Programowanie instrumentów MIDI. Plansza interaktywna w języku angielskim.

E-materiały do kształcenia zawodowego

Programowanie instrumentów MIDI. Plansza interaktywna w języku angielskim.

AUD.09. Realizacja nagrań dźwiękowych - Technik realizacji nagrań 352123

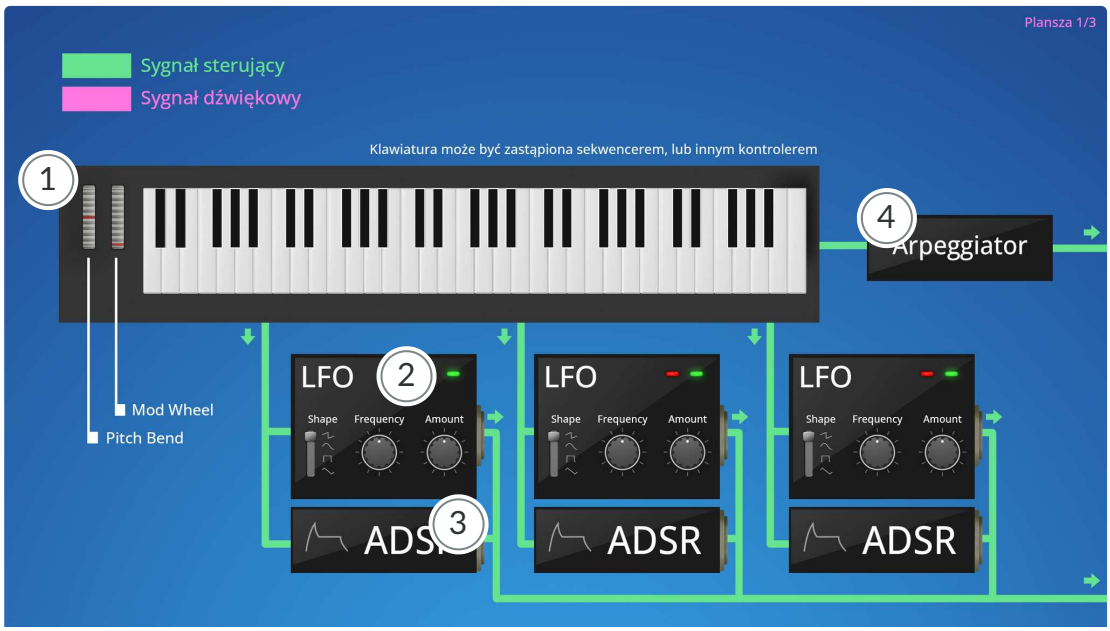
Synthesiser block diagram

INTERACTIVE BOARD

Przejście do planszy interaktywnej w języku polskim.

Synthesizer block diagram
Board 1
Board 2
Board 3

Board 1



1

Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

Control keyboard with pitch bend controller and modulation wheel.

A synthesiser needs a controller to control the oscillator frequency and other parameters.

The most widely used controller to play a synthesiser is a keyboard, but a synthesiser can also be controlled with finger-pressed or baton-picked pads, with ribbon controllers, touchscreens, pedals, brass controllers, proximity controllers and more. A standard control keyboard has two modulators in the form of vertical, circular knobs that are located to the left of the keys. The first modulator is the "pitch wheel" outlier controller and the second is the "modulation wheel", also referred to as the "mod wheel".

The pitch control is positioned in the middle of its range and returns automatically to the middle when swung and released. It allows the pitch of the sound being played to be changed smoothly, upwards when moving up and downwards when moving down. Its pitch range in semitones is determined by a parameter called "bend range", "bend" or "range". For example, setting the range to 2 allows you to bend the sound down or up by two semitones, while when you set the range to 12, you bend the sound an octave down or up.

Advanced keyboards have an "aftertouch" function that allows control messages to be sent by applying additional pressure to an already pressed and held key. This function can modify various parameters, often the depth of modulation of the oscillator frequency or the filter cut-off frequency. Modern synthesisers provide extensive possibilities for assigning parameters to the aftertouch function.

The synthesiser can also receive control signals from a pre-programmed sequencer.

A Sequencer is an external device or computer software that controls a MIDI device, such as a synthesiser, which allows a sequence of MIDI messages to be programmed and then played back as audio or other control signals.

- pitch bend
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- mod wheel
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- aftertouch
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- glide
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

2

Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

An LFO with variable waveform and frequency assigned to modulate the oscillator, filter and amplifier parameters.

The standard module is a free waveform generator referred to as an LFO (short for *Low Frequency Oscillator*). Unlike audio-generating oscillators, the signal from a slow waveform oscillator is not routed to the audio output of the instrument, but is used to modulate the parameters of the synthesiser. In contrast, unlike an envelope generator, a free waveform generator does not operate once, but cyclically, i.e. its waveform is repeated.

An important parameter controlling the slow waveform generator - in addition to the modulation depth - is the speed at which modulation occurs, usually expressed in hertz, less often in seconds, described as "speed", "rate" or "frequency".

As the name suggests, the slow waveform generator operates in the low frequency range, often below the frequencies heard by humans, i.e. 0.1Hz to 20Hz, with some modern synthesisers having the ability to set the speed of the LFO to 50Hz or even 200Hz. By default, this oscillator is used to control the amplifier, filter or oscillator that generates the sounds, i.e. to automate volume, cut-off frequency and pitch. Many modern synthesisers allow the envelope to be assigned to other parameters as well.Since the principle of the free waveform generator is identical to that of the sound-generating oscillator, it is possible to select the waveform that the free waveform generator generates, and therefore the way in which this generator modulates the signal during operation. The usual waveforms are:

- sinusoidal;
- triangular;
- sawtooth rising;
- sawtooth descending;
- rectangular;
- and sometimes noise.

Modern synthesisers offer the possibility of drawing a modulating waveform, so that almost arbitrarily complex modulating waveforms can be created that take on the character of extended sequences.

Within the low-frequency generator - and in some synthesisers as a separate modulating module - there is a random waveform generator that operates continuously, but not cyclically. This means that its waveform constantly introduces changes to the modulated parameter, but these changes are of a random rather than repetitive nature. The most common type of waveform generated by a random waveform generator, is the so-called "sample and hold"

(SNH) waveform, which is a waveform in which the generator has a fixed time to hold the value of a parameter, but continuously, stepwise and randomly changes this value. Some synthesisers allow other randomness algorithms to be selected or the settings of the "sample and hold" algorithm to be manipulated.

- sine LFO pitch control (vibrato)
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- sawtooth LFO controlling PWM
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- sine LFO controlling filter cutoff (wobble)
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- square LFO panning control
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- triangular LFO volume control (tremolo)
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

3

Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

ADSR envelope for the amplifier, filter and pitch.

One way to control the signals in a synthesiser is to use a module called an envelope generator called an EG (short for *Envelope Generator*) or envelope. When the envelope generator gets a gating signal from the controller, it sends a new signal that can be used to control another module and that determines what is to happen to the audio signal at each stage of the envelope during and after the gating signal.

The envelope generator sends the signal to the modulator once and each time anew when it receives a message from the controller, i.e. when a key is pressed, a pad is hit, etc. Each message is a restart of the envelope cycle. The envelope generator is used to control:

- the amplifier, i.e. to automate the volume of the signal at the time specified by the envelope;
- the filter cut-off frequency;
- the oscillator frequency.

Many modern synthesisers allow the envelope to be assigned to other parameters as well.

The parameters of any naturally occurring sound, including its intensity, pitch

and timbre, change over time, in a way that is characteristic of the sound source. This is because every sound has a beginning, middle and end. In a synthesiser, this phenomenon is supposed to be simulated by an envelope that determines the timing and direction of changes in a parameter, i.e. it determines how long the value of a parameter rises, falls, and at what level it lasts.

The most common envelope is ADSR, and its name comes from the 4 phases: "attack", "decay", "sustain" and "release":

- „attack” – the rising phase of the parameter value from zero to maximum:
  - a zero attack time will result in an immediate occurrence of the maximum parameter value;
  - a short attack time will result in a rapid change in the parameter value from zero to maximum;
  - a long attack time will result in a slow ramp-up of the parameter value from zero to maximum;
- „decay” – the descent phase, from the maximum value achieved in the previous phase to the value determined by the next phase. As for the „attack”:
  - zero descending time will immediately move to the next phase;
  - a short descent time will affect the quick transition to the next phase;
  - a long descent time results in a slow transition;
- „sustain” – the sustain phase, which, unlike the other phases, does not determine the change in sound over time, but the level at which the envelope remains during the duration of the controlling signal. This phase lasts as long as the envelope gets information about sound generation, which in practice is as long as the synthesiser key is pressed. Since this phase is determined by the level difference between zero and maximum, its value is most often expressed in %;
- „release” – the fade or decay phase, like "attack" and "decay", measured in time. Unlike the previous phases, it starts after the envelope control signal has ceased. In practice, this means that it starts when the synthesiser key is no longer pressed. This parameter determines how long the value of the controlled parameter will fall from the level determined by the previous phase to zero, analogously:
  - as in the first two phases, a zero bleep time will result in an immediate drop to zero;
  - a short dwell time will cause a rapid descent to zero;
  - a long dwell time will cause a slow drop.

The cessation of the envelope control signal at any time during the envelope affects the immediate jump to the "release" phase, i.e. whether the key is

released during the "attack", "decay" or "sustain" phase, the moment it is released, the "release" phase occurs.

- ADSR filter cutoff
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- ADSR pitch
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- ADSR volume
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

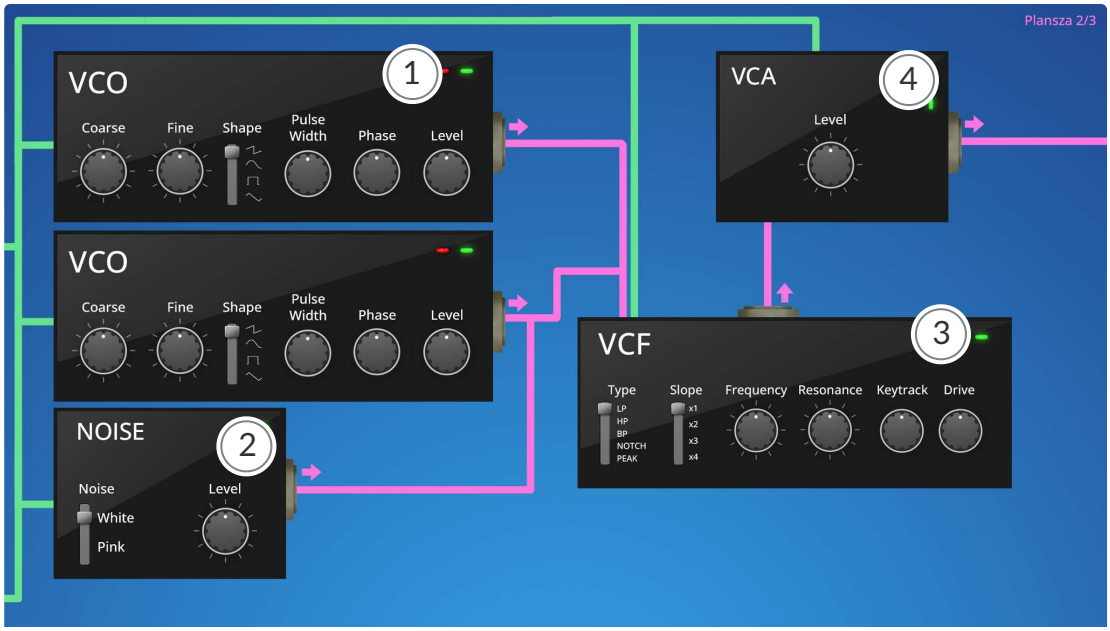
4

Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

Arpeggiator is an internal hardware synthesiser module or software that changes an incoming MIDI message into a sequence of sounds in the form of an arpeggio with selected parameters.

- arpeggiator 1/16 down
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- arpeggiator 1/32 up
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

Board 2



1

Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

VCO oscillators

The basic module of a sound synthesiser is a generator, called an oscillator,

which - by oscillating - produces sound waves. The first oscillators were fully analogue and voltage-controlled, hence their name VCO (short for *Voltage Controlled Oscillator*). Subsequently, analogue, digitally controlled oscillators appeared, bearing the name DCO (short for *Digitally Controlled Oscillator*). Currently, oscillators can be fully programmed into both hardware and virtual synthesisers.

An oscillator controller described as "pitch" or "coarse" allows the pitch generated by the oscillator to be set to within a semitone in relation to the note being played.

The controller described as "fine" allows precise tuning of the oscillator in cents.

The "phase" controller allows the signal to be shifted horizontally.

Some synthesisers also provide the ability to set the depth of random phase shifts.

A particularly important controller is the switch for the wave generated by the oscillator. In addition to the sine wave, waveforms are typical for subtractive synthesisers:

- *Sawtooth*;
- *Square*;
- *Triangle*.

In addition, the selection of a rectangular wave allows the selection of the pulse width of this wave, or "pulse width" (denoted as PW).

Modern synthesisers in the oscillator section often offer a "unison" function, which creates out-of-tuned copies of the oscillator. It is then possible to control:

- their number, usually described as "voices";
- the out of tune - "detune";
- the stereo base - "spread";
- and the volume at which the copies are added to the main signal - "blend".

Some synthesisers allow you to set the panorama of the oscillators. The relevant controller, although technically part of the mixer section, is usually located in the oscillator section.

- pitch coarse
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- pitch fine
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- square 25%
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- square 50%
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- square 80%
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- triangle
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- saw
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- sine
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- detune
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

2

Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

Noise source (white noise and pink noise)

Depending on the type of synthesiser, noise generation is an option that can either be indicated as part of the oscillator wave selection, is a separate module or appears in the mixer section. Some instruments give you the option to select the colour of the noise using a switch, knob or slider.

3

Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

Variable VCF filter

A filter is a module that allows the attenuation, removal and amplification of selected frequencies to shape the timbre of a sound. Filters in analogue synthesisers were voltage-controlled, hence they may appear under the name VCF (short for *Voltage Controlled Filter*).

The most important filter parameter is the cut-off frequency, which determines at what frequency filtering starts to be applied. This parameter decides which frequencies will be heard after the signal has passed through the filter and which will be attenuated or removed.

The resonance or goodness of the resonant circuit, denoted "reso" or "q", affects the level of gain of the filter's peak cut-off frequency. In some synthesisers, a high resonance setting can introduce audible self-oscillation of the filter.

Older synthesisers only featured "low pass" (labelled LP), or low pass filters, whose function was to mute high frequencies and pass low frequencies. In contrast, modern synthesisers offer a choice of filter types.

The most common, in addition to the low-pass filter, are:

- "high pass" (HP) filter;
- band pass filter „band pass” (BP);
- band-stop „notch” filter.

In addition, filters that have additional controllers appear in selected instruments. These include shelving, peak, comb, formant and other filters.

Some synthesisers allow the filter cut-off characteristics to be changed infinitely. A separate controller is used for this. Modern synthesisers often emulate the sound of filters from different instruments, so within a single filter cut-off characteristic there may be several filter types, affecting the sound in different ways.

If a synthesiser does not offer a choice of filter steepness within the filter type selection, it is usually equipped with a controller for this parameter, the "slope". This parameter determines how quickly the filter reduces frequencies above its cut-off frequency. Slopes are usually expressed in dB per octave or as a "field", or pole, where one pole of slope means 6 dB of reduction per octave, two means 12 dB, and so on.

The filter section of fixed-architecture synthesisers also gives the option to set the depth with which the envelope affects the filter cutoff. This parameter is usually described as "amount" or "contour". It is absent in synthesisers that allow the envelope to be assigned to parameters in a user-defined way. In this case, the control of the depth of effect of the envelope on the parameter appears next to the envelope.

The "key track" or "key follow" function makes the filter receive messages from the control keyboard. This function allows the filter cut-off frequency to follow the pitch of the sound being played. That is, if the controller is set to 0%, the filter cut-off frequency setting remains constant regardless of the pitch of the sound being played. By contrast, when the controller is set to

100%, the cut-off frequency will be perfectly correlated with the pitch of the sound being played and will be higher the higher the sound is played..

Some filters have a "drive" or "distortion" controller, which introduces signal distortion in the form of overdrive.
There is also a "mix" controller on selected synths, which allows the ratio of clean and filtered signal to be balanced.

- bandpass 12dB Q2
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- distortion (dry/wet)
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- hipass 24dB Q4
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- lowpass 6dB Q0.707
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- velocity
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

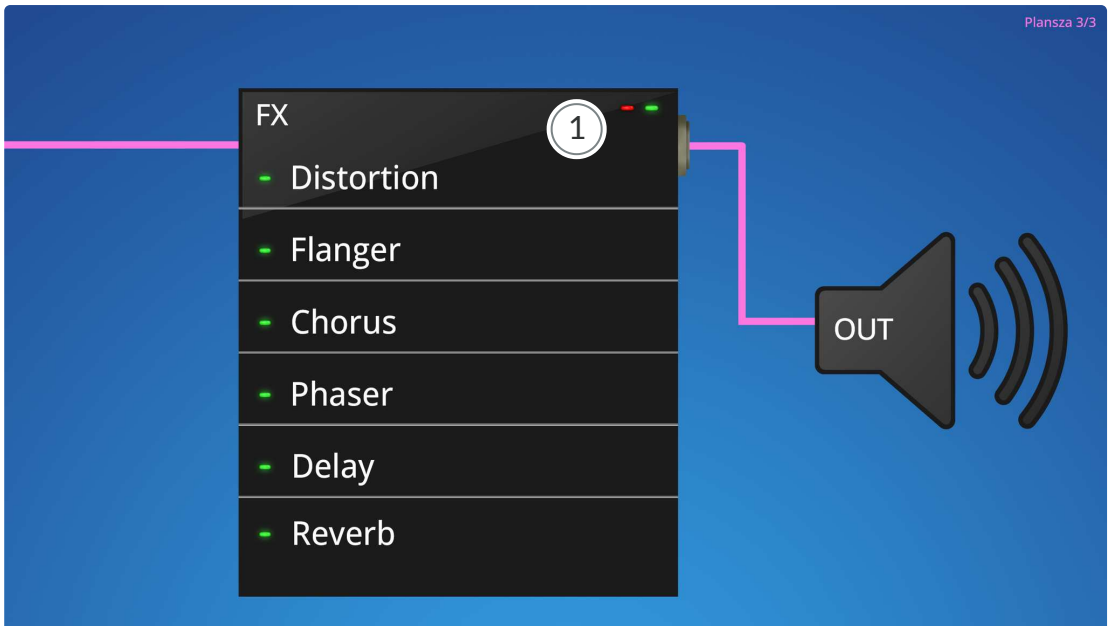
4

Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

VCA amplifier

The oscillator will continuously generate sound after receiving a message from the controller, so in analogue voltage-controlled instruments another essential module is the sound amplifier, appearing under the name VCA, or ***Voltage Controlled Amplifier***. The control signal, referred to as the "gate" signal, sent from the controller to the amplifier when the key is pressed determines the passing of the signal at maximum intensity from the oscillator through the amplifier. When the key is released, it causes the passing of the signal to stop and the intensity of the sound immediately drops to zero. In the amplifier or mixer section, there are controllers for setting the volume of individual signal sources and the ratio between these sources. This option exists when such controllers are not assigned to the signal source section in the synthesiser architecture.

Board 3



1

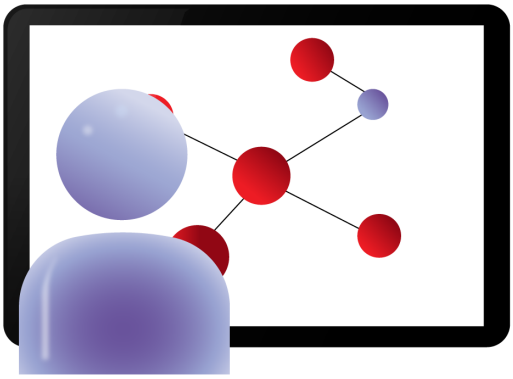
Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

FX effects block

Many synthesisers allow you to shape the sound using effects. The most common effects are:

- chorus
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- flanger
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- phaser
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- distortion
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- delay, or echo
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa
- reverb.
  Nagranie dostępne pod adresem https://zpe.gov.pl/b/P1FyKzoZa

Plansza interaktywna w języku polskim



Programowanie instrumentów MIDI.
Plansza interaktywna w języku polskim.

Materiały powiązane

Film edukacyjny animowany,Podstawy syntezy...

Film edukacyjny animowany, Bloki generując...

Film edukacyjny animowany,Modulacja dźwięku

Film edukacyjny animowany,Programowanie bar...