

Sound Waves

What are they?

Technology

How do we make it?

Euro rack DIY

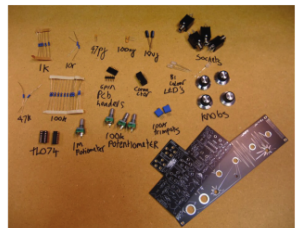
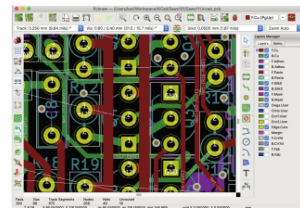
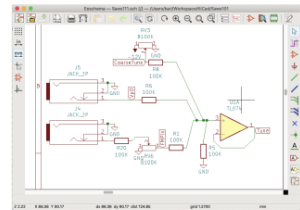
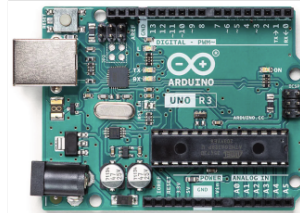
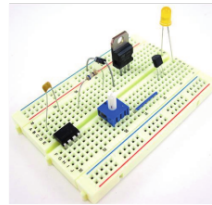
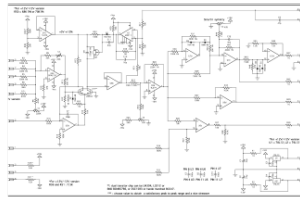
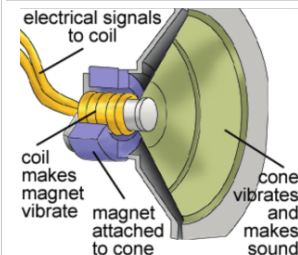
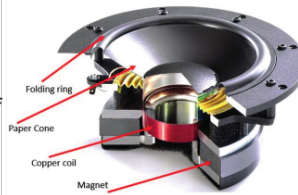
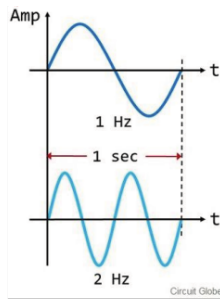
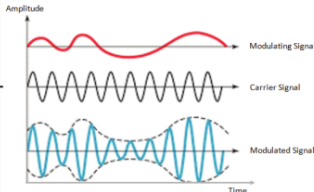
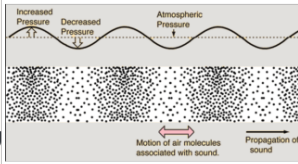
hand-crafted electronic music
Presented by Karl D. Stamm, Ph.D.
www.karltron.com

Sound is a pressure wave which is created by a vibrating object. This vibrations set particles in the surrounding medium in motion, transporting energy through the air. Our ears detect the vibrations as sound.

Amplitude is the volume or scale of a wave, the amount of motion the air particles travel is related to the power used.

Frequency of a wave is the number of complete back-and-forth vibrations per unit of time. We perceive frequency as the pitch of a sound; with 'middle C' at 256 waves per second, or Hertz. The range of human hearing is about 20 Hz through 20,000 Hz. While a pure tone has one frequency, complex sound will have various amplitudes at every frequency. At the extreme, white noise is a sound with equal power at every frequency.

The Speaker is a device that converts an electrical audio signal into a sound. The driver is a linear motor attached to a diaphragm which couples that motor's movement to motion of air. An audio signal must be amplified to a power level capable of driving that motor. When the electrical current from an audio signal passes through the voice coil a permanent magnet is forced to move rapidly back and forth due to induction; this attaches to a speaker cone in contact with air, creating sound waves.



Open source designs and shared schematics are available online, for free.

Schematics are arrangements of parts carefully diagrammed. Parts configurations are like math and cannot be copyrighted. A particular image or printing is copyrighted, and the image at left belongs to Yves Usson of Ysynth but the same arrangement of parts is free for us to build upon.

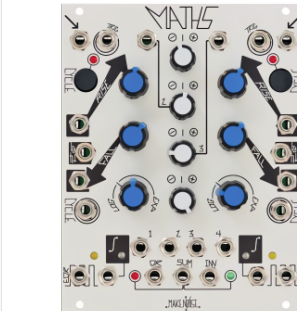
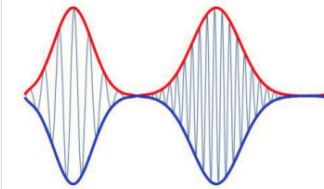
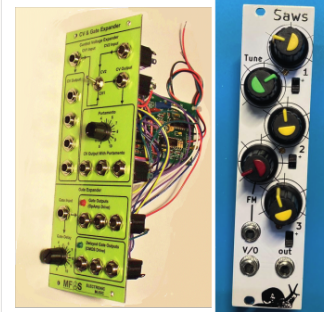
Breadboards are grids of holes for easily and quickly prototyping circuits.

PCB is the printed circuit board. All modern circuits are made on printed boards, allowing for electrical paths that are intricately detailed and layered. Computer aided drafting is required for high density arrangements.

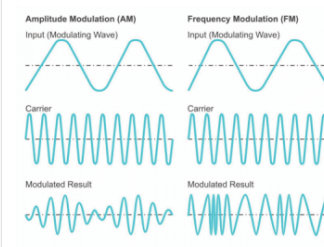
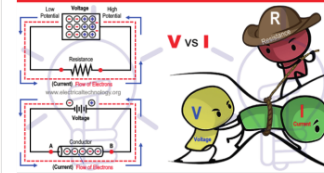
KiCad is a free software for drawing your own schematics and PCBs. CAD software takes a little while to learn, because there are many buttons and tools required.

Manufacturing PCBs can be done at home with a mill or etching acid, but is now available from international factories for only a few dollars, plus shipping.

Parts you can buy online at various electronics retailers. Passives like resistors, capacitors and connectors cost only pennies, but there may be hours of work to find the right parts at an industrial supplier like Mouser or DigiKey. You could buy a kit including just what you need from synth DIY vendors like Think or ModularAddict. Add a soldering iron and you can put together a module in an evening, or a synthesizer in a week.



Difference between CURRENT & VOLTAGE



Modular Synthesizers are like normal musical synthesizers but inside out, so the components and audio path are interchangeable. A basic synth has several vital modules inside, on a modular you can have a different brand for each one, and create a unique instrument.

Oscillator is the core noise maker, a Voltage Controlled Oscillator makes a tone based on the voltage it is given.

Amplifier controls the volume, so a Voltage Controlled Amplifier lets you automatically vary the volume, creating separate notes.

The envelope generator makes shapes that can specify the shape of a sound, like a slowly rising swell, or a sharp snappy drum. Trigger generators or rhythm generators can drive the synth to play sequences.

More than 11 thousand unique modules are described on the wiki modulargrid.com

Voltage is the measure of electrical potential, and because it drives a speaker so directly, voltage becomes equivalent to sound. Using electrical control we can manipulate signals and produce any sound.

Modulation is the process of changing something, amplitude modulation changes the amplitude, and frequency modulation changes the frequency. Multiplying one signal by another can create new interesting tones.

Artists

Who uses it?



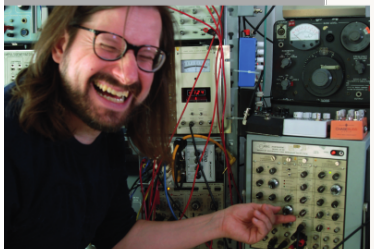
Hans Zimmer is a film score composer and record producer. His works are notable for integrating electronic music sounds with traditional orchestral arrangements. Since the 1980s, he has composed music for over 150 films and received four Grammy Awards, two Golden Globes, and an Academy Award.



Deadmau5 is a Canadian electronic music producer, DJ, and musician. He produces progressive house music and has six Grammy Award nominations for his work.



Radiohead are an English rock band formed in 1985. Their experimental approach is credited with advancing the sound of alternative rock. Rolling Stone named Radiohead one of the 100 greatest artists of all time.



Hainbach is an electronic music composer and performer from Berlin, creating shifting audio landscapes. He searches for 'the sounds in between' on modular synths, tape and test equipment. Through his YouTube channel Hainbach brings experimental music techniques to a wider audience. Using antique electronics not intended for musical use gives him a unique sound.

Eurorack DIY

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Sam Battle is a musician and hardware hacker, operating a Youtube channel as **Look Mum No Computer**, where he demonstrates circuit bending, hardware hacking, and music production with otherwise obsolete equipment. His philosophy of 'Don't be scared to try it' was the inspiration for much of my work here.



He is known for the Furby Organ, where dozens of simple, familiar robots sing in horror or harmony.



Robert Moog was an American engineering physicist and pioneer of electronic music. He was the inventor of the first commercial synthesizer in 1964.



Moog created fundamental synthesizer concepts such as voltage control, the pitch wheel, modularity, and envelope generation. He is credited for helping bring synthesizers to a wider audience and influencing the development of popular music.

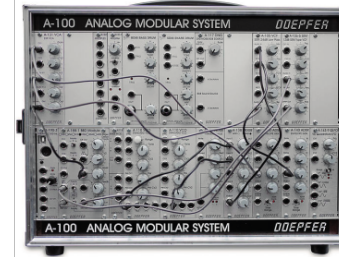


Dieter Doepfer is, if any one person can be responsible for modern modular synthesis. With the invention and publication of the **Eurorack** open standard for his own company's A-100 system in 1995, Doepfer paved the way for others to start producing an array of compatible modules.



Invention

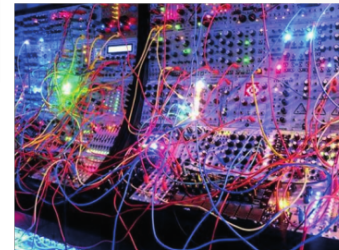
What is it?



Eurorack is a modular synthesizer format originally specified in 1995 by Doepfer Musikelektronik. It has become the dominant format, with over 9000 modules available from more than 300 manufacturers ranging from boutique independent designers to well-known synth mass-manufacturers like Moog and Roland.



Its compact size, 3.5mm mono jacks and cables for **all signals**, and lack of a single aesthetic defned by one manufacturer sets Eurorack apart from other formats.



Make Noise is the largest American eurorack manufacturer. It was founded in 2008 by Tony Rolando, a self-taught electronic musical instrument designer who got started by reading amateur radio books at the public library, building electronics for artists, working for Moog Music, and playing in bands for many years.



Their crew in Asheville, NC, works to design and build strange and thoughtful synthesizers. They see their instruments as a collaboration with musicians who create once in a lifetime performances that push boundaries.



"Also, we think what we do is fun and we hope you like it, too."

for more information
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Brochure for MakerFaire
Milwaukee 2022
October 21-23, 2022