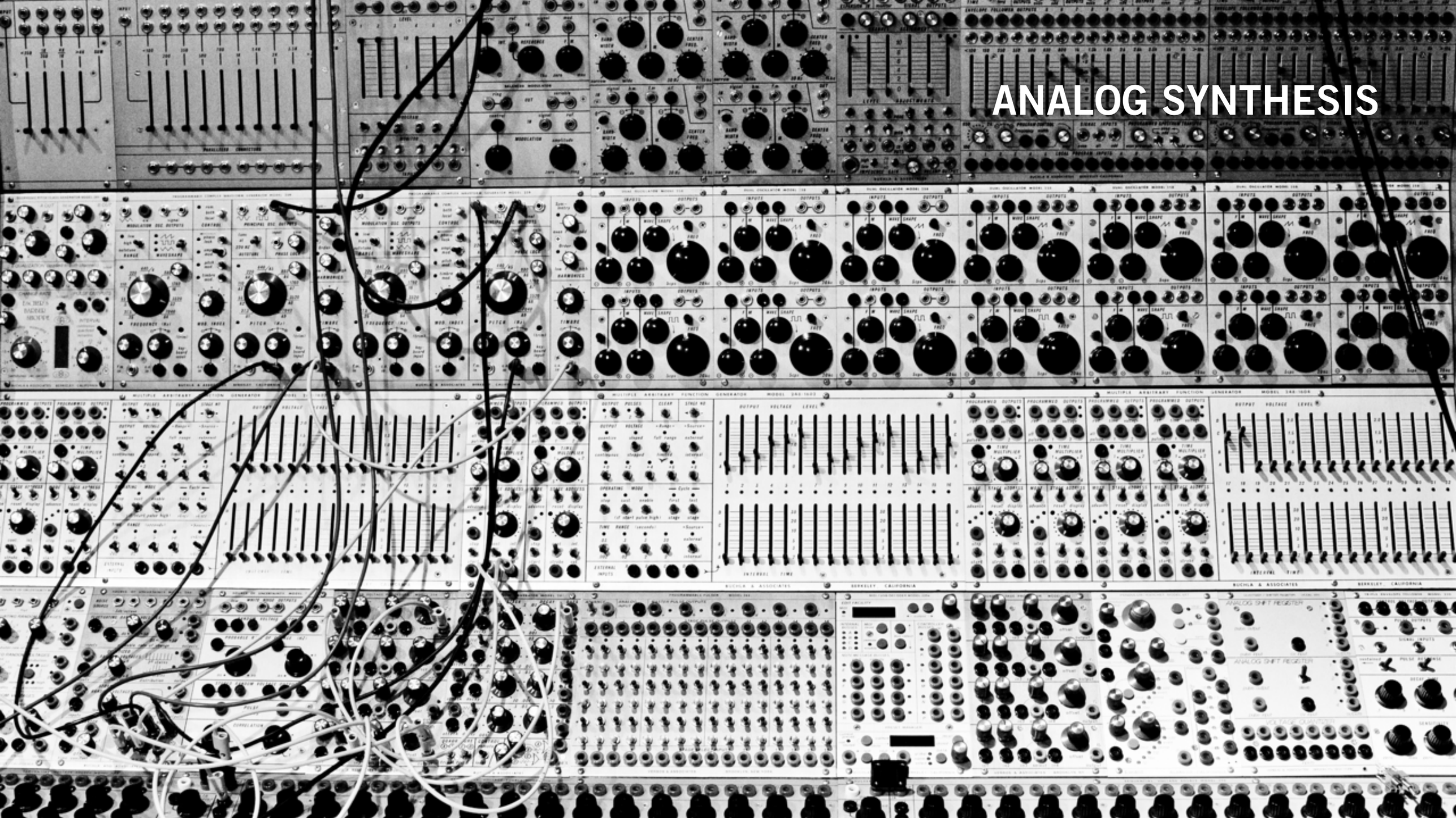

ANALOG SYNTHESIS

SYNTHESIZER HISTORY (REVIEW)

1897 Telharmonium (Thaddeus Cahill)

1919 Theremin (Leon Theremin)

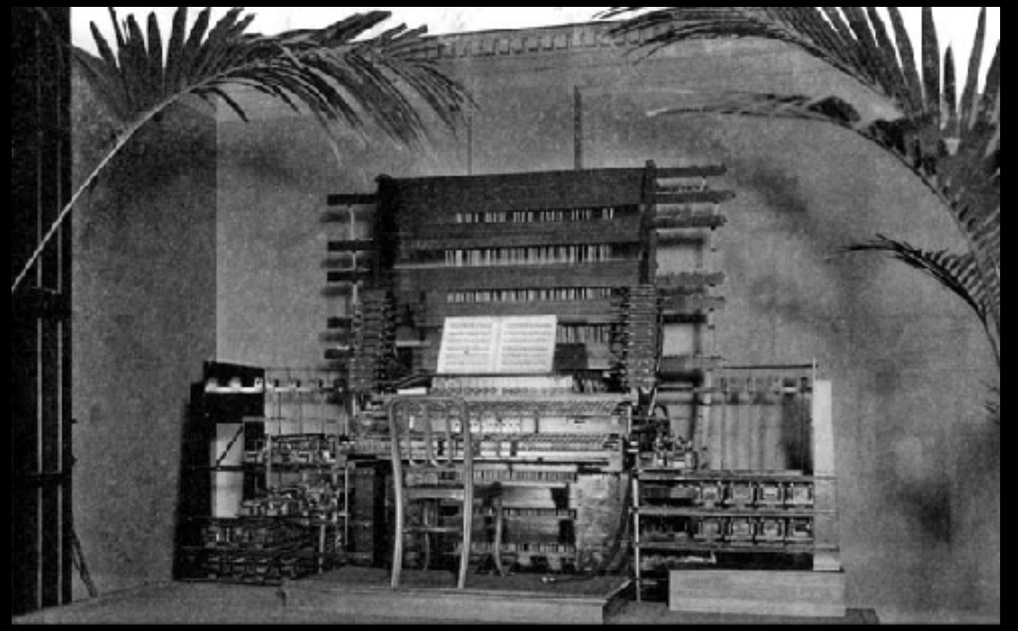
1928 Ondes Martenot (Maurice Martenot)

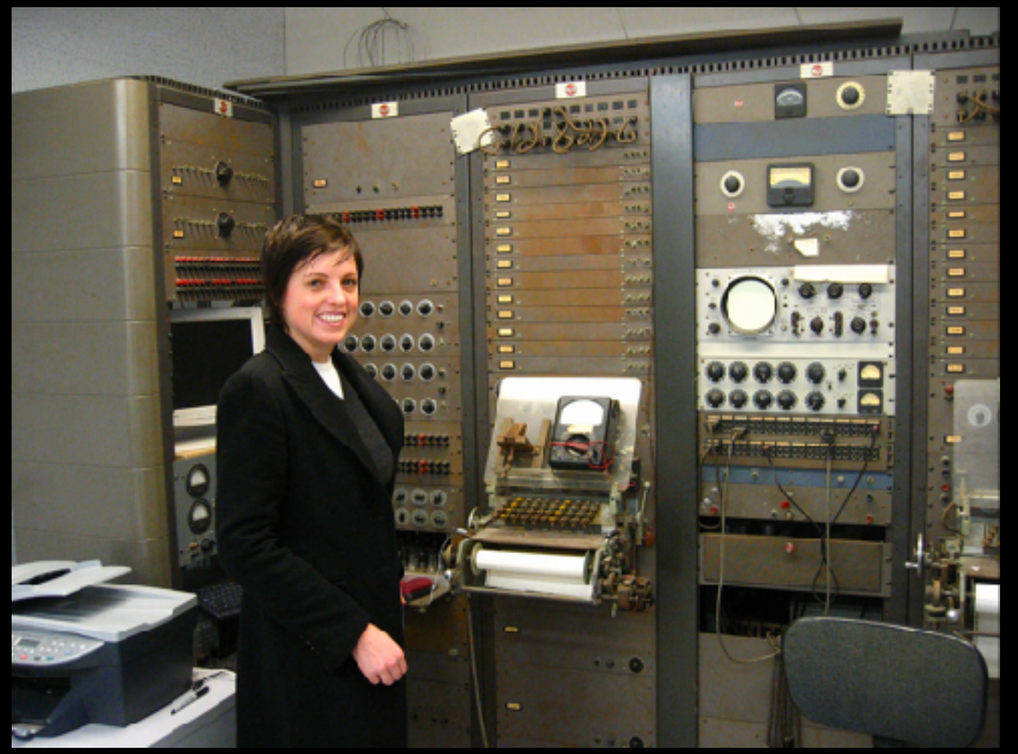
1930 Trautonium (Trautwein)

1935 Hammond Organ (Laurens Hammond)

1945 Electronic Sackbut (Hugh Le Caine)

1956 RCA Mark I & II (Olson and Belar)





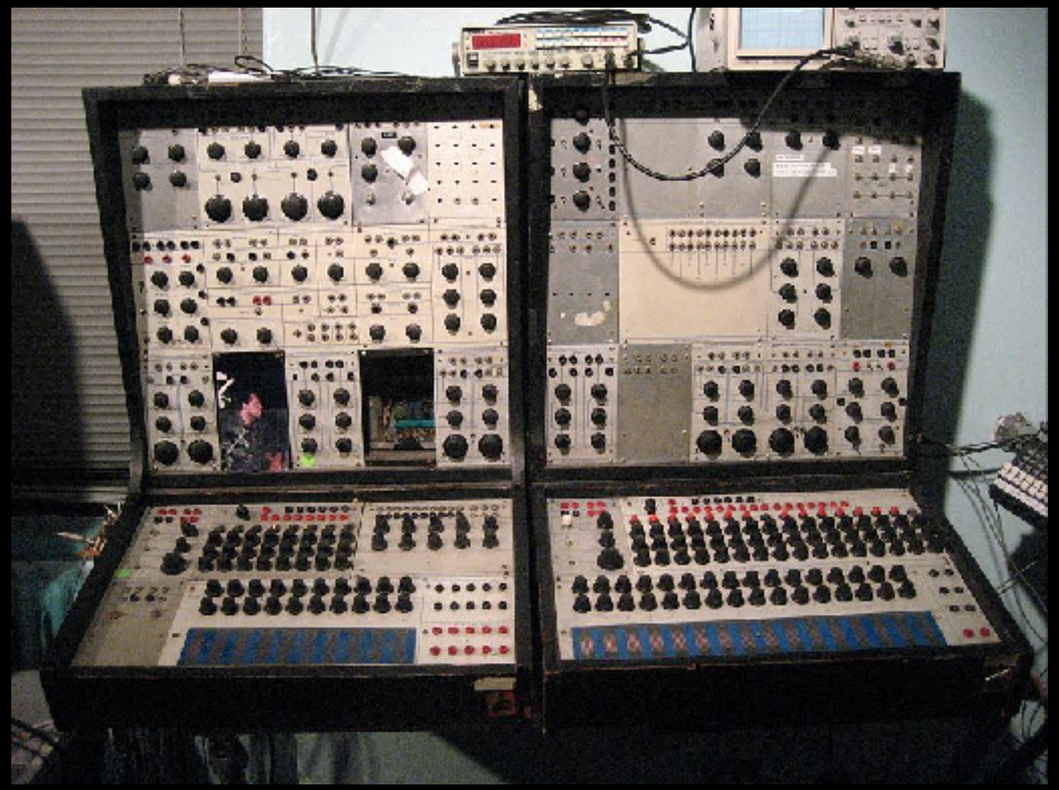
Types of Synthesis

Additive Synthesis
Combining sine waves to make more complex waveforms.

Subtractive Synthesis
Removing some part of the sound spectrum through filtering.

Modulation
Amplitude Modulation (AM Synthesis, Ring Modulation)
Frequency Modulation (FM Synthesis)

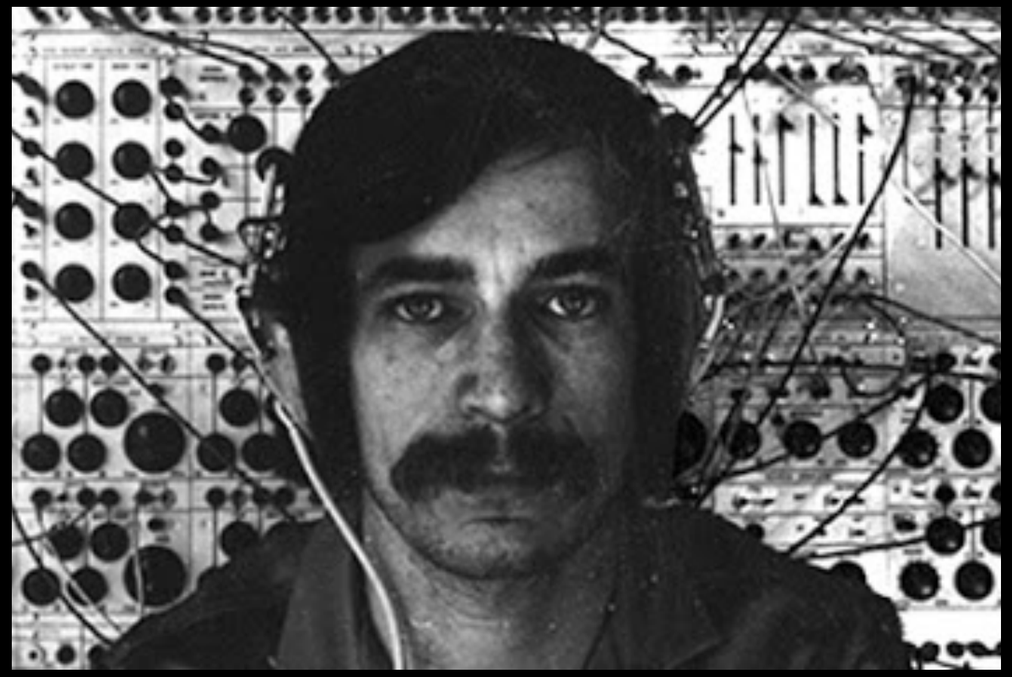
Granular Synthesis
taking short snippets (grains) of sound and building flexible tones and textures that take on qualities of the source sound.



The modular design allowed each unit to be custom made and reconfigurable.

Donald Buchla

West Coast



Robert Moog

East Coast

Voltage Control

an electronic communication paradigm

automation

musical system more than an instrument

Buchla 200

Modules

Independent modules connected by patch cables

Moog developed general standards for synthesizer voltages including logarithmic 1-volt-per-octave pitch control and a standard for triggering pulses.

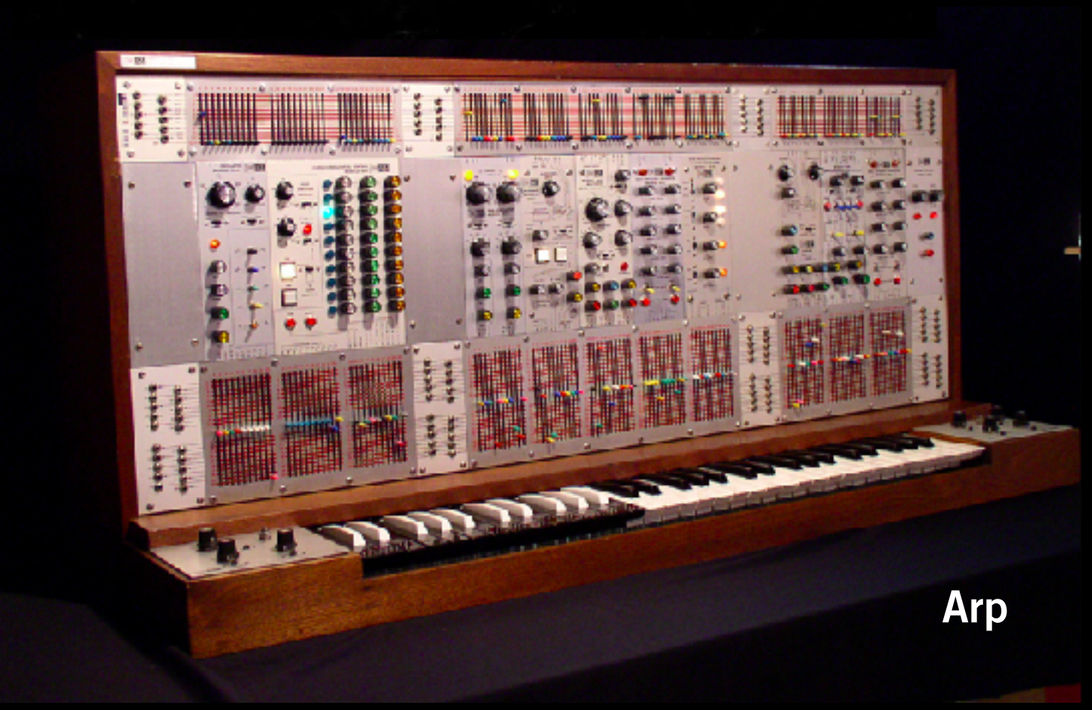
Generally (at least initially) monophonic

MOOG MODULAR

Moog

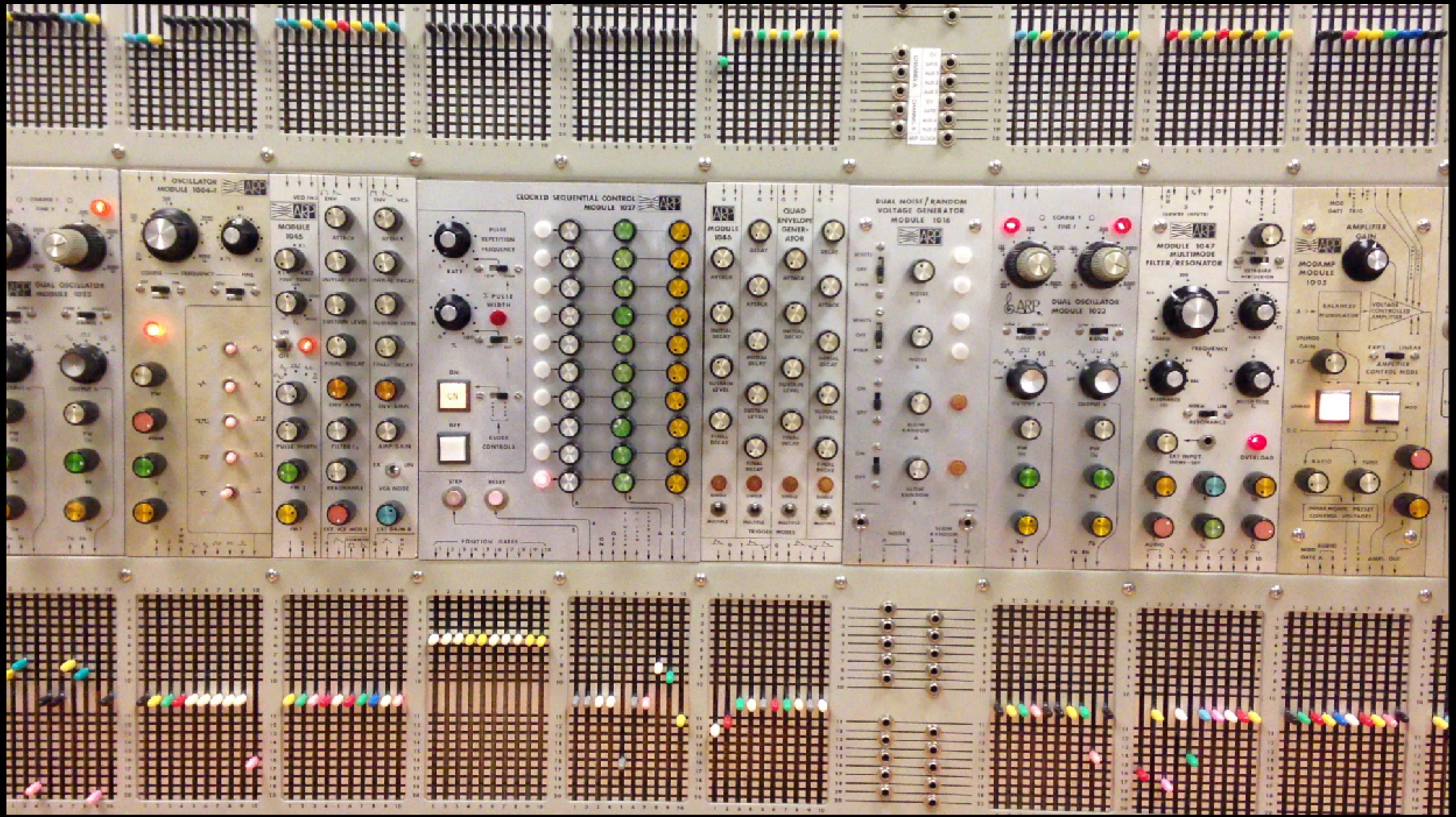
4 Companies

EMS



Arp

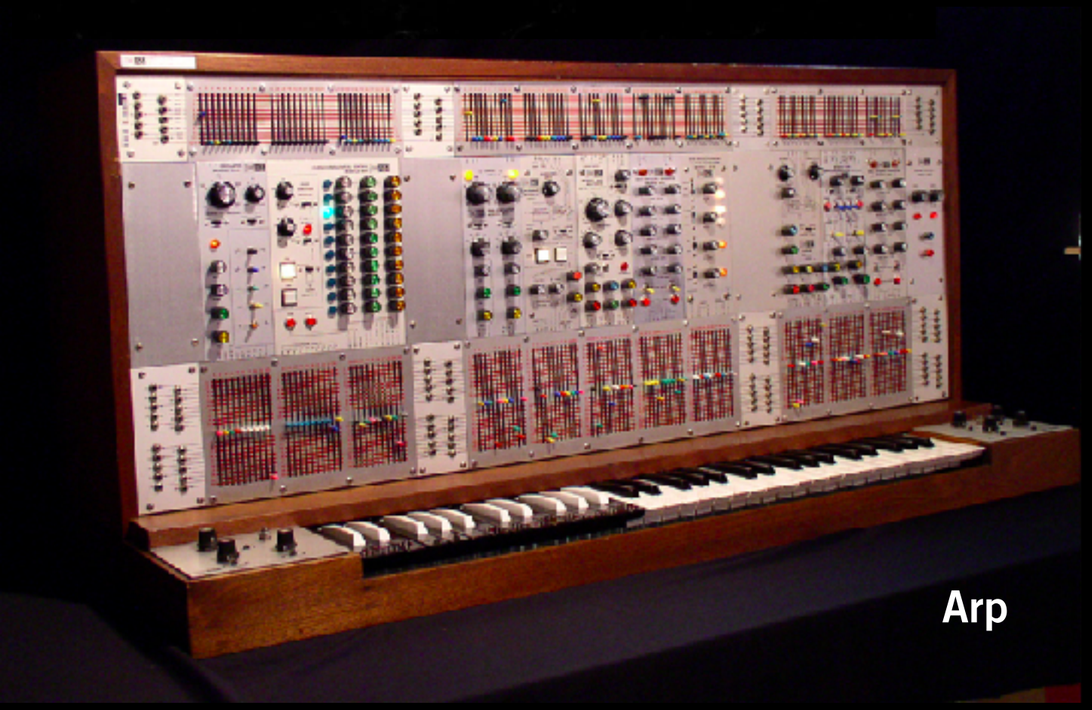
Buchla


OSCILLATOR
MODULE 1004-I
DUAL OSCILLATOR
MODULE 1023
MODULE
1045
CLOCKED SEQUENTIAL CONTROL
MODULE 1027
MODULE
1046
QUAD
ENVELOPE
GENER-
ATOR
DUAL NOISE / RANDOM
VOLTAGE GENERATOR
MODULE 1016
MODULE 1047
MULTIMODE
FILTER/RESONATOR
MODAMP
MODULE
1005
AMPLIFIER
GAIN

Moog

4 Companies

EMS



Arp

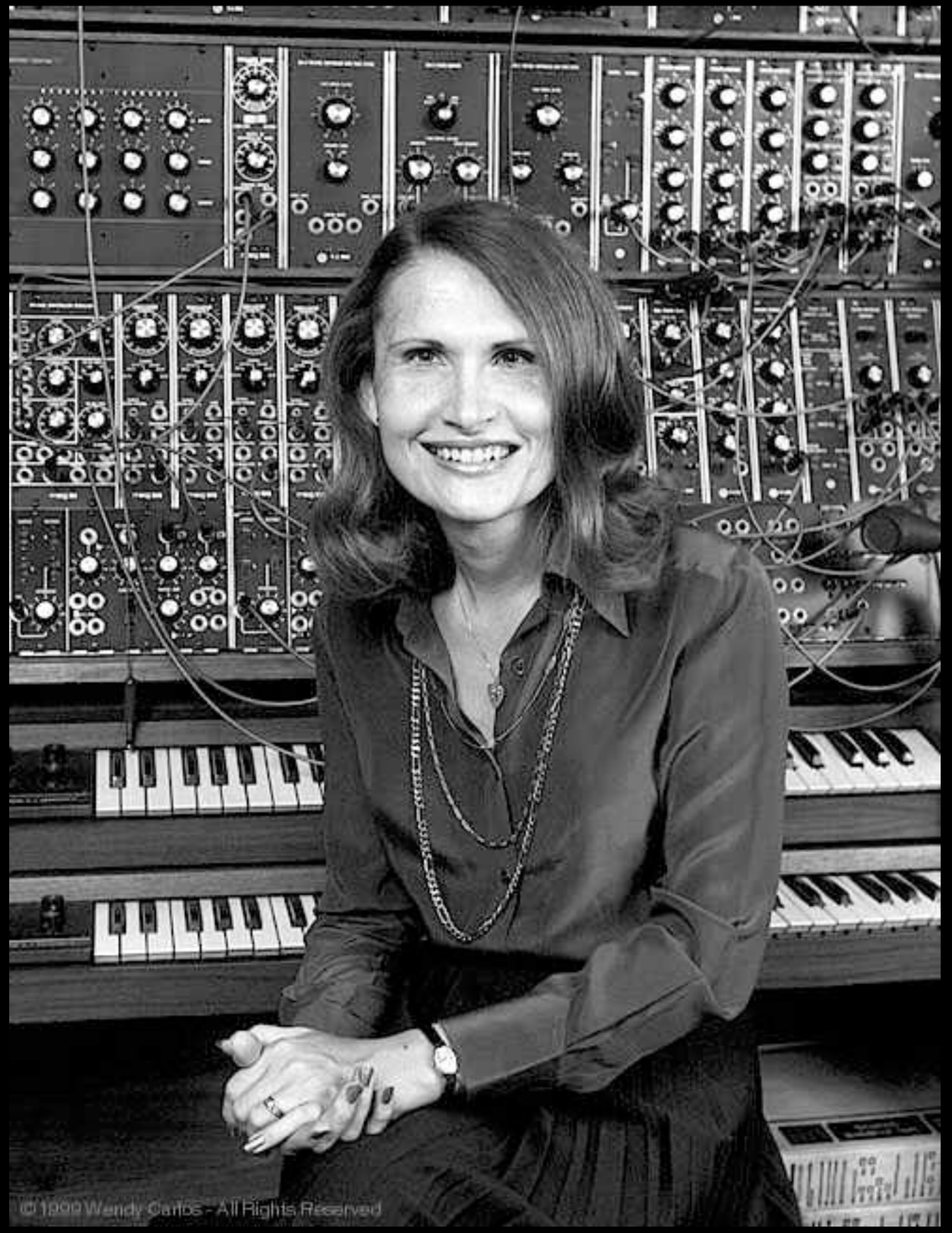
Buchla

SWITCHED-ON BACH

Performed by Wendy Carlos on a Monophonic Synthesizer!

Won Three Grammy awards

Brought the sound of the Moog synthesizer to the masses.

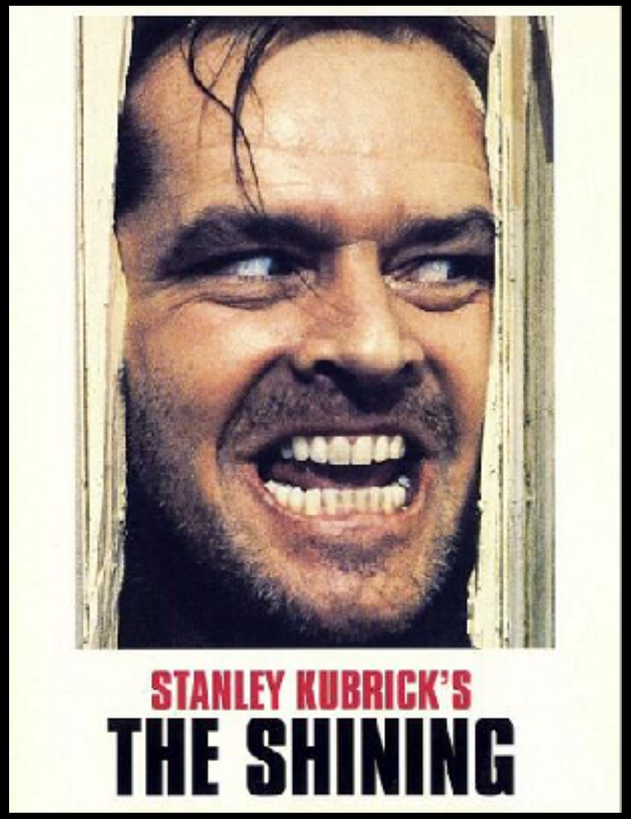


WENDY CARLOS

Masters in Music Composition at Columbia, with Ussachevsky

Met Robert Moog in New York and became one of his first customers, providing feedback for the development of the Moog Synthesizer.

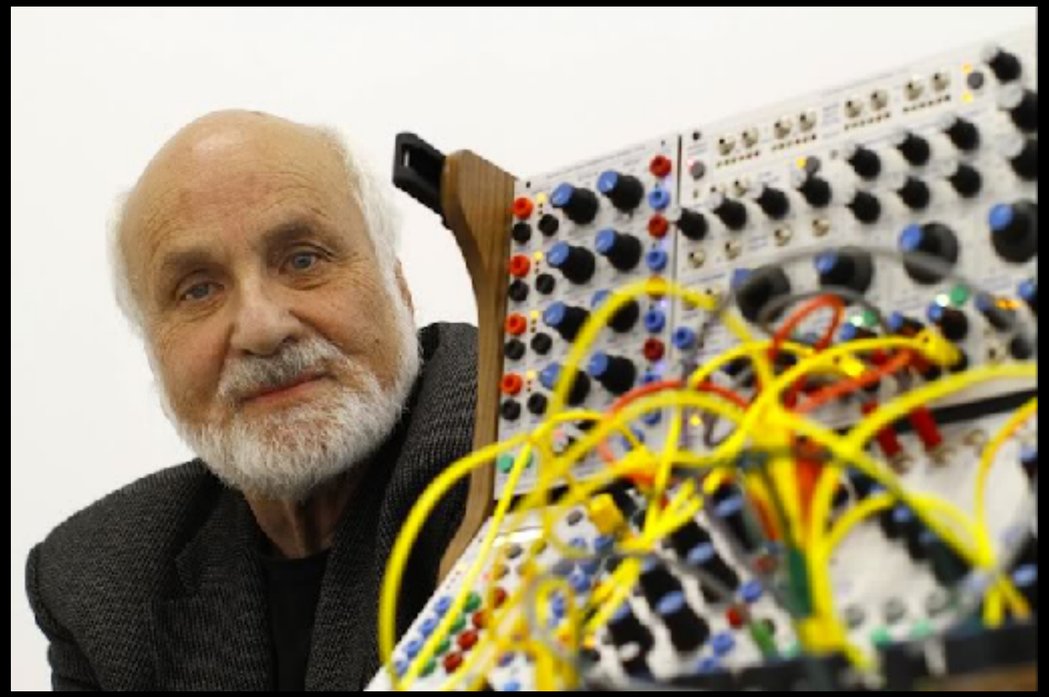
FILM SCORES BY WENDY CARLOS




TRON

The **San Francisco Tape Music Center**

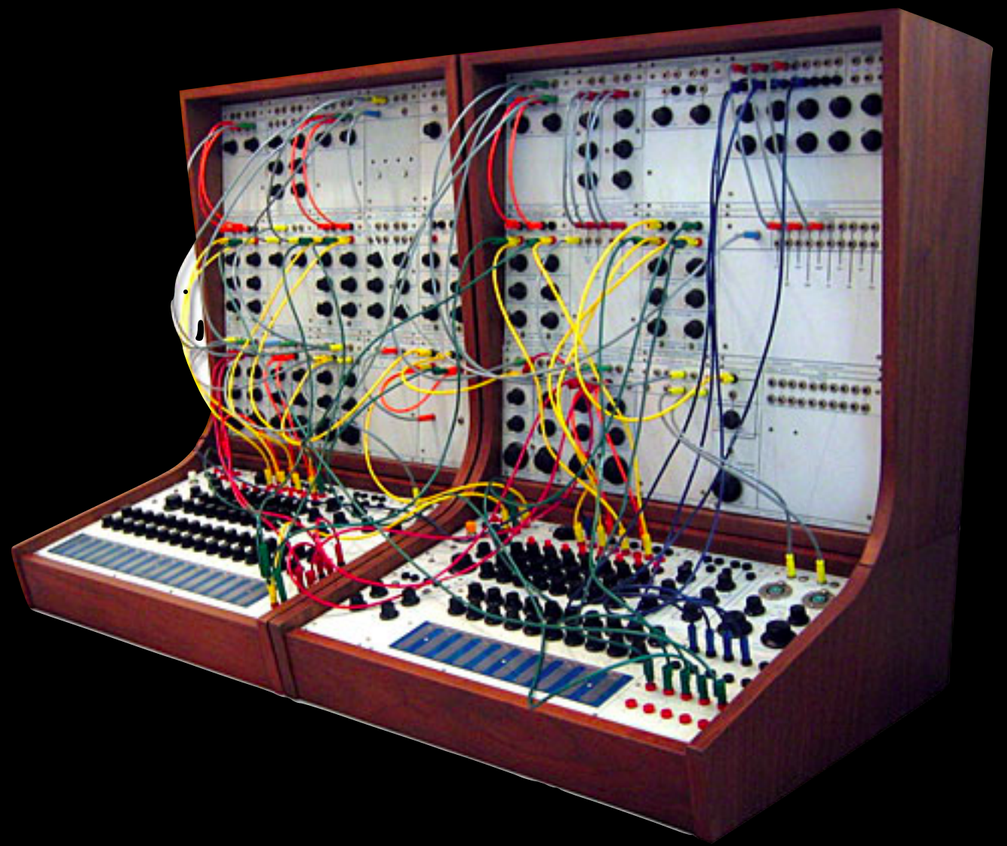
Morton Subotnick, Pauline Oliveros, Ramon Sender, & Terry Riley (who would use tape loops as an inspiration for minimalism) among others

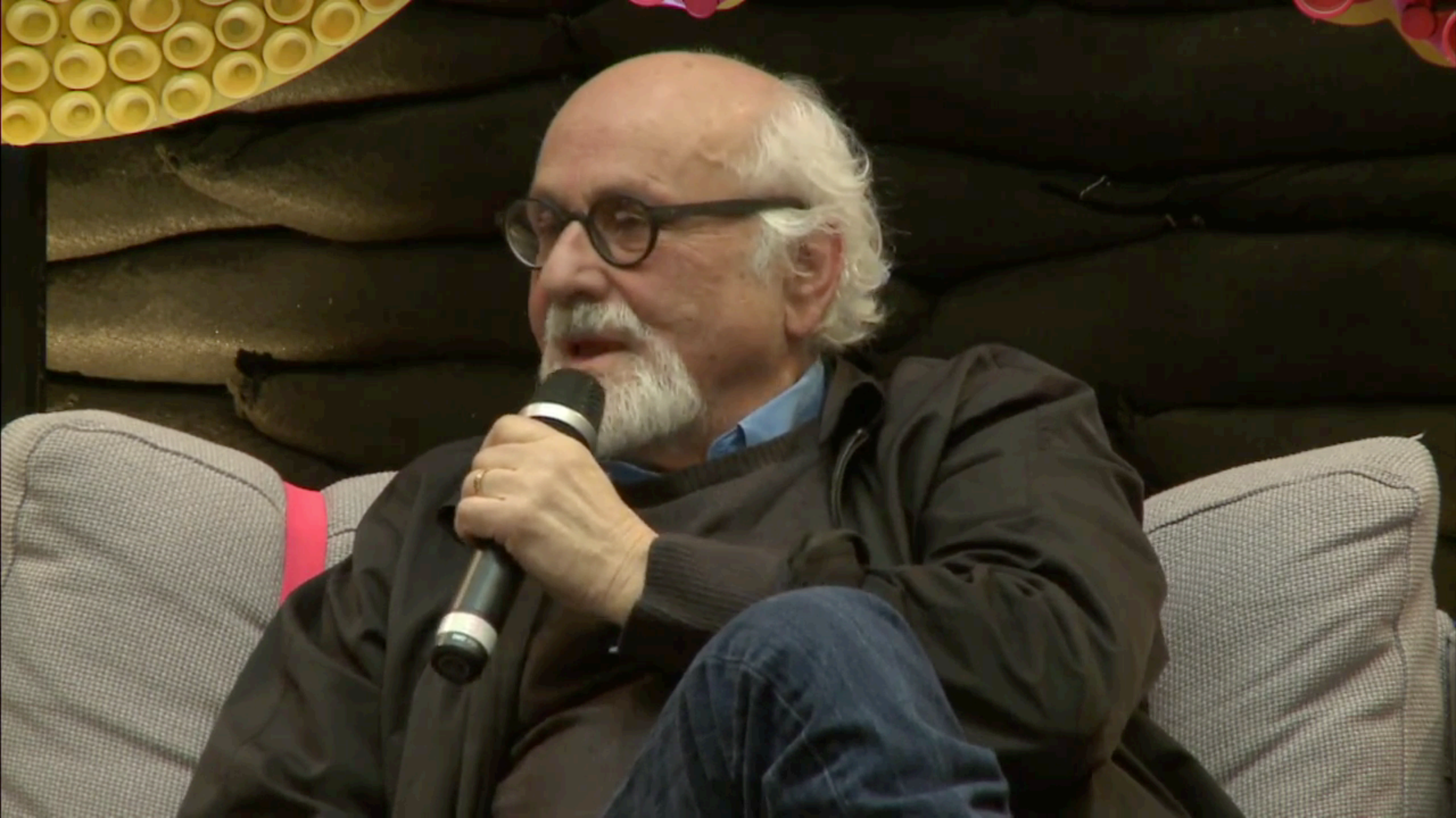


Morton Subotnick

Silver Apples of the Moon (1967)

created entirely with the Buchla 100 Synthesizer that he helped develop with Donald Buchla.





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A Sky of Cloudless Sulfur (1978)

The In Sound from Way Out (1966)

Jean Jacques Perrey and Gershon Kingsley

Their philosophy:

“The future is upon us, and the future is fun.”

"To take the mystery out of the legend that says electronic music is an art that is esoteric, exclusively-reserved for a few initiates, an elite of avant-garde intellectuals and artists."

“One Note Samba” - exploration of timbre as main compositional element.

Notes from ***In Sound from Way Out*** (1966)

“Here are a dozen electronic pop tunes. They are the electrifying good-time music of the coming age, the switched-on dance music that will soon be it. This is the lively answer to the question that puzzles—and who knows, even frightens—people who have heard the serious electronic compositions of recent years and wonder, is this the music of the future? As for that avant-garde wing, we say more power to it. But there are other things in the future, such as pleasure. And so presented here is the electronic "Au Go Go" that might be heard soon from the juke boxes at the interplanetary way stations where space ships make their rest stops. The idiom is strange and yet familiar; here a touch of rock, there a touch of bosa nova, a whiff of the blues in one piece and a whiff of Tchaikowsky in another. But these atoms of pop music are exploded into fresh patterns. They outline a strange new sound world.”

“Computer in Love“

ISAO TOMITA

Like Carlos, built a career on covering classical works on monophonic synthesizers.

Pioneer of ‘Space Synth Music’

4 Grammy nominations for his album ***Snowflakes are Dancing***, 1974

Played a Moog III modular synthesizer

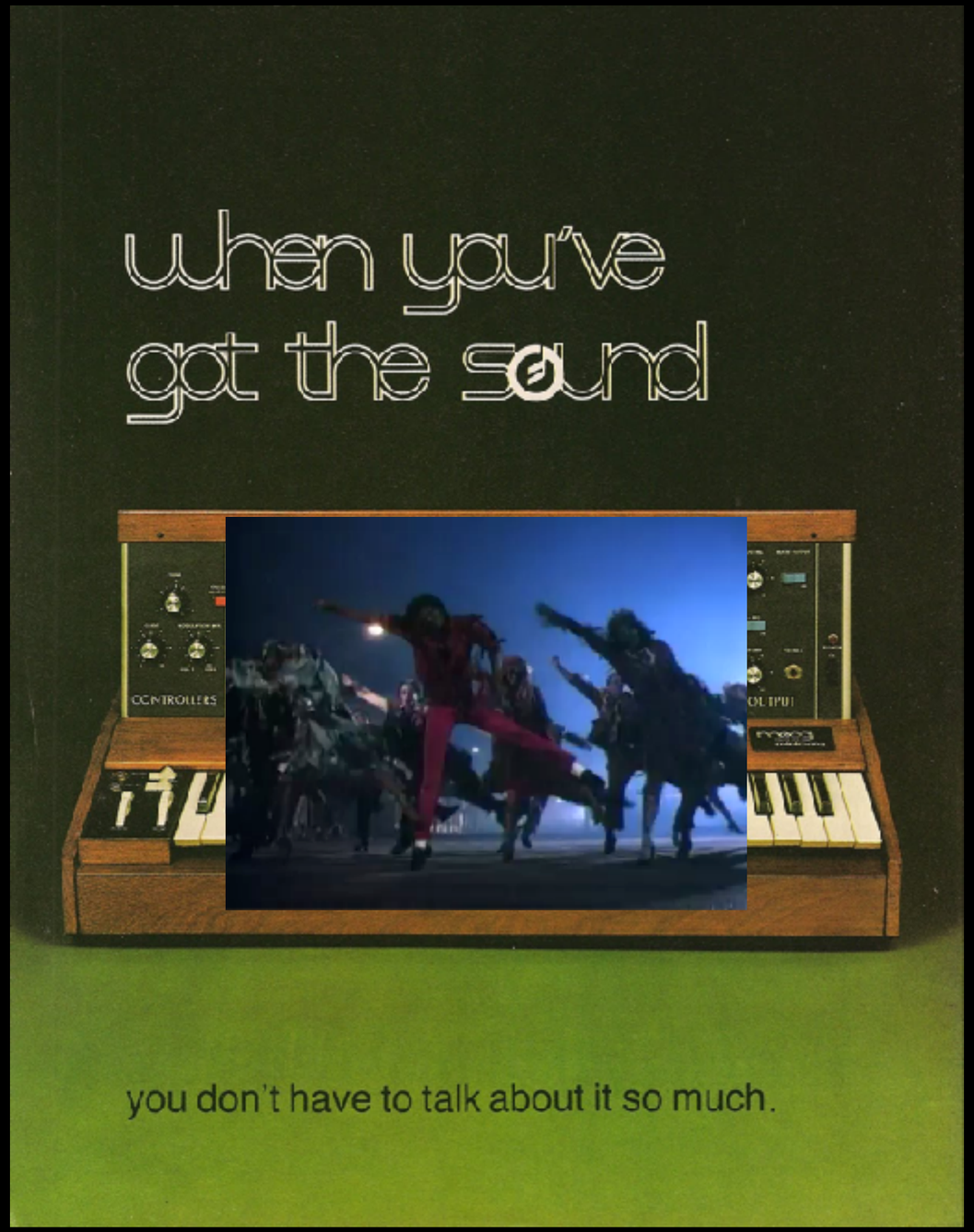
His sounds are often emulated in synth presets

ARP 2600

Fixed arrangement of modules... a transition towards portable forms.

had more stable oscillators that solved the pitch-drifting problem plaguing earlier synths.

Dominated the synth market in 1970



Minimoog (1970)

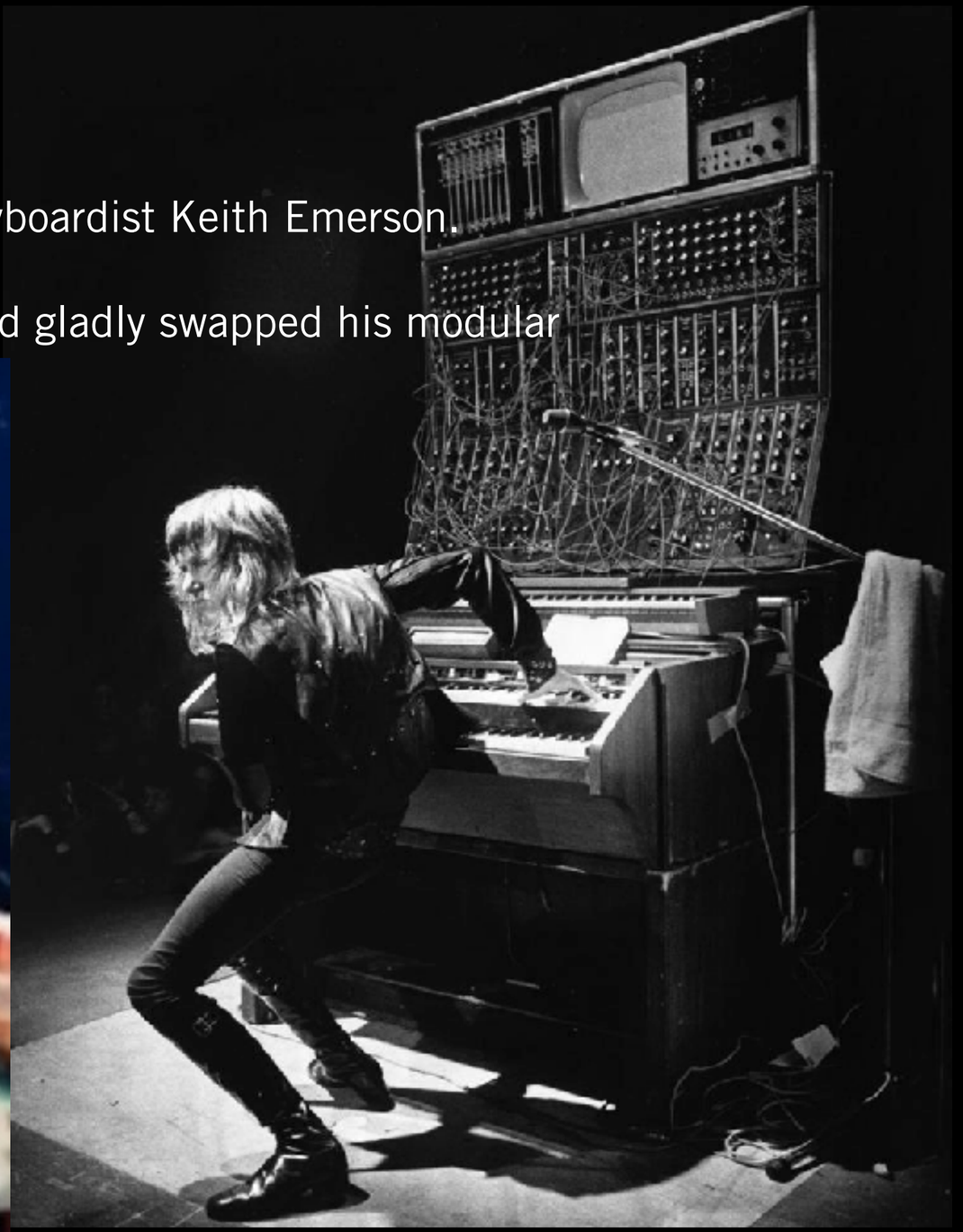
The first pre-patched, portable performance synthesizer.

Keith Emerson

In designing the minimoog, Bob Moog worked with virtuoso keyboardist Keith Emerson.

Emerson played in the band Emerson, Lake & Palmer (ELP) and gladly swapped his modular touring rig for the portability of the Minimoog.

ELP also covered a few classical tunes...




OSCILLATOR BANK
MIXER
MODIFIERS
OUTPUT
R. A. MOOG


TAE
TUNE
OSCILLATOR MODULATION
GLIDE
MOD. MIX
OSC. 3
NOISE
CONTROLLERS
RANGE
OSCILLATOR - 1 FREQUENCY
WAVEFORM
OSCILLATOR - 2
OSCILLATOR - 3
OSC. 3 CONTROL
OSCILLATOR BANK
VOLUME
ON
OUT
EXTERNAL INPUT VOLUME
OVERLOAD
NOISE VOLUME
WHITE
PINK
MIXER
FILTER MODULATION
KEYBOARD CONTROL
CUTOFF FREQUENCY
FILTER EMPHASIS
AMOUNT OF CONTOUR
ATTACK TIME
DECAY TIME
SUSTAIN LEVEL
M-SEC
SEC
LOUDNESS CONTOUR
MODIFIERS
VOLUME
MAIN OUTPUT
UNISON
A-440
VOICE DETUNE
POLYPHONIC
OUTPUT
SOFT CLIPPING
minimoog V
R.A.MOOG
GLIDE ON
DECAY ON
LEGATO ON
BEND
RANGE
BEND
MOD

Synthesizer Functions

1. **Sources**: produce or generate a signal

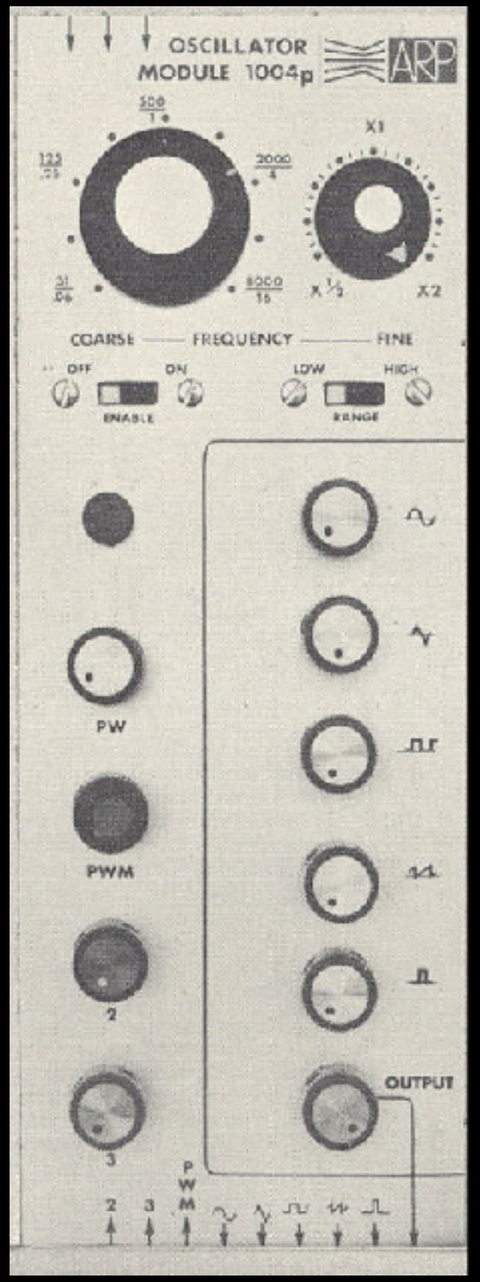
   Oscillators, noise generators, input sounds

2. **Processors**: modify a signal

   Filters, envelope generators (ADSR), effects.

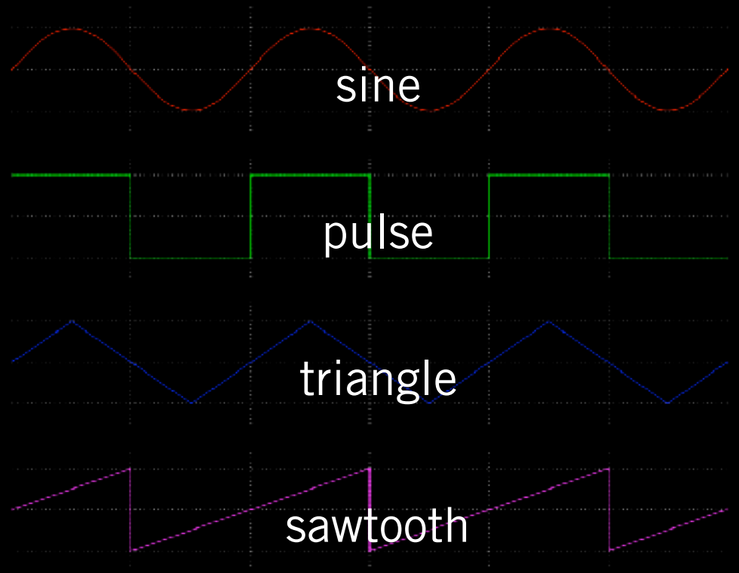
3. **Controllers**: control the behavior of another function (module)

   Physical input devices: keyboard, joystick, pedal
   Automated controls: sequencer, LFO



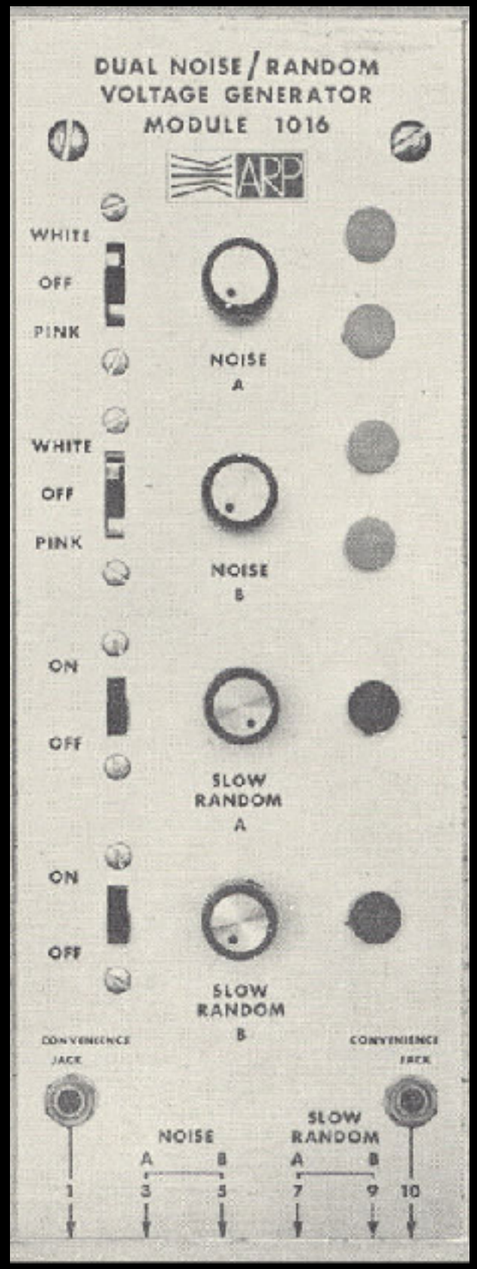
SOURCES

OSCILLATORS (VCO)



NOISE GENERATORS

Often the simplest module on the machine. There may be a choice of white or pink noise, or even a species of low frequency noise for random control voltages.



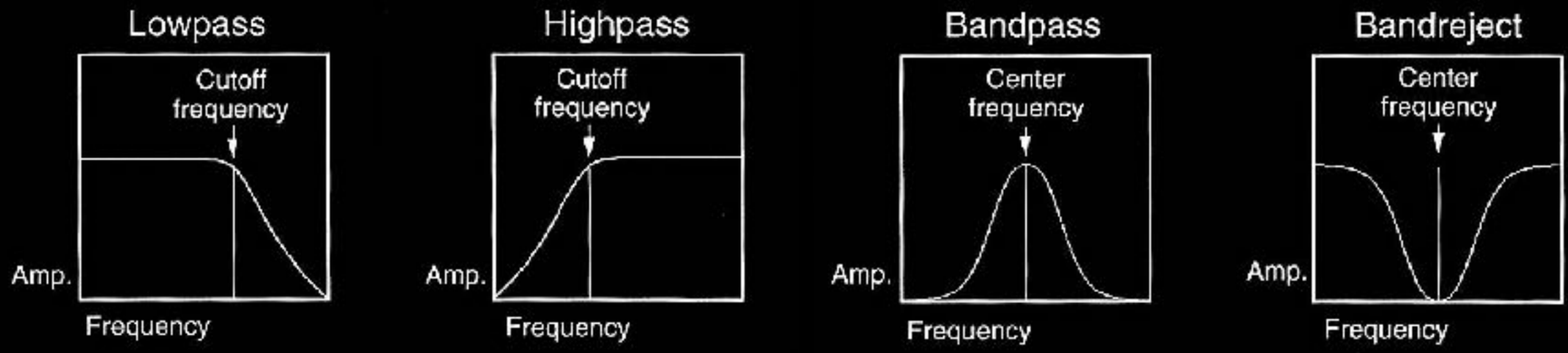
FILTERS

signal processing module, Voltage-controlled filter (VCF)

much of the timbral flexibility of a synthesizer comes from the filters

Boost or cut the amplitude of spectral components

Common varieties: low pass (LPF), high pass (HPF), band pass (BP), notch



“Q” characterizes a resonator's bandwidth relative to its center frequency. Higher the Q, narrower the filter

ENVELOPES

An envelope generator produces a control voltage that rises and falls once, according to a voltage command. The output rises to full on (ATTACK) and then falls over some time (DECAY) to an intermediate value (SUSTAIN) remains there before continuing to zero (RELEASE), often when the key is released.

ADSR design built by Moog at request of Ussachavesky