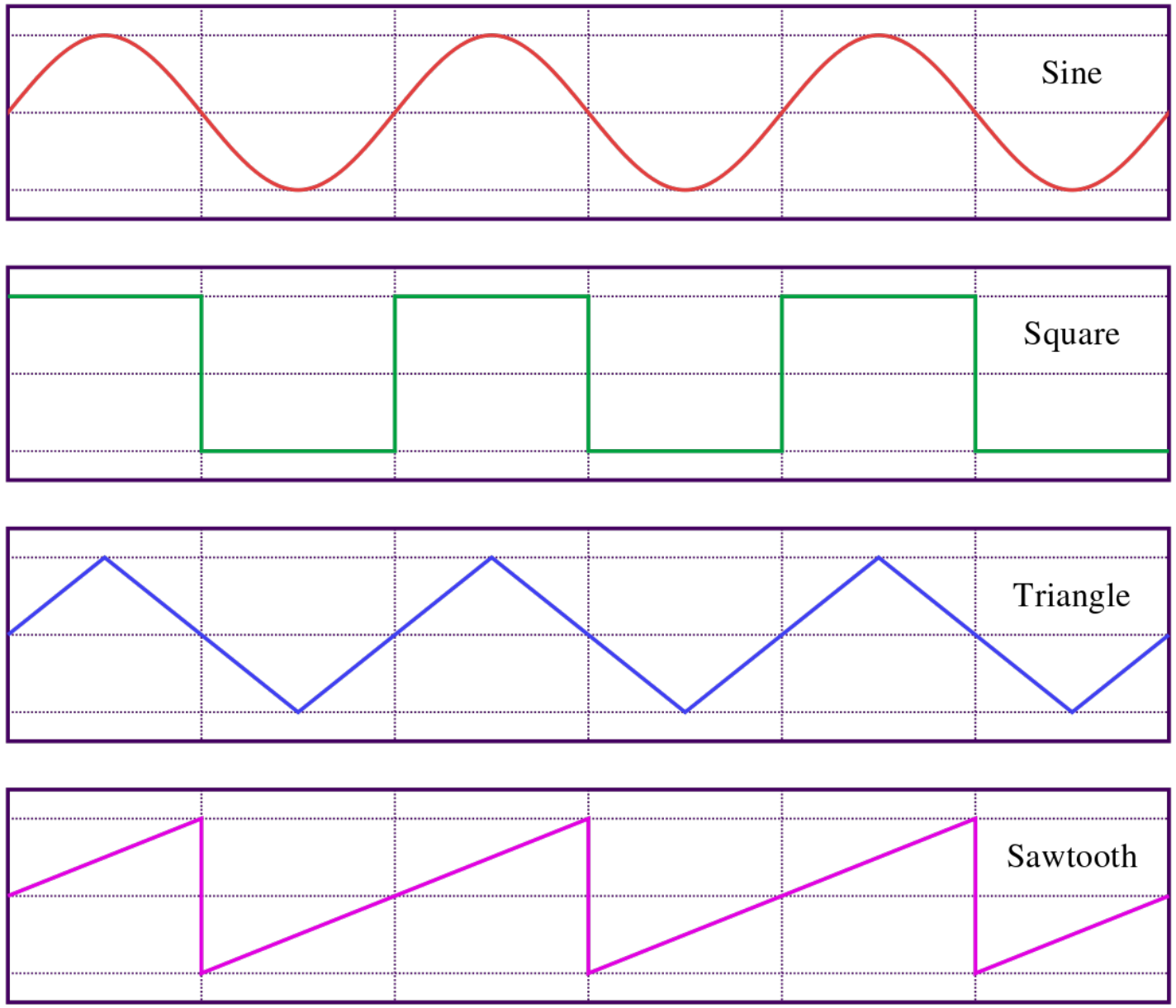


Oscillators

Oscillators create voltages which moves up and down in a pattern.

The shape of the repeating pattern is known as the “waveshape.”



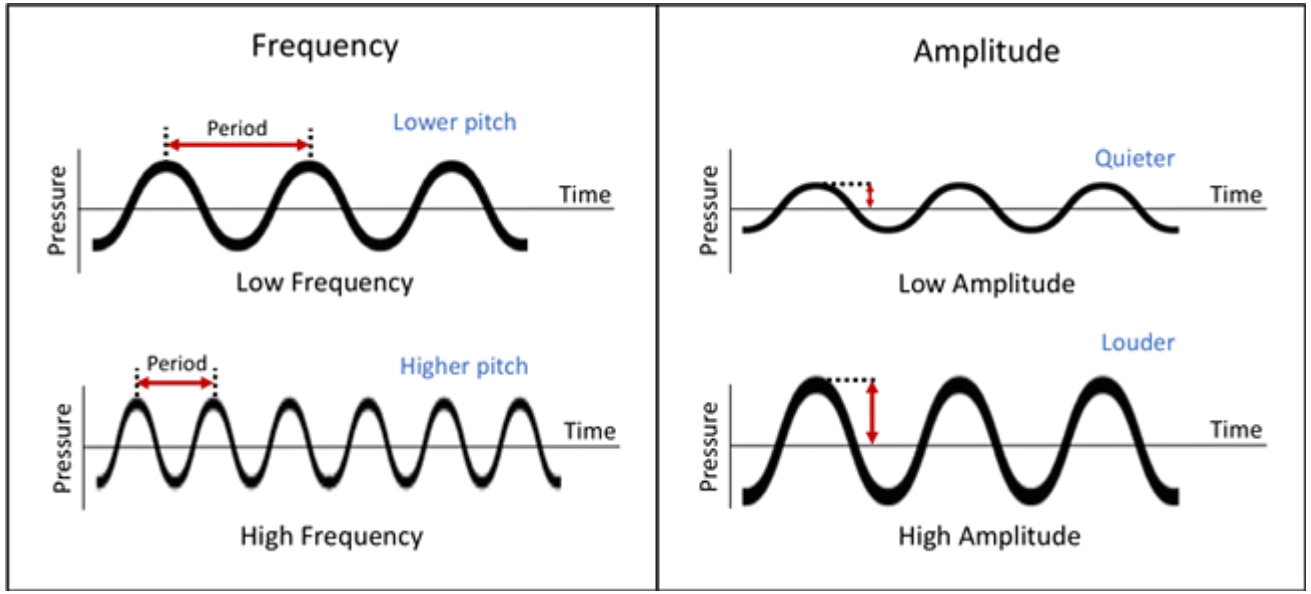
Oscillators

Period: the time it takes to complete one *cycle* of the pattern.

Frequency: the number of cycles completed per second, and is measured in Hertz (Hz)

Hertz (Hz): 1Hz = 1 cycle completed per second

If the frequency is greater than 20Hz, the oscillating voltage can be used to drive a speaker cone back and forth creating pitched sound waves. Higher frequencies correspond to higher pitches.

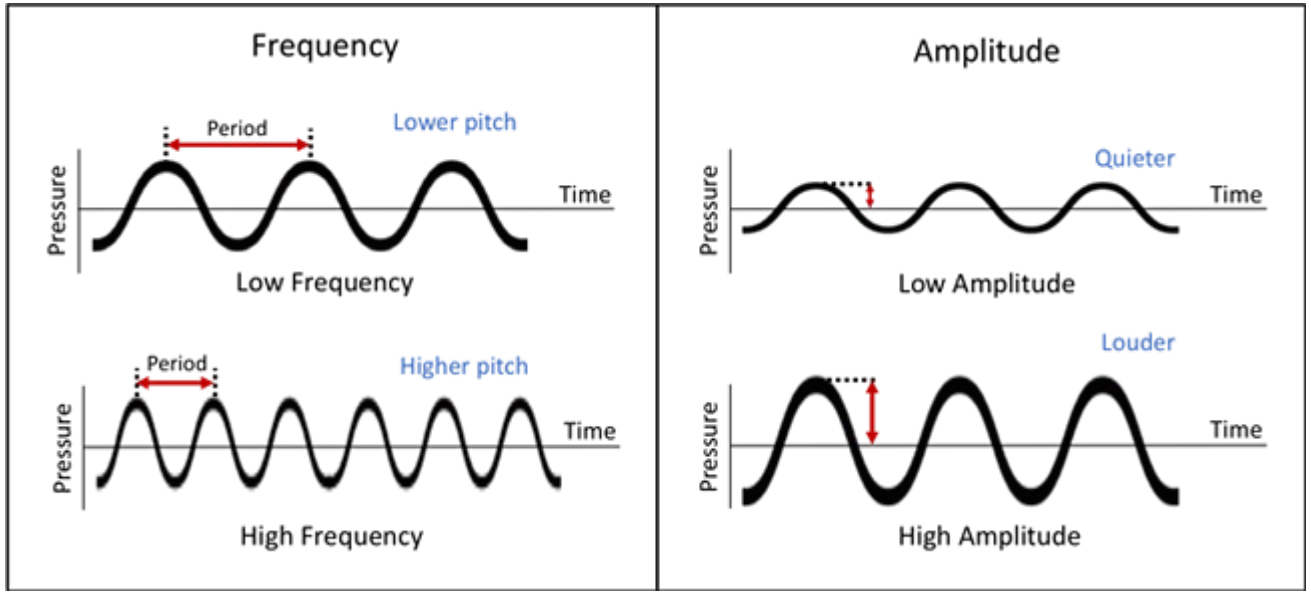


Oscillators

Amplitude: the difference between the largest (peak) and lowest (trough) voltage the oscillation reaches.

Peak-to-peak voltage (Vpp): Voltage difference between peak and trough

For audio-rate oscillations, the amplitude of the oscillation corresponds to its loudness: greater amplitude means louder sound.

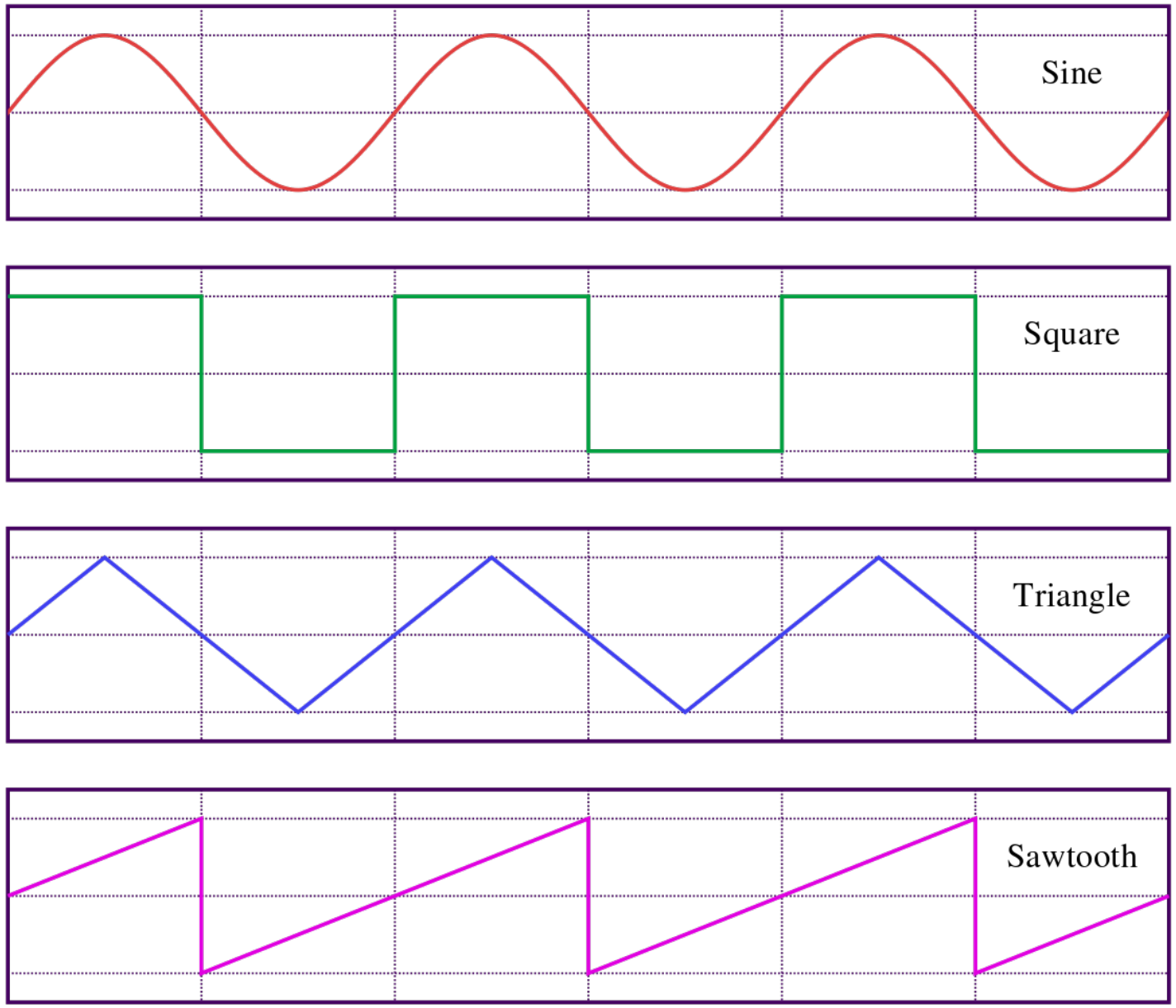


Oscillators

Waveshape: the pattern an oscillator follows as it rises and falls

The waveshape of an audio-rate oscillator determines its timbre.

Sine waves are the “purest”, simplest sound.



VCOs & LFOs

Voltage-controlled Oscillators (VCOs) are oscillators whose frequency can be controlled by external control voltage.

Low-Frequency Oscillators create oscillations which are too slow to be used as sound but can be used instead to controls parameters of another module, like the frequency of another VCO.

Frequency input jacks are often labeled “FM Input” for “frequency modulation.”

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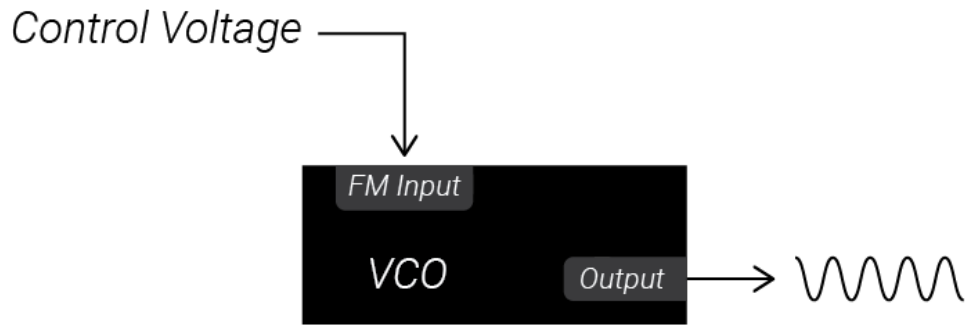

Attenuators, Inverters & Attenuverters

Attenuator: Changes the amplitude of an incoming signal without changing the shape of it in time. Vertically stretches/shrinks a voltage

Inverter: Flips the polarity of an incoming voltage but leaves the magnitude unaffected

Attenuverters: Similar to an attenuator, but it can also invert voltages before attenuating them.

Attenuators and Attenuverters generally scale the incoming voltage proportionally to the knob position. This allows us to control the depth of modulation by a given control voltage signal.

<scope placeholder>

VCAs

Voltage-Controlled Amplifiers: Similar to attenuators, but instead of using a knob to set the attenuation, a VCA checks its control voltage input to set the attenuation of another incoming signal. The higher the control voltage input, the greater the amplitude of the signal output.

VCAs can be used to control the volume of an audio signal.

VCAs can also be used to control the modulation depth of another CV signal.

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