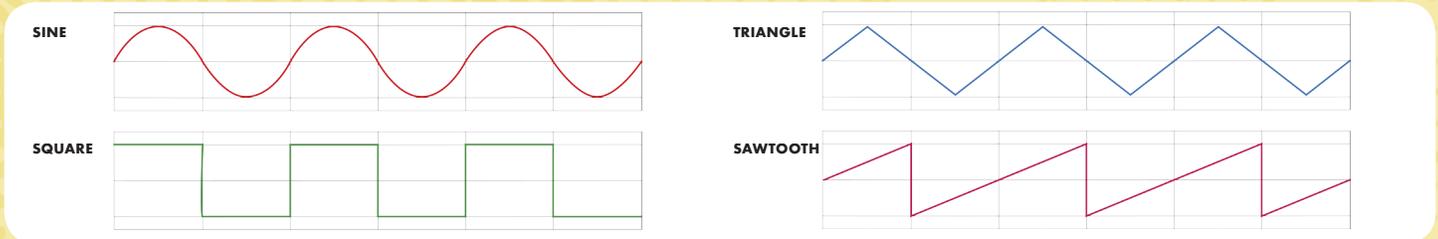


# Synthesizer Basics

## WAVEFORMS + OSCILLATORS

Sound waves are vibrations in the air. The shape of these vibrations can be represented visually as *waveforms*. Synthesizers often use just a few simple waveforms: sine, square, triangle, and sawtooth. Each has a distinctive sound.

In synthesizers, sound waves are produced by electronic *oscillators*. These oscillators have a selector for waveforms and a control for pitch/frequency. The sound can also be changed in other ways via modulation.



## FILTERS

A musical pitch is made up of the note you hear and a lot of other notes you don't hear, called *harmonics*, which give a sound its unique tone color.

A *filter* selectively removes or accentuates some of the harmonics in the oscillator's sound, changing the tone color.

## ENVELOPE

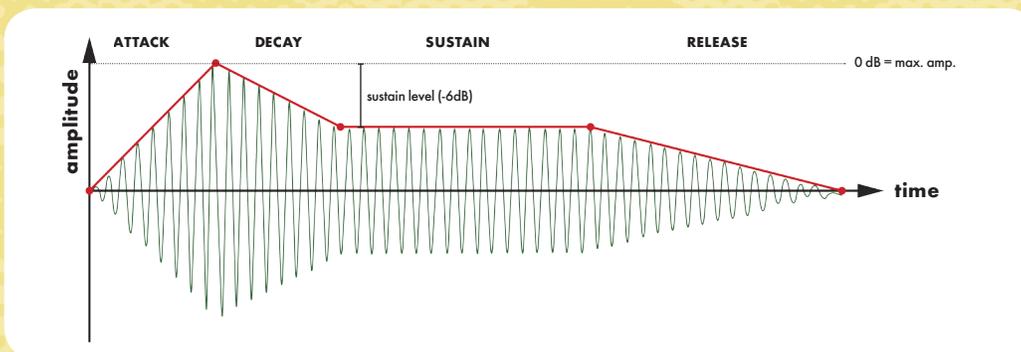
The envelope is the shape of a sound over time. Changing the envelope can make a synthesizer's sound fast and sharp or long and sustained. The envelope is divided into four parts: *attack*, *decay*, *sustain*, and *release*.

**ATTACK** controls how long it takes for the sound to reach its maximum volume after the note starts.

**DECAY** controls how long it takes for the sound to dip from its maximum down to its normal sustain level.

**SUSTAIN** sets the standard volume of the note as it's held.

**RELEASE** controls how long it takes for the sound to reach silence after the note ends.



## L.F.O.

An LFO, or *low-frequency oscillator*, is a very low-pitched oscillator, often below the range of human hearing. It can be used to introduce a slow fluctuation into a synthesizer's sound. LFOs are used to gradually change or *modulate* the pitch, tone color, or volume of the note. On a synthesizer with one or more LFOs, there are controls that let you

choose which characteristic to modulate and how quickly to modulate.

For more information about synthesizers, watch *I Dream of Wires* (DVD 786.7 I), and make sure to check out the synths in the AADL's Tools collection!

## RECOMMENDED CDs

The Art of the Theremin, by Clara Rockmore (CD Electronic Rockmore Art)  
Switched-On Bach: Virtuoso Electronic Performances of J.S. Bach (CD Electronic Bach Switched 2001)  
Trans-Europe Express, by Kraftwerk (CD Electronic Kraftwerk Trans)  
Computer Controlled Electronic Instruments pt2, by Aphex Twin (CD Electronic Aphex Computer)

Three Willow Park: Electronic Music from Inner Space 1961-1971, by Raymond Scott (CD Electronic Scott Three Oversize)  
Silver Apples of the Moon : The Wild Bull, by Morton Subotnick (CD Electronic Subotnick Silver)  
Ambient 1 : Music for Airports, by Brian Eno, the last track (CD Electronic Eno Ambient)  
Forbidden Planet : Electronic Music, by Louis and Bebe Barron (CD Soundtracks Forbidden)

# A Brief History of Synthesizers

## EARLY SYNTHESIZERS

1896

Thaddeus Cahill (US) patents the Telharmonium, a 200-ton electronic instrument driven by 12 steam-powered generators. It produces multiple sounds at once using pressure-sensitive keys, features not matched in synthesizers until the 1970s.

1919

Leon Theremin (Russia) invents the theremin, which generates sound using the movements of the player's hands through an electrostatic field between two antennae.

1920s

Inventors in France and elsewhere build a variety of electronic instruments including the Ondes Martenot, the Trautonium, the Mixturtrautonium, and the Electronic Sackbut.



## MODULAR SYNTHESIZERS

1964

Robert "Bob" Moog (US) collaborates with Herbert Deutsch (Germany) to combine an oscillator and amplifier module with a keyboard, the first prototype of a voltage-controlled synthesizer.

1966

Donald Buchla (US) independently develops his own modular, voltage-controlled synthesizers. His synthesizers never become as well known as Moog's outside of avant-garde music circles.

1968

Wendy Carlos (US) releases the album *Switched-On Bach*, an all-electronic classical album featuring Moog's synthesizers. The album makes Moog's name famous.

1970

Moog and his team release the Minimoog Model D, a compact, portable, and affordable synth marketed to the public.

1975

1976

1978

The Polymoog is released, the first commercially available synthesizer that can produce multiple notes at once (polyphony).

The Synclavier, the first completely digital synthesizer, is introduced by New England Digital Corporation. Because of the cost, it never gains widespread success.

Sequential Circuits company creates the Prophet-5, a fusion of digital and analog technology. Despite its high price, 8,000 are produced from 1978-1985.

1989

Modern computer sound cards are introduced. Sound production and processing with computers begins to replace standalone synthesizers.

1996

Dieter Doepfer (Germany) releases the A-100 Analog Modular System, which employs a unique enclosure system known as the Eurorack standard. The Eurorack DIY modular synth building system has seen a surge in popularity in the last decades, with enthusiasts collecting, building, and attaching a variety of modules to make their own setups.

## DIGITAL SYNTHESIZERS & BEYOND