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NYA

version 4.4 "phoenix"

Apr 2026

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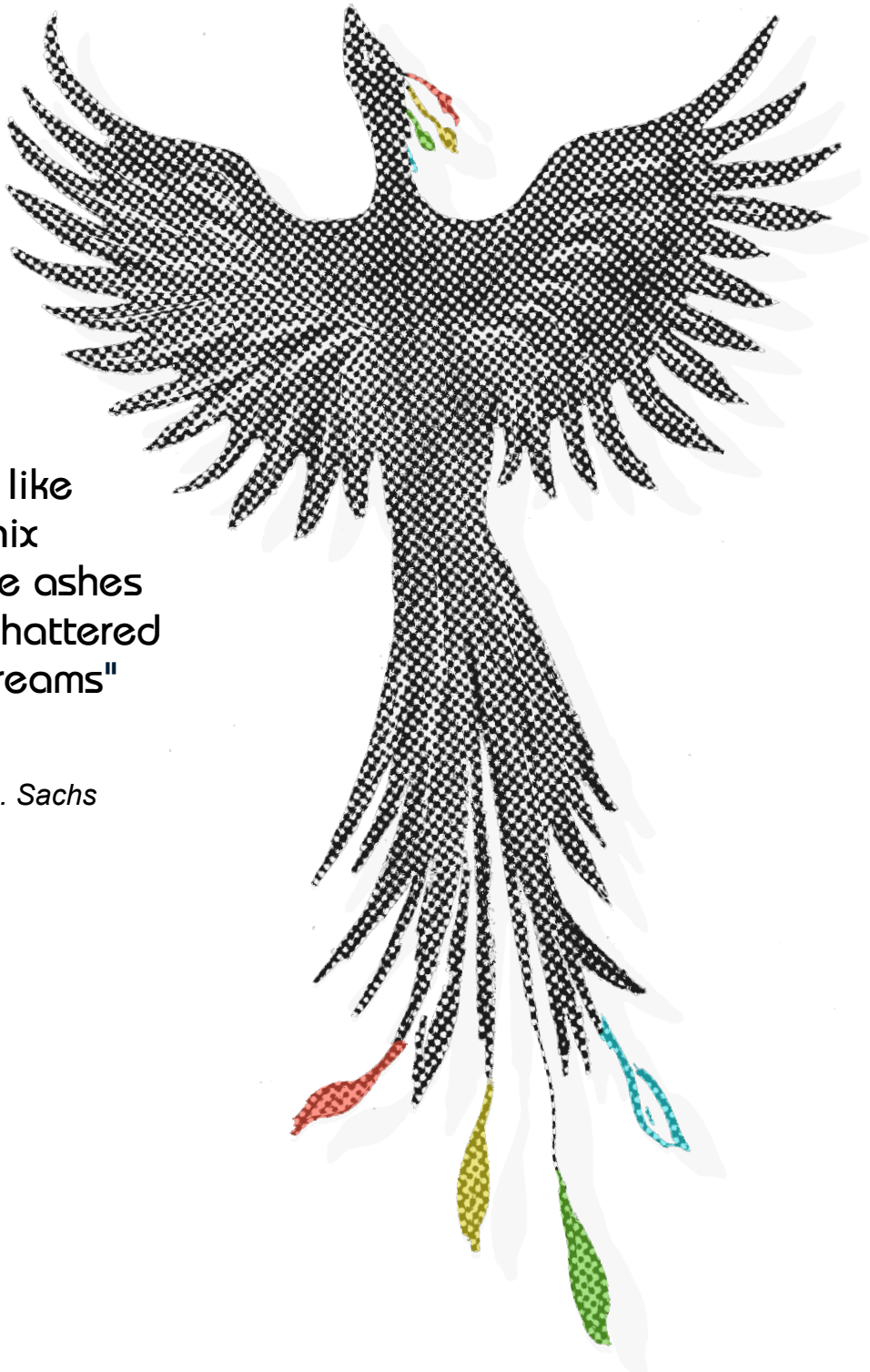

"Hope rises like
a phoenix
from the ashes
of shattered
dreams"

S.A. Sachs

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Thanks! ...Overview

Thank-you for choosing the AY3! Time to take a break from HI-FI land and enjoy some good old 8-BIT nostalgia!

The AY3 features two AY3-8910 chips boasting 6 voice polyphony. You can apply sequences, arpeggiators, noise, envelopes and pitch modulation to each voice with a click of a button.

Now, after **more than 10 years**, the AY3 is experiencing a meteoric rise with many new features. These offer direct access to all parameters, allow you to play songs from your childhood, and even modify them in real time.

Please note that one of the new features is the support for different clock rates. In versions < 4, a significantly lower clock rate was selected (500 KHz), but the clock speed is now set by default to 2 MHz (Atari ST) for revision A and to 1.77 MHz (ZX Spectrum) for revision B. However, this also means that your previous presets now sound **2 octaves higher for the same note**, but this does not apply to the new sound banks that are to be flashed internally. Now, three different clock speeds (including the legacy) can be configured.

Take the video AY3 Synth & Remix Tour!
https://www.youtube.com/watch?v=IcXeGEhGb5I
https://www.youtube.com/watch?v=8k46qZAkDSg

About the sound chips:
The AY-3-8912 and its variants became popular chips in many arcade games, and were used on, among others, the Intellivision and Vectrex video game consoles and the MSX, Amstrad CPC, Oric 1, Colour Genie, Elektor TV Games Computer and Sinclair ZX Spectrum 128/+2/+3 or as 48K interface and Atari ST home computers as well as the Mockingboard sound card for the Apple II family.

Open source!

The AY3 Firmware is open source on github, feel free to join the coding party.
https://github.com/orgs/twistedelectrons/repositories

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What's new? It looks the same...

Yes, it seems so, but the firmware has been revised in terms of behavior, timing, and sound. Although most settings and algorithms remain the same as in the previous version, a few things have changed:

1. The sound chips are now controlled at a specific clock frequency that is identical to that of the old home computers and triggered with data at 50 Hz. However, since there are two chips that are supposed to reproduce the sound simultaneously, the second chip is controlled with an offset of 50 Hz relative to the first chip, which in itself creates a stereo image and produces interesting phase effects, even if these are rather subtle. For some older boards that probably have AY-3-8912 stuffed, the timing for communication with the chip had to be changed, which was fixed since **version 4.3**. Otherwise, the chip would not output any sound.

2. The processing of information during operation of the device has been redesigned so that the sound remains largely unaffected by possible interference. As a result, the internal timing for Arpeggios or LFOs, for example, as well as for the internal clock of the sequencer, deviates slightly, but these changes lead to more direct control of the engine.

3. Some elements of the user interface, such as the flashing of a selection or the preselection of settings, as well as the duration of certain displays, have been redesigned to make operation more user-friendly. This also applies to a modified way of saving presets.

4. There are new features, such as the “Note Follow” options for noise or envelope settings. Noise is now only applied to played notes, and the envelope range is now interpreted differently (a mix of logarithmic and linear ranges), but these settings can also be configured in the old way.

5. All issues that were noticed in version 3 have been fixed including the sequencer functionality, which can now also be defined with a length.

6. The AY3 has now been expanded with an interface protocol (AYMID) that allows song data to be played back and remixed in real time.

Connectivity & Power

The AY3 features two 1/8” audio outputs, a 1/8” MIDI input and a power socket
The MIDI is TRS type A (same as Korg).

The AY3 is equipped with a bridge rectifier so can be powered by any AC or DC voltage source between 8V and 15V, 4 between 500mA and 2000mA.

All functions, including the transfer of song data, do not require any special hardware, but a standardized MIDI 1.0 interface that can reliably process sysex data.

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Configuration

The AY3 can be configured for different motherboard revisions and with various clock rates (depending on the revision).

The global midi channel can also be set. However, care should be taken with all wild pre-configuration with the BOOT + NOISE + e button combination, as this performs a factory reset. Alternatively, only the last 4 banks can be flashed using the "a" instead "e" hotkey combo.

The following configurations are possible:

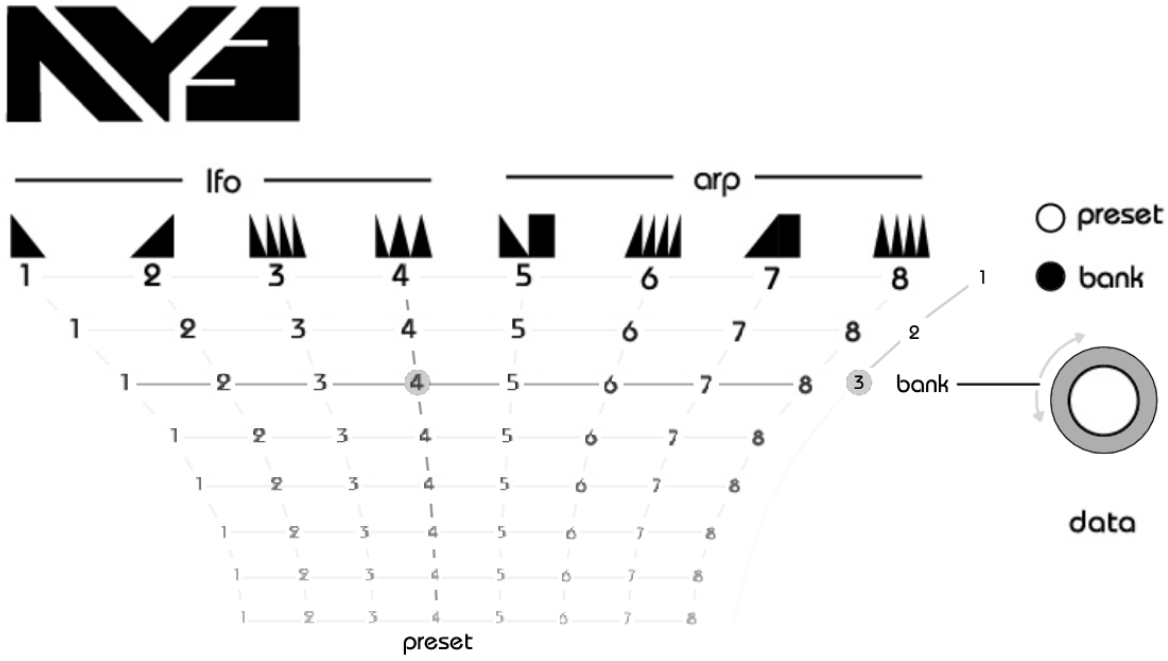
Config Parameter	Hotkey	Values
Board Revision	**BOOT + VOICE**	**A** (2014 - 2025) **B** (Nov 2025)
Clock Rate	BOOT + ARP	**1** = 2 Mhz (Atari ST) **2** = 1.77 Mhz (ZX Spectrum) 3 = 500 Khz (legacy) *note: 1.77 Mhz can only be used with revision B*
Factory Reset *bank 1-8* *bank 5-8*	BOOT + NOISE + e BOOT + NOISE + a	Factory reset! Indicated by “F” or with an “F.” (upper half)
Calibration Reset	BOOT + VOICE + d	Factory calibration! Indicated by "X"
Envelope Period Mode	BOOT + ENV	**1** = logarithmic / linear scale 2 = legacy note's lookup table *note: mode 1 allows envelope's “Full Range” mode or “Note Offset” mode during operation*
Midi Channel	BOOT + SEQ	Global Midichannel 1-16
Bootloader	BOOT + ENC	Enters bootloader for firmware updates

Note: In addition, the AY3 has two options for controlling the envelope period, with one mode being more suitable for processing older presets (version < 4).

Preset load / save

The AY3 can hold 64 presets in 8 banks of 8 presets.

The storage system uses **two independent cursors**, which are global.
They define the actual position of the selected preset. The following illustration should describe this in more detail. If you move the bank cursor to position 3, the previously selected preset cursor stays on position 4, but now it points to preset 4 of the 3rd bank, if it had previously pointed to bank 1, for example.

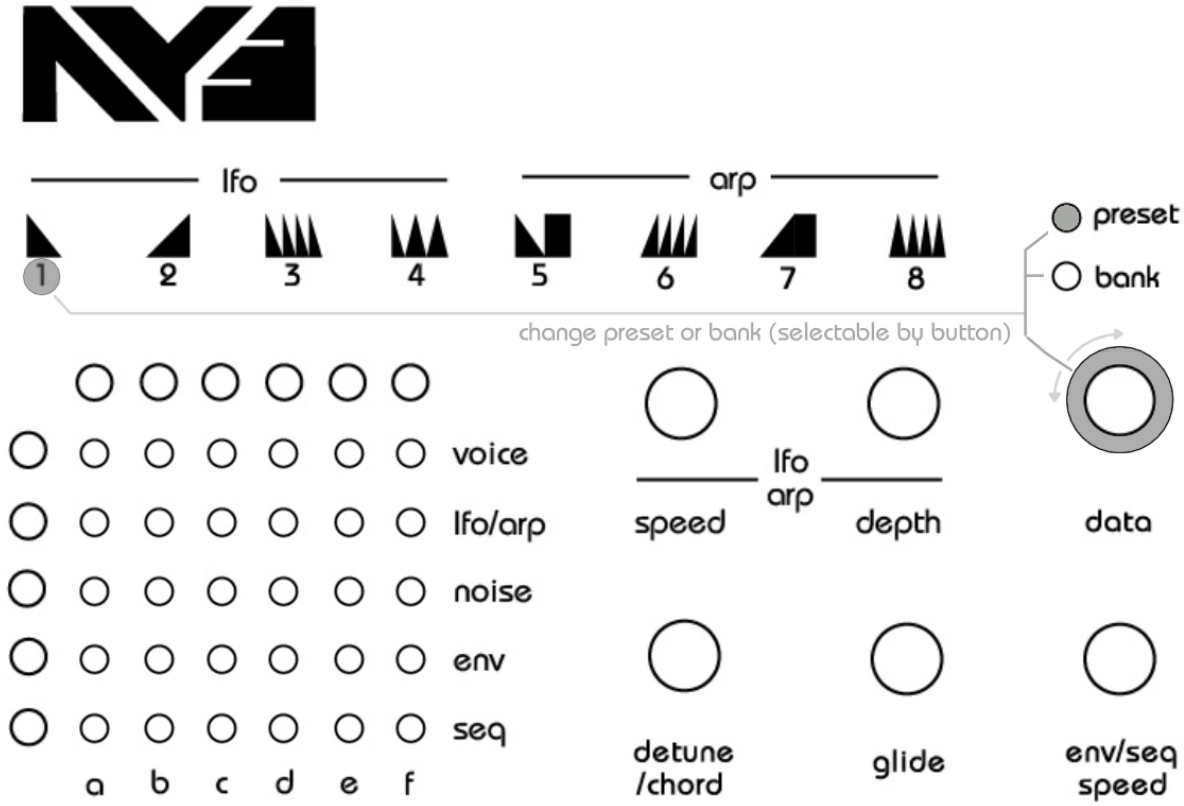


Saving presets has changed slightly in version 4. Hold down the **data knob** til the count down LEDs disappear. Presets are not saved immediately; instead, the selected cursor flashes and you can select a new slot for saving by moving the data encoder. The preset is saved after confirmation by pressing the data button again.

This makes it possible to save presets within a bank, but also to save the selected preset for another bank in **bank mode** at the same position, if bank mode was selected before the countdown was initiated.

To toggle between preset and bank mode (indicated by the LED), press the data knob down. Turn the data encoder to move the cursor, which will load the preset directly.

Hold the data knob down for 3 seconds to start the process of saving the current preset (countdown is displayed on LED **8** to **1**, after which the LED number starts to flash). Press again to save the preset or if you want to select a new position, you can move the cursor to another slot by the data encoder. You can cancel the storage mode by pressing any other button.

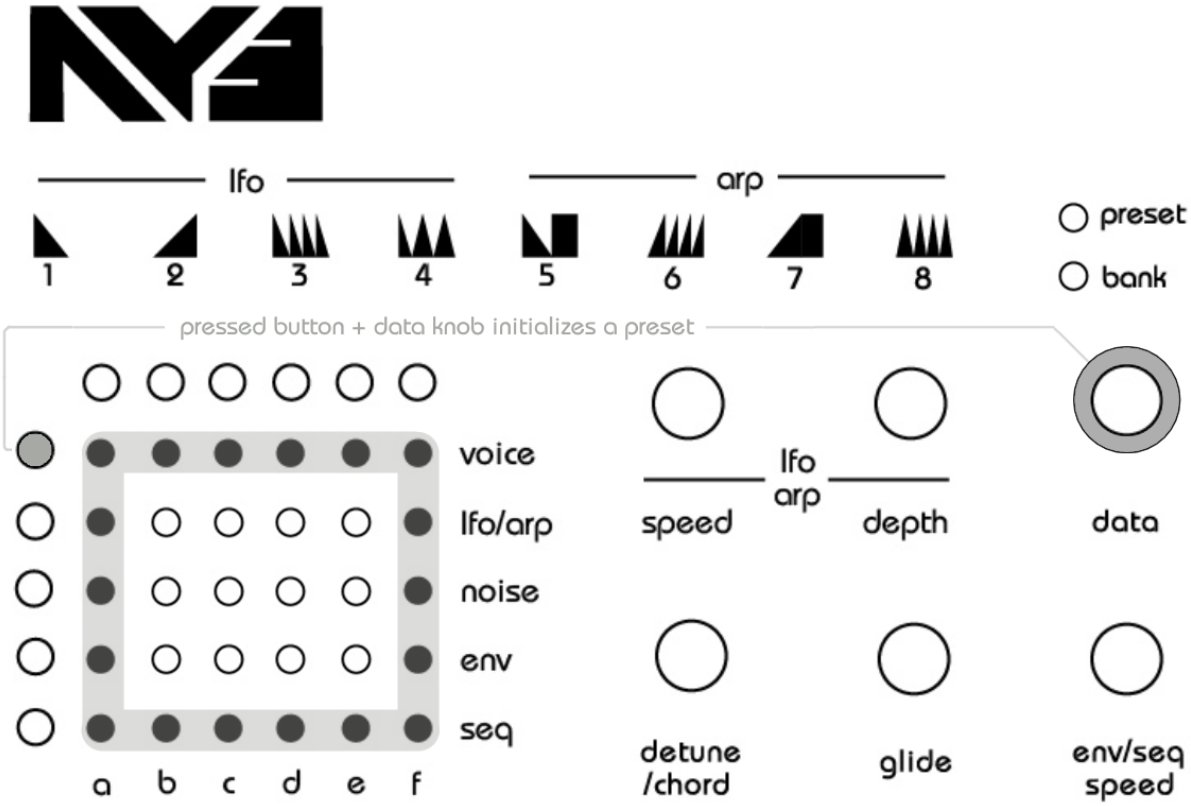


Keep in mind that the factory presets can be restored for the entire EEPROM, but you can also choose to restore them only for the upper banks (5..8). It is therefore best to start saving your own presets in banks 1..4.

Init preset

Presets can be easily initialized by pressing the voice button and data knob simultaneously. A blank rectangle will be displayed temporarily, as shown below. This does not save the preset, but simply activates **voice a** and **d** and resets the tuning and all other parameters.

Regardless of this, the tuning can only be reset by holding down the voice button for 5 seconds.

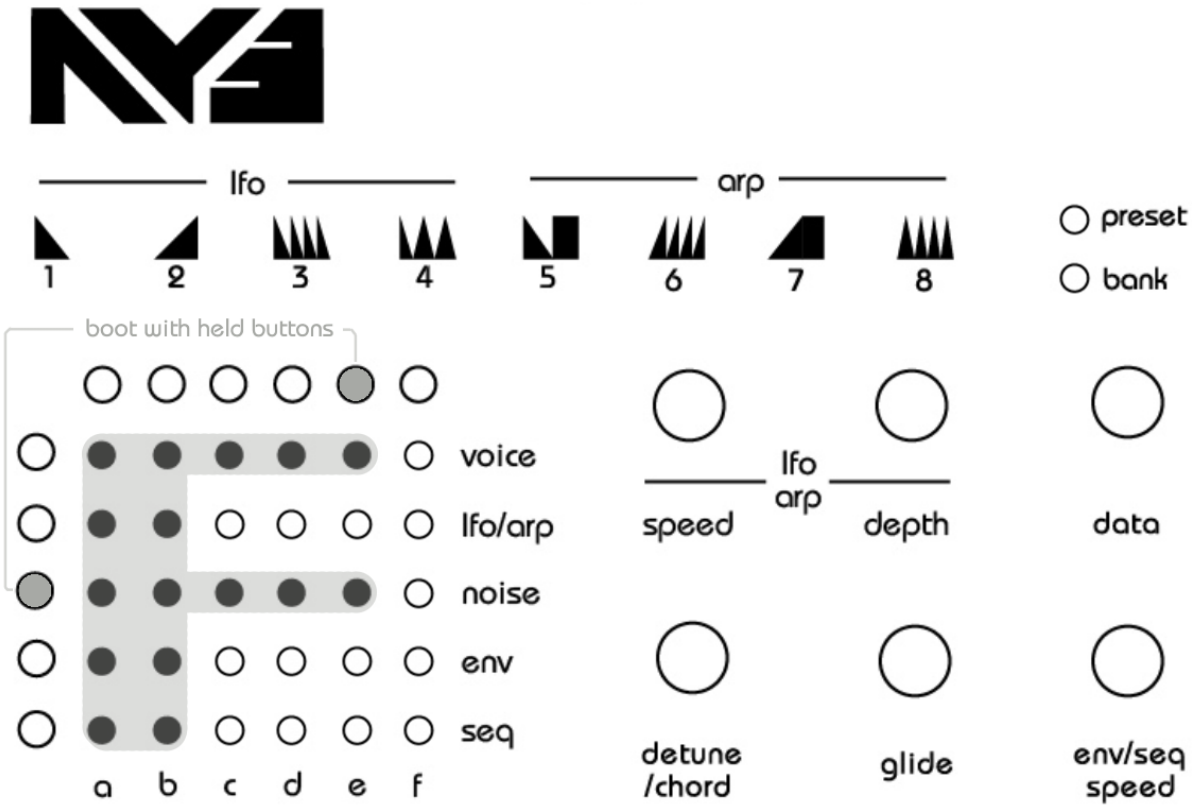


Factory Reset

Starting with version 4, a factory reset can be obtained directly from the firmware to initialize the Ay3 with **creator sound banks**. The presets contain 4 banks (1..4), which are mirrored again on banks 5..8.

To reset your AY3 presets to factory hold the (**noise + e**) buttons at startup.
Beware: This will erase your custom presets and replace with the factory ones.

However, it is also possible to flash only the upper half (banks 5..8) by holding down the **noise + a** buttons during the start-up process. In this case, a small dot will also appear next to the F, and your presets for banks 1-4 will remain unchanged.



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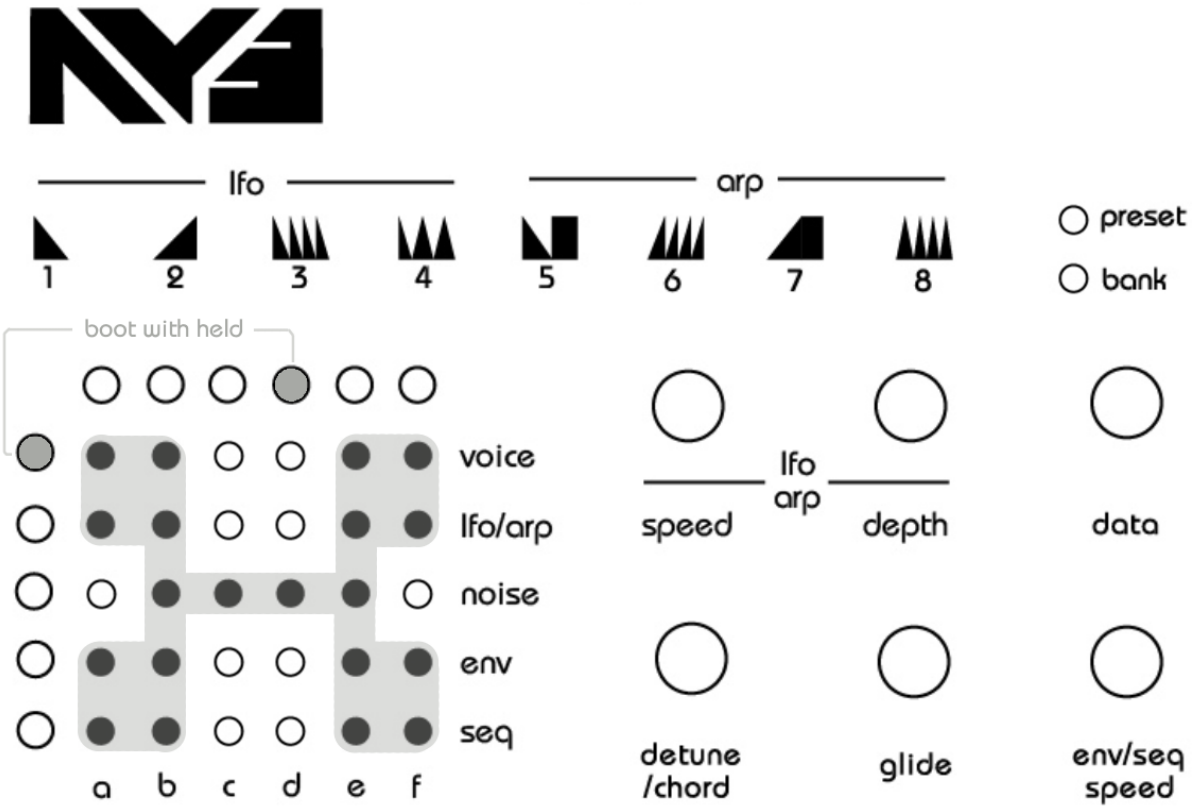
Calibration Reset

From **version 4.4** onwards, calibration can be carried out using the AY3 Tool (see the previous chapter). The timers are already factory-calibrated, and users should be able to perform a calibration reset directly via a boot key (**voice + d**) combination, although a reset via the web tool is also possible.

The user only needs to perform a calibration reset if changes have previously been made using the AY3 tool and they wish to revert to the **original timer settings**.

In this case, an ‘X’ appears briefly after the AY3 starts up.



Creator Sound Banks

Bank 1/5: ARCADE

1	AY VALLEY
2	THE LEADER
3	PING PONG
4	RADIO BEAM
5	BEAT 'EM
6	WAITING
7	TIME PASSED
8	HYPERSQUARE

Bank 2/6: CHILLIN'

1	THE SECRET
2	THE HOPE
3	LITTLE ROCKET
4	STRANGE WORLD
5	GOT THE TRAIN
6	MALFUNCTION
7	SLAP ME
8	INVADERS

Bank 3/7: RIVIERA

1	CHOPPER GETAWAY
2	POOL PARTY
3	GRAND PRIX
4	LEAD ROYAL
5	TRAIN TRAX
6	AMATEUR CHOIR
7	CRICKET DANCE
8	PUMP CLUB

Bank 4/8: AQUATICA

1	LOST AT SEA
2	LITTLE BROTHER
3	SPARKLE PAD
4	GREAT ANNE
5	SHIMMERING WAVE
6	TWISTER
7	SURF-ACE
8	CPU CHAT

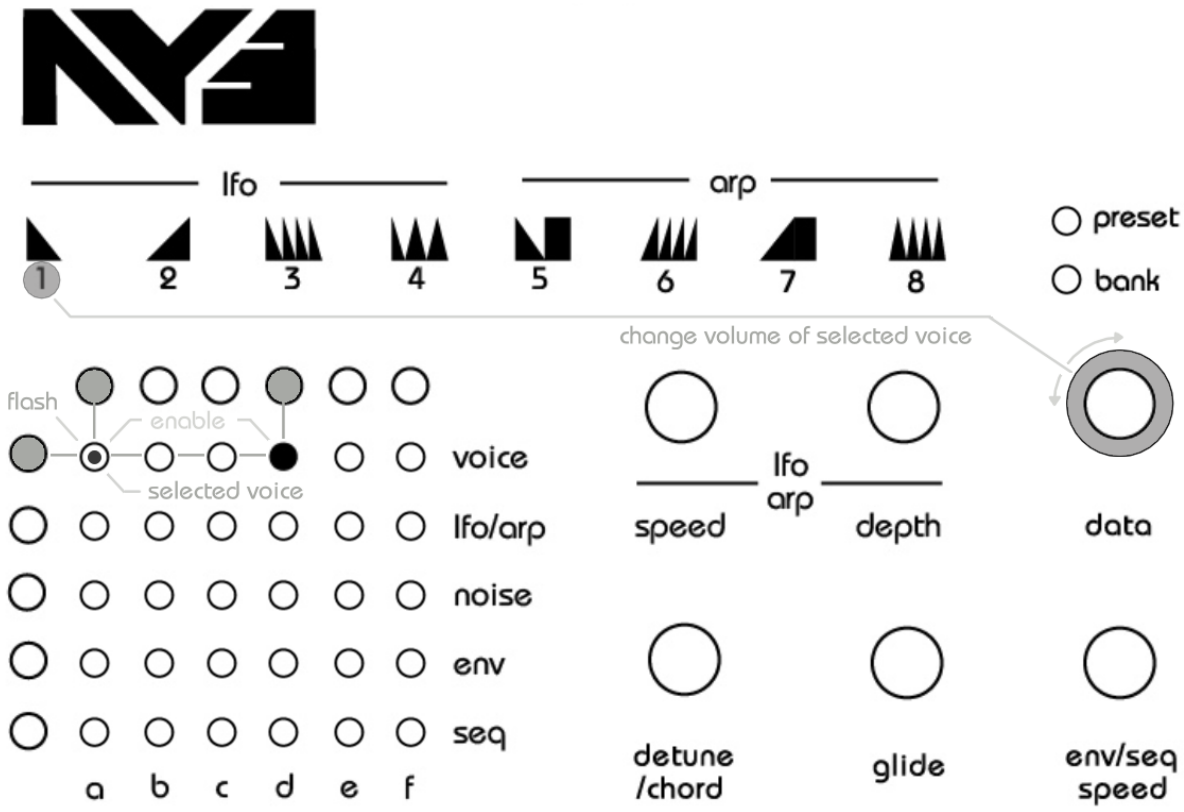
Voice

Voice edit mode has 3 sub-modes to enable/disable, adjust tuning & volume of each voice. Cycle through these sub-modes by tapping **row button 1.** The LED matrix will announce the selected sub-mode by displaying the letters **E**, **V** or **T**.

As soon as you press a button a, b, c, d, e, f, the selected voice is selected and begins to flash.

Enable: Enable/disable a voice via buttons **a** thru **f**.

Volume: Select a voice via buttons **a** thru **f.** Adjust the selected voice's volume with the data encoder. Volume is displayed on LEDs **1** thru **8**.



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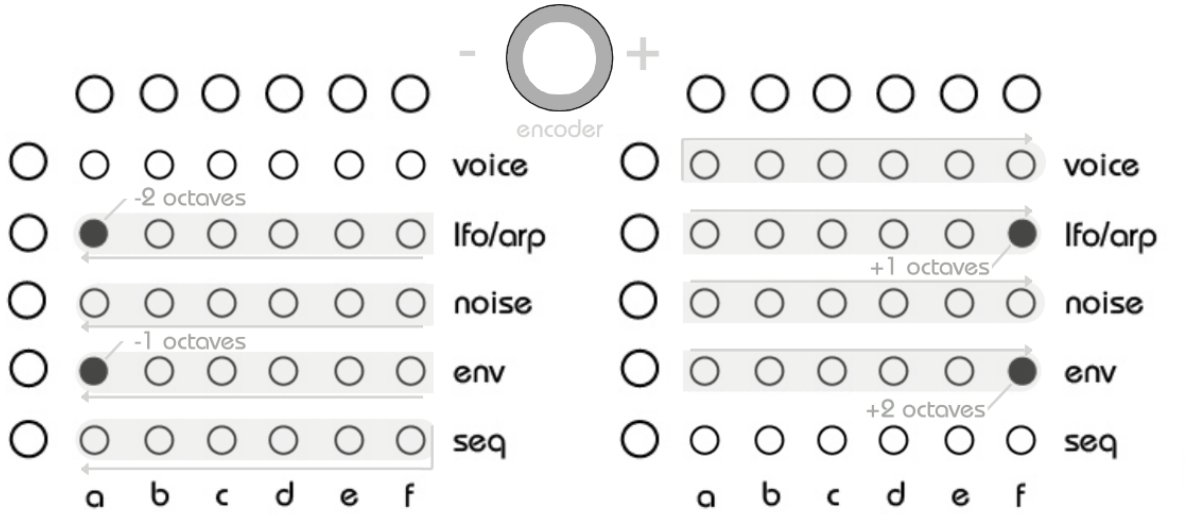
Tune: Select a voice via buttons **a** thru **f.** Transpose the selected voice with the data encoder. The voice can be shifted by +/- 2 octaves and is temporarily visualized in the matrix as follows:



As soon as you turn the data encoder, the LED matrix temporarily displays a dot representing the shift in semitones. It is back to the zero position when no LED lights up when moving.

Note: The tuning does not shift the envelope frequency along with it, so that the tuning can be adjusted to a selected envelope frequency if the envelope was previously activated for the respective voice.

The parameters of a voice can also be changed and selected without a voice being switched on beforehand. However, although the selected voice can then be adjusted, it cannot be heard.

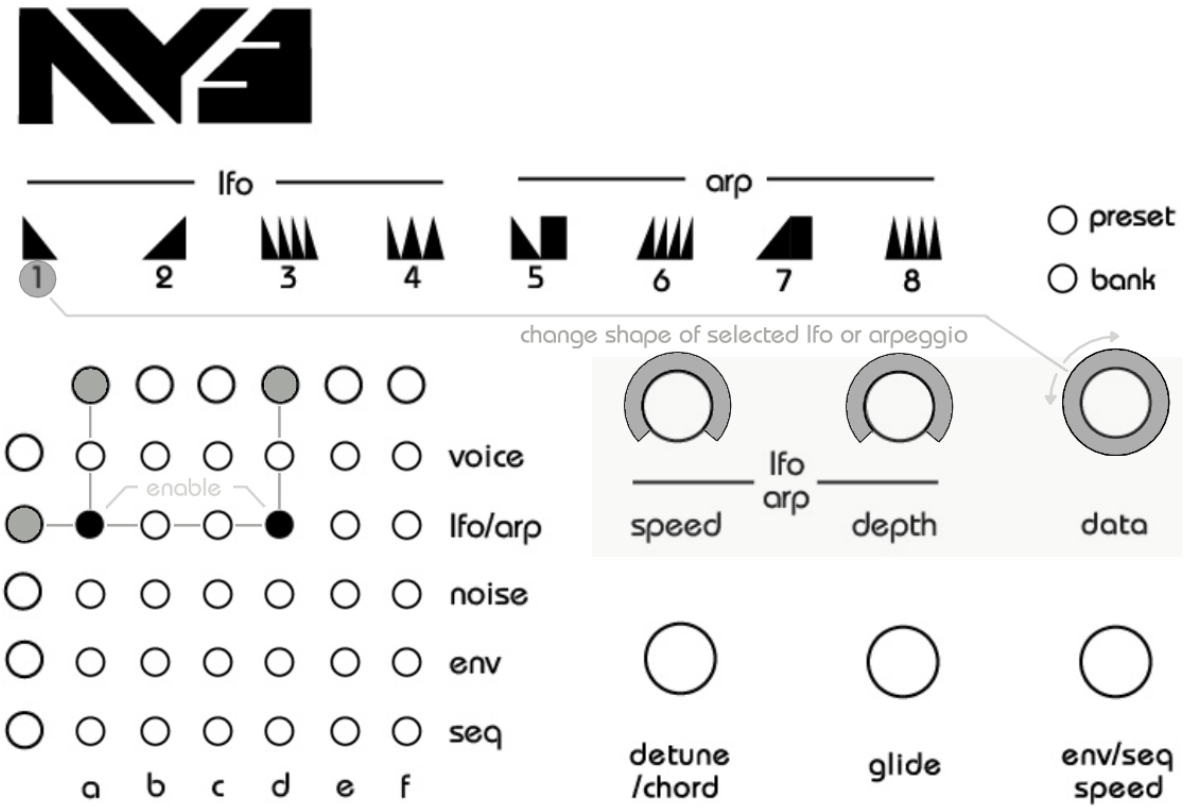
The mode is **exited** at the end of the scroll (E, V, T) or alternatively by pressing the data knob.

lfo/arp

Lfo/arp mode offers 2 types of pitch modulation: lfo & arpeggiator. Tap **row button 2** to enter lfo/arp mode. There are 4 modes for both lfo and arp. Enable or disable the lfo/arp on each voice by clicking the buttons **a** thru **f**. Scroll through them with the data encoder.

lfo: The icons above LEDs **1–4** indicate the selected LFO shape.. Use the **speed** and **depth** knobs to adjust the lfo accordingly.

arp: The 4 arp modes are up, down, up/down & random. The **speed** knob will adjust the arp's rate and the **depth** knob changes it's range in octaves.



Note: The arp loves to slave itself to midi clock!

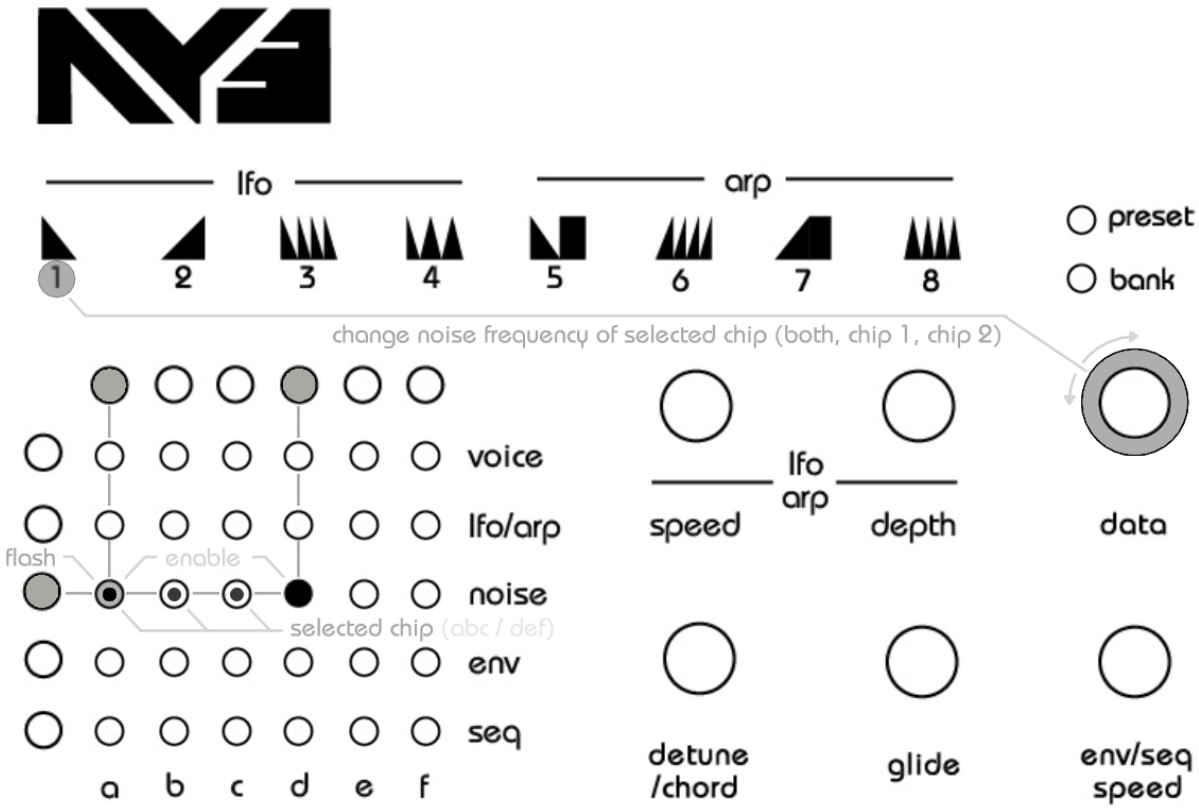
Noise

Noise can be applied to each voice by clicking on the buttons **a** thru **f**.
Click **row button 3** to enter noise mode.

Noise always applies to an entire chip: either voices **a–b–c** (chip 1) or **d–e–f** (chip 2). However, when called up for the first time, both chips are selected, and when repeated, chip 1 and then chip 2 are selected, and only then is noise mode **exited**.

Like Voice, Noise is triggered by a Note On/Off event and it can be switched between an “Extended Range” or a “Note Follow” mode by pressing the **data knob**. Due to its dual function as an **exit** button, noise mode can also be exited by holding the data button for a longer period.

The overall noise frequency can be adjusted by rolling the data encoder. Noise frequency is represented by LEDs **1** thru **8**.



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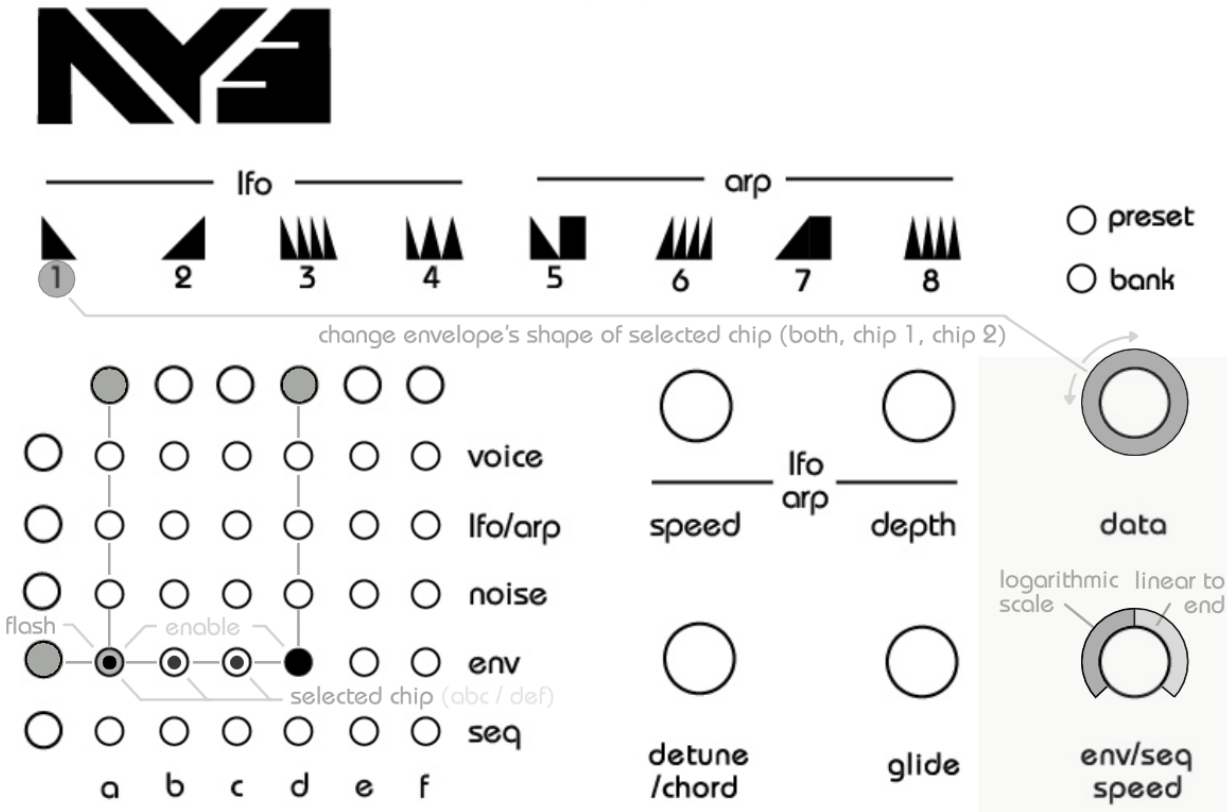
Env

Envelopes can be applied to control a voice amplification based on its shape. Tap **row button 4** to enter env mode.

Same here like noise: Envelope shapes refers to an entire chip, which relates either to voices **a–b–c** (chip 1) or **d–e–f** (chip 2). When called up the row for the first time, both chips are selected, then chip 1, chip 2 and then the mode **exited**.

Envelope can be switched between “extended range” and “note follow” mode by pressing the **data knob**, but you can also **exit** envelope mode by holding down for a longer period.

8 shapes can be scrolled with the data encoder (LEDs **1** thru **8**) and the speed can be adjusted via the **env / seq speed** knob.



Note: The repeating envelope shapes (3, 4, 6 and 8) are audible even when no voices are activated and at high speeds the envelope will self-oscillate!

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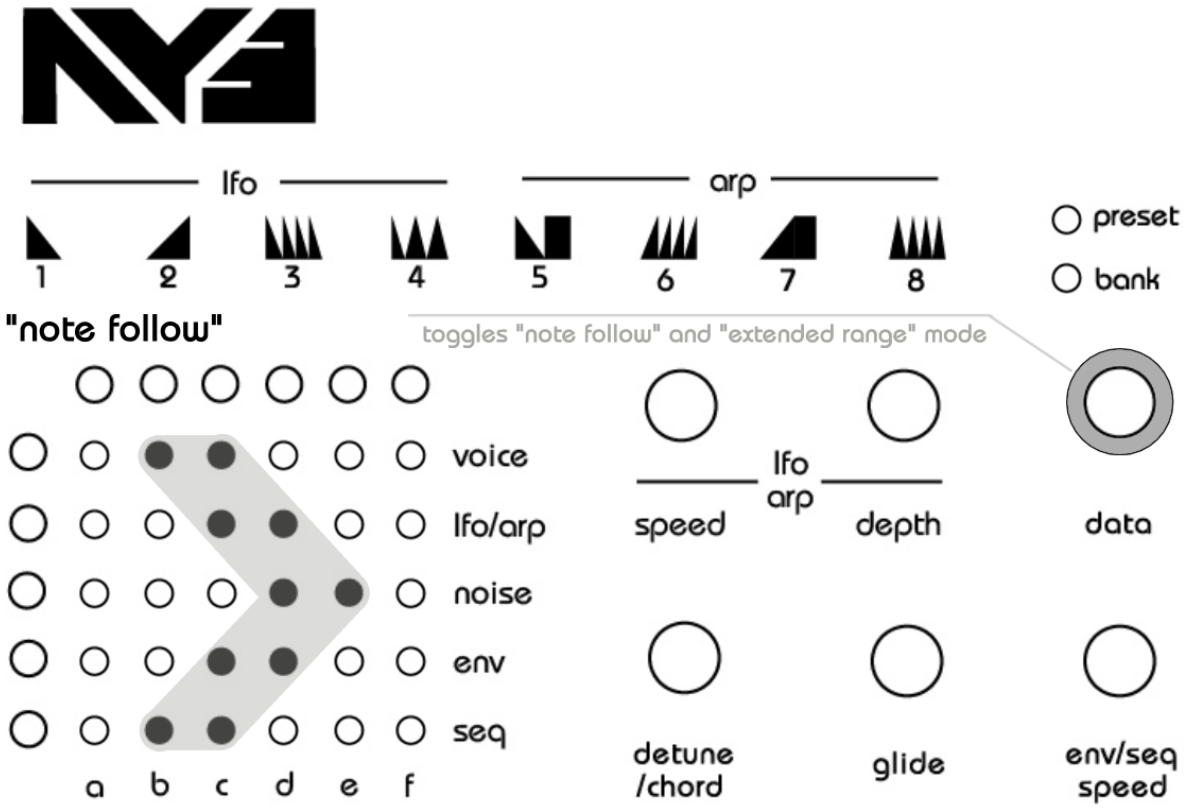
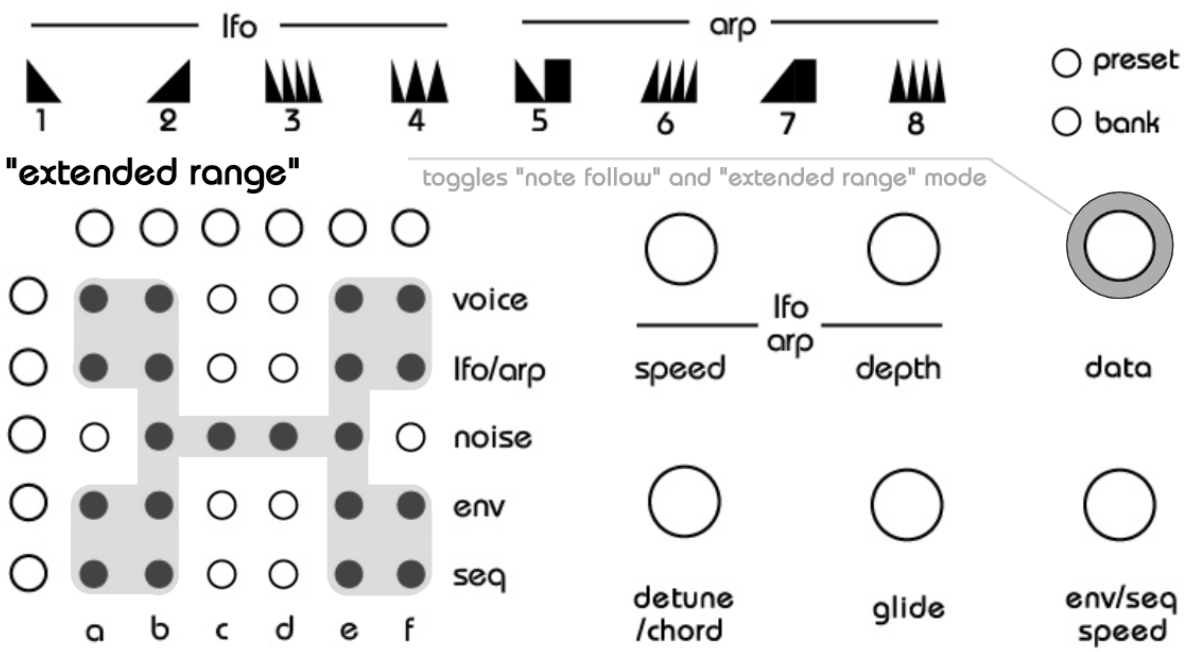
Note Follow vs Extended Range

The difference between the two modes, which can be set for noise and/or for envelope, is that with “Note Follow" Mode, the frequency of the incoming notes is mapped according to the tuning of the first channel of each chip (**a** and **d**). This can also be adjusted using the frequency parameters of the respective chip.



Unlike the "Note Follow" mode, "Extended Range" allows independent adjustment of the entire frequency range.

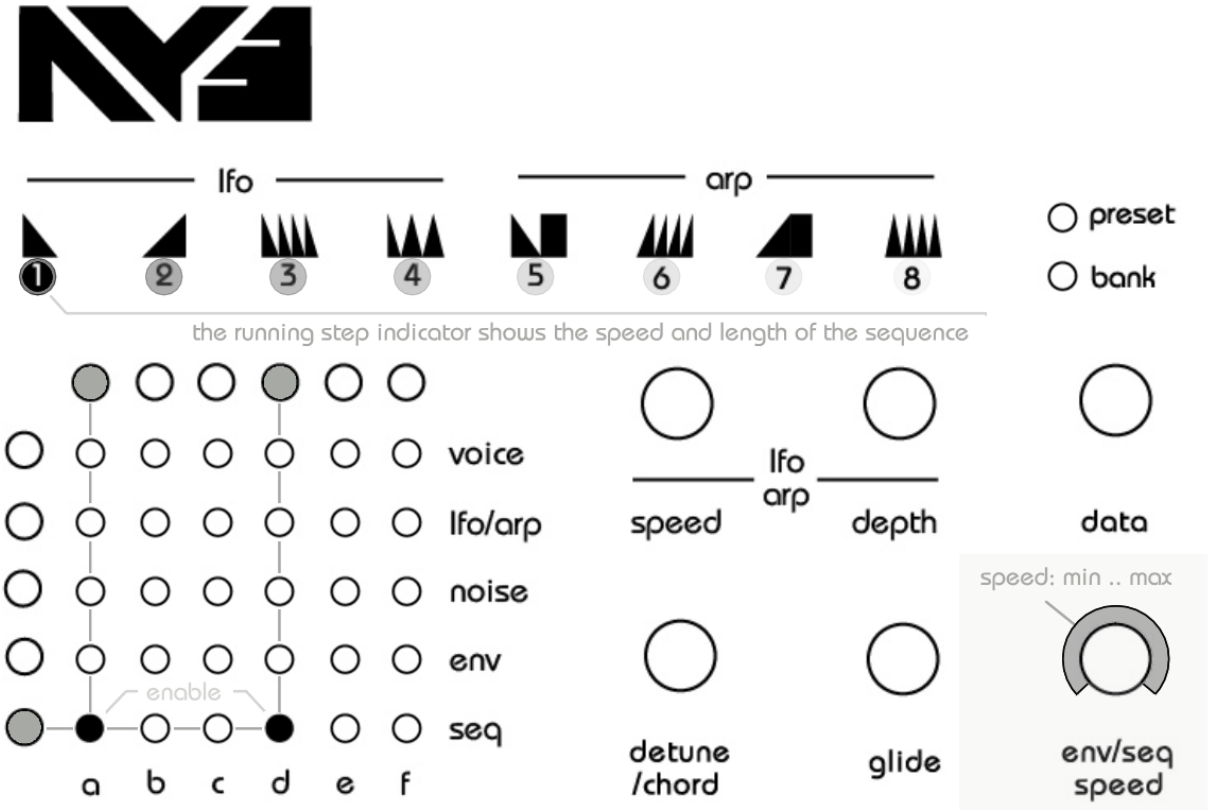


Note: Both modes can be stored separately for noise or envelope in the presets.

Sequencer

Each preset can store a 16 step sequence of 3 parameters: note, voice on/off, noise on/off and additionally the sequence length.

Tap **row button 5** to apply the sequence to a voice using buttons **a** thru **f**.
Note: If you press and hold the row button 5 for a little longer, you will enter sequencer edit mode (indicated by "S"), which you can exit by tapping the button again.



Each time a note is played, the sequencer is triggered for the assigned channels. Adjust the speed of the sequencer via the **env / seq speed** knob.

Note: The sequencer and envelope share the same speed, but the speed of the lfo/arp can be set separately, which together produces interesting effects. The speed parameter loves to slave itself to midi clock!

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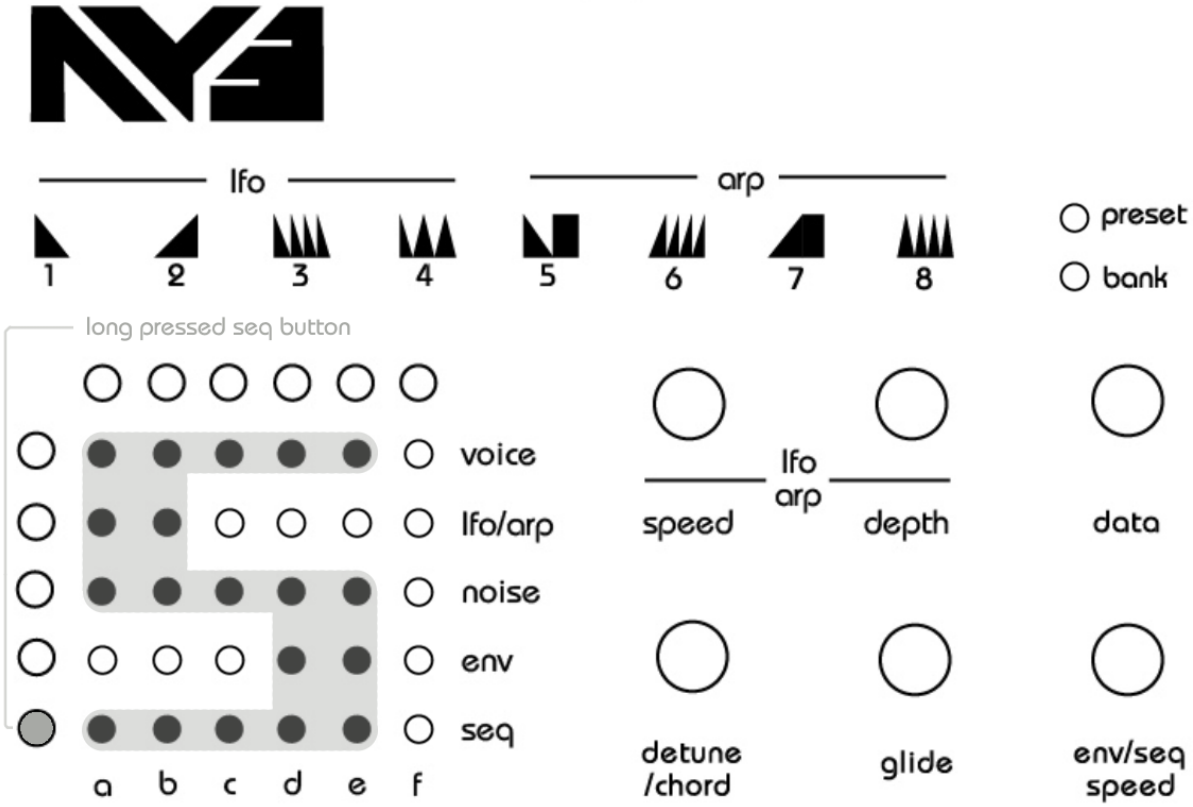
Programming the sequencer

Hold **row button 5** for **1 second** to enter sequencer edit mode (count-down displayed on LEDs **3** thru **1**). A big “S” should appear.

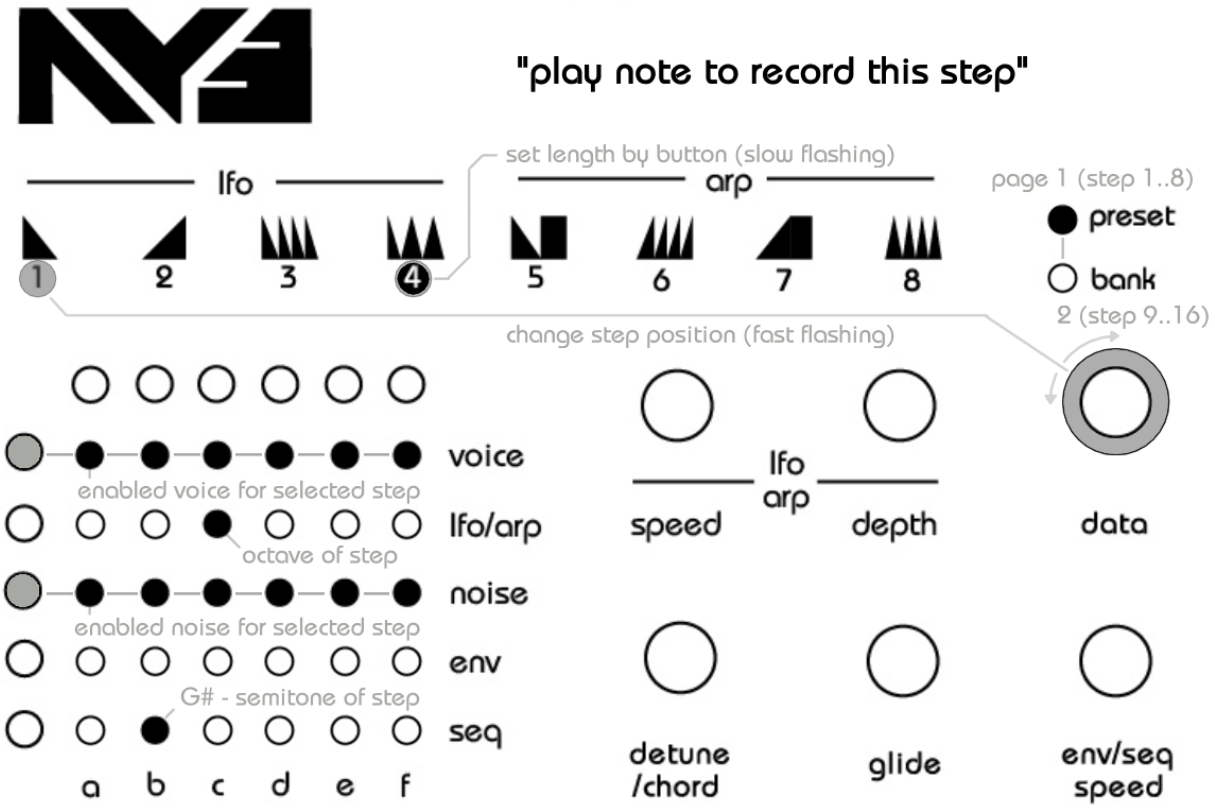


Now simply roll the data encoder to select a step to edit. The step position is displayed as a flashing LED number at the top. Now press a key on your midi keyboard to input the note, which should be saved for the step. The octave of the tone is displayed in **row 2** and the semitone itself in **row 4** and **5** (C..B). Tap the **row 1** button to toggle the voice on and off (the entire row is displayed). Tap the **row 3** button the toggle the noise on and off. The displayed lines indicate that voice and/or noise are activated for the selected step and only for this purpose can the sound be listened to.

A second slowly flashing LED indicates the **end** of the sequence (default position: 15).

Remember that the maximum length for the sequencer can be 16, and the LED ticker only goes up to 8, which means that the sequencer is split into two pages, which can be easily distinguished here using the preset LED (**page 1**) and bank LED (**page 2**).

If you want to limit the length of the sequence, turn the data encoder to a specific position and press the **data knob** once. The slowly flashing LED is now displayed at this point.



Note: If the length is limited to 1, the entire sequence range is reactivated.

Press **row button 5** once to exit sequencer edit mode.

Detune/chord & glide

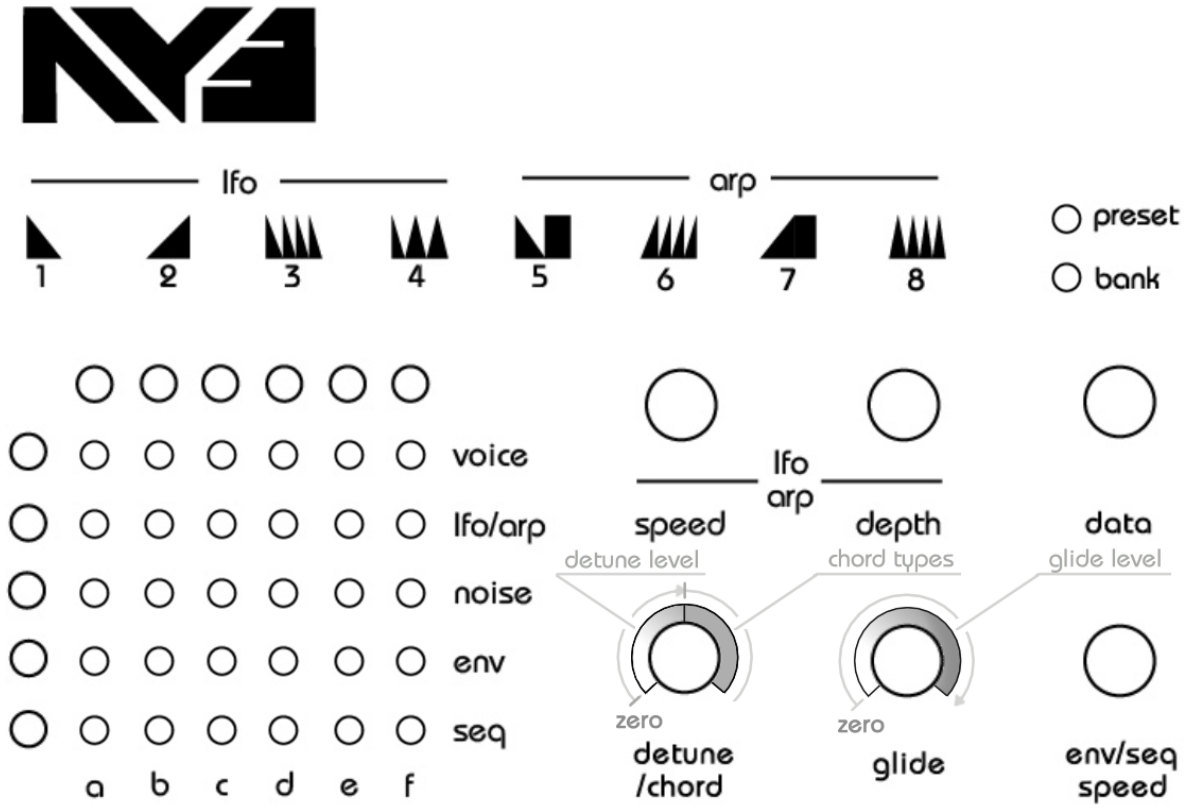
Detune/chord: The **detune/chord** knob has multiple modes:

0 %	hold all voices to perfect unison
1 - 50%	detune the 6 voices (aka fatness)
51 - 90%	choose between chords (LEDs **1** thru **8**)
100 %	the AY3 becomes a polysynth. You can play up to 6 voices simultaneously

Note: If you want to hear the chords in their entirety, all voices must be activated.

Glide: The **glide** knob adds glide aka portamento to the synth's pitch.

Note: Try gliding between the chords!



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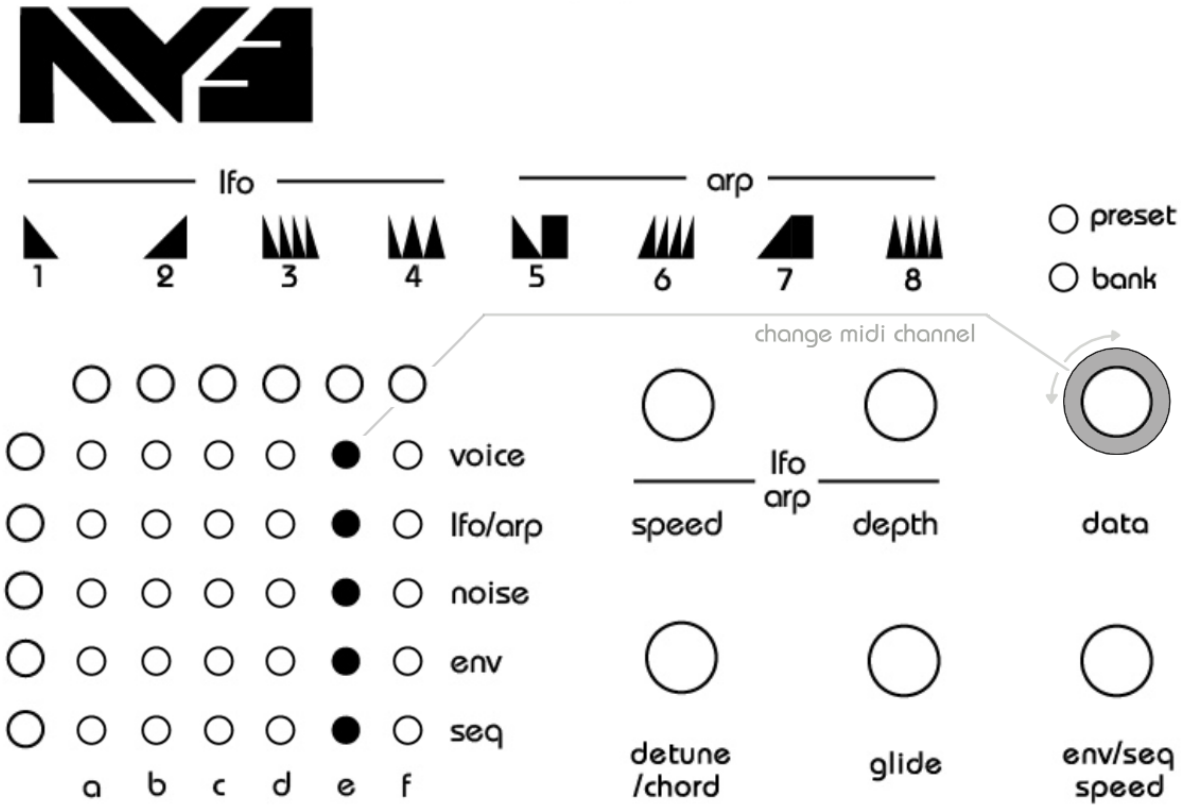
Change Midi channel

To change the global midi channel AY3 responds to (default 1):

- Hold the bottom left button (seq) on startup
- You will see a big number 1 on the display, turn the data encoder to set the desired channel then unplug the AY3 and reboot



Playback

Starting with version 4, it is possible to play original songs from the great era of home computers directly on the AY3 in real time and also modify the incoming parameters.

Note that the playback pitch depends on the home computer the author originally used, which was used to create the song. The AY3 can be operated at a clock speed of **2 MHz** (Atari ST), but newer versions of the voice boards (>= revision b) can also be operated at **1.77 MHz**, which corresponds to the widely used ZX Spectrum, resulting in a difference of approximately 2 semitones compared to the Atari clock. There are also other variants in which the AY3 chip was used with even lower clock rates, but these are not supported by the AY3 in its current form.

In short: If you have owned an AY3 for a long time, only the higher Atari clock is available to you.

Preparation

You need a host player (a modified AY Emul 3.0 for Windows that supports the AYMID protocol), a collection of songs you would like to play, a MIDI connection, and that's it.

You can get the modified **AY Emul 3.0** with **AYMID support** in AY3 section: https://www.twistedelectrons.com/downloads-firmware

Fortunately, the author of AY Emul (*Sergey Bulba*) not only hosts the player, but also maintains a complete song collection (Tr_Songs archive) on his website, similar to the HSVC for the SID melodies of the C64.

The original source of AY Emul and the song collection (archives of music) can be found here: https://ay.strangled.net/

Configuration

The **AY Emul - AYMID** version looks like this, which uses a modified skin from **Ironfist** by default (thanks to him).

You can also design your own skins. On the Author's page, you will find a Skin Manager II that is compatible with this version.

The AY Emul can also be registered with file types. General information on operation and supported formats can be found at:

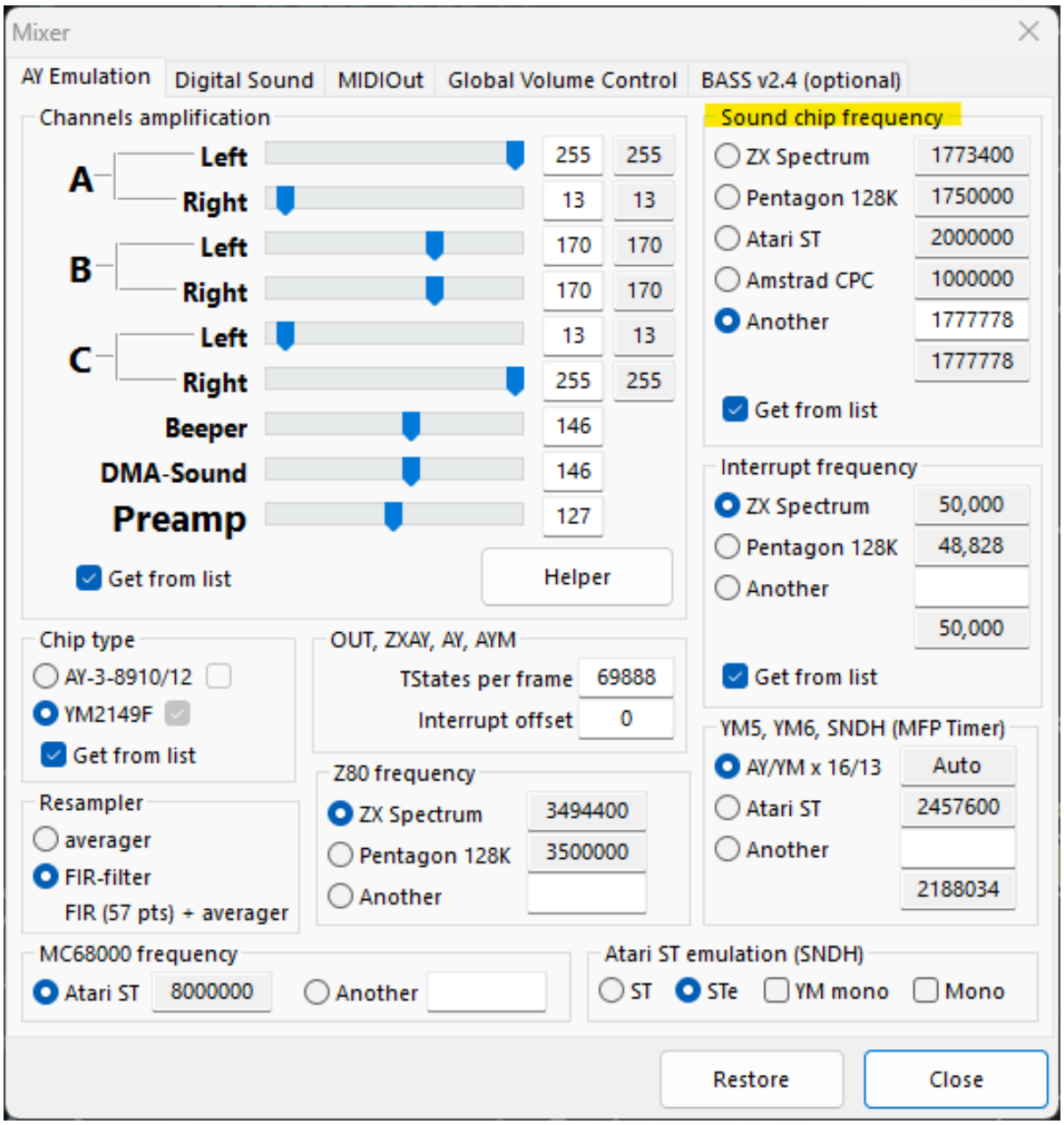
https://documentation.help/AY-3-8910.12-ZX-Spectrum/documentation.pdf
or directly on the https://ay.strangled.net/ page.

Once you have familiarized yourself with the program, you can easily create playlists, search for specific songs, change playback behavior, and much more. Please note, however, that AY Emul no longer runs as an audio emulator in AYMID mode and therefore it does not send sound data to your sound card. Instead, the program only serves as a host to transfer the register values to the AY3 for the respective register state in real time. This can also be seen in the volume control, which can no longer be operated once AYMID is activated.

Nevertheless, it is still possible to use AY Emul as an emulator in this variant.

Three steps must be completed in advance so that the host sends the data to the AY3. To do this, press the small mixer icon in the upper rig:

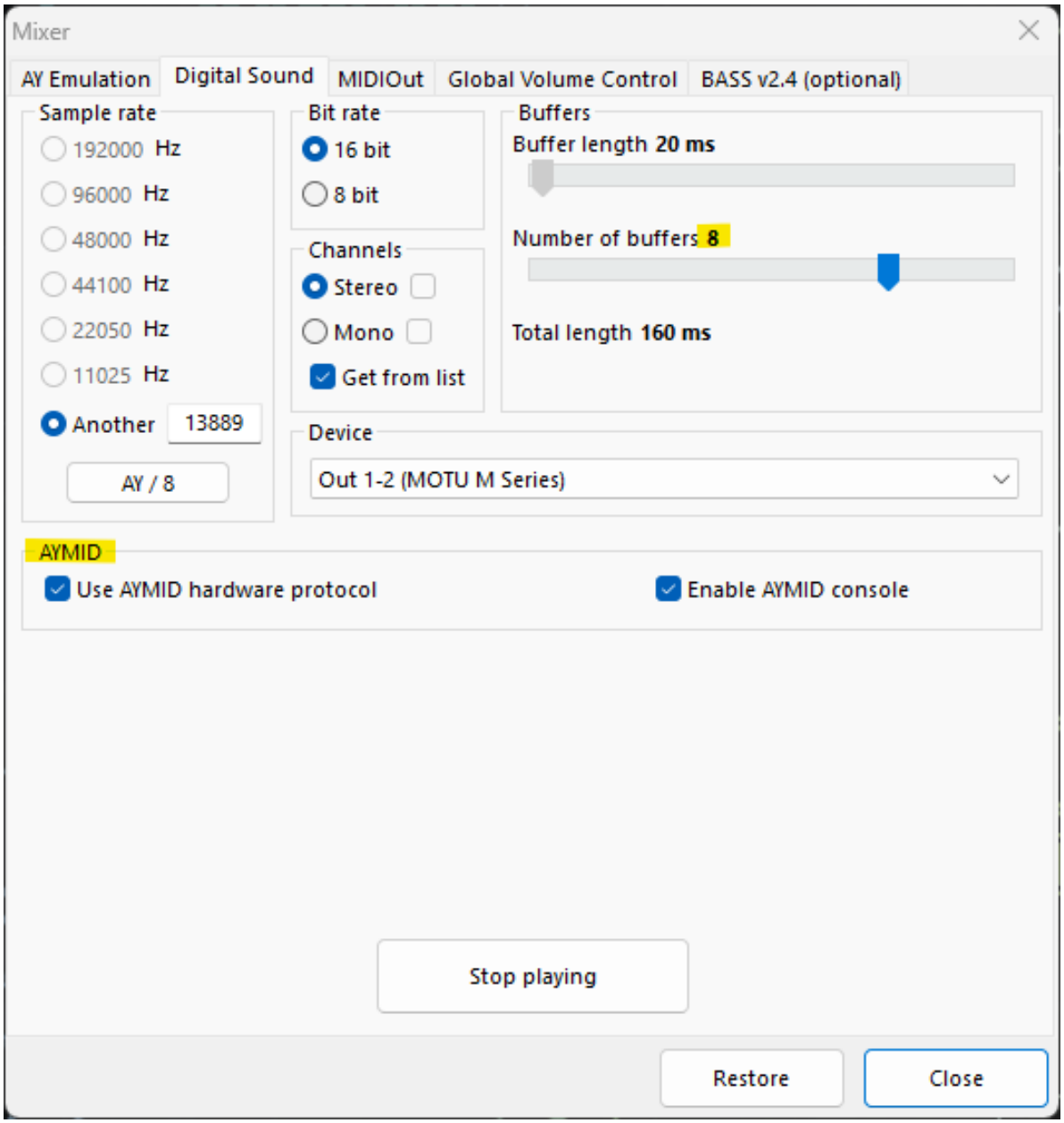
Here you can access the first tab to adjust the sound chip frequency:



This step is more about processing the data in sync than directly influencing the AY3. However, both programs (emulator + firmware) should be configured with the same clock speed so that it matches exactly with the data stored in the register data at that clock speed. So if you are running AY3 at **2 MHz** (default), this must also be configured here as **Atari ST**; Otherwise, you can also set the odd frequency of **1.777778 MHz** for your revision B board to match the ZX clock.

The player's operating mode can be set on the second tab. The sample rate should be calculated automatically based on the clock speed selected in the first tab as soon as the AYMID protocol is activated here. The buffer length is fixed at 20 ms, and with **8 buffers**, the host runs best for real-time transmission.

If anyone is interested, the **AYMID console** can also be activated to see which data is being transmitted in real time.



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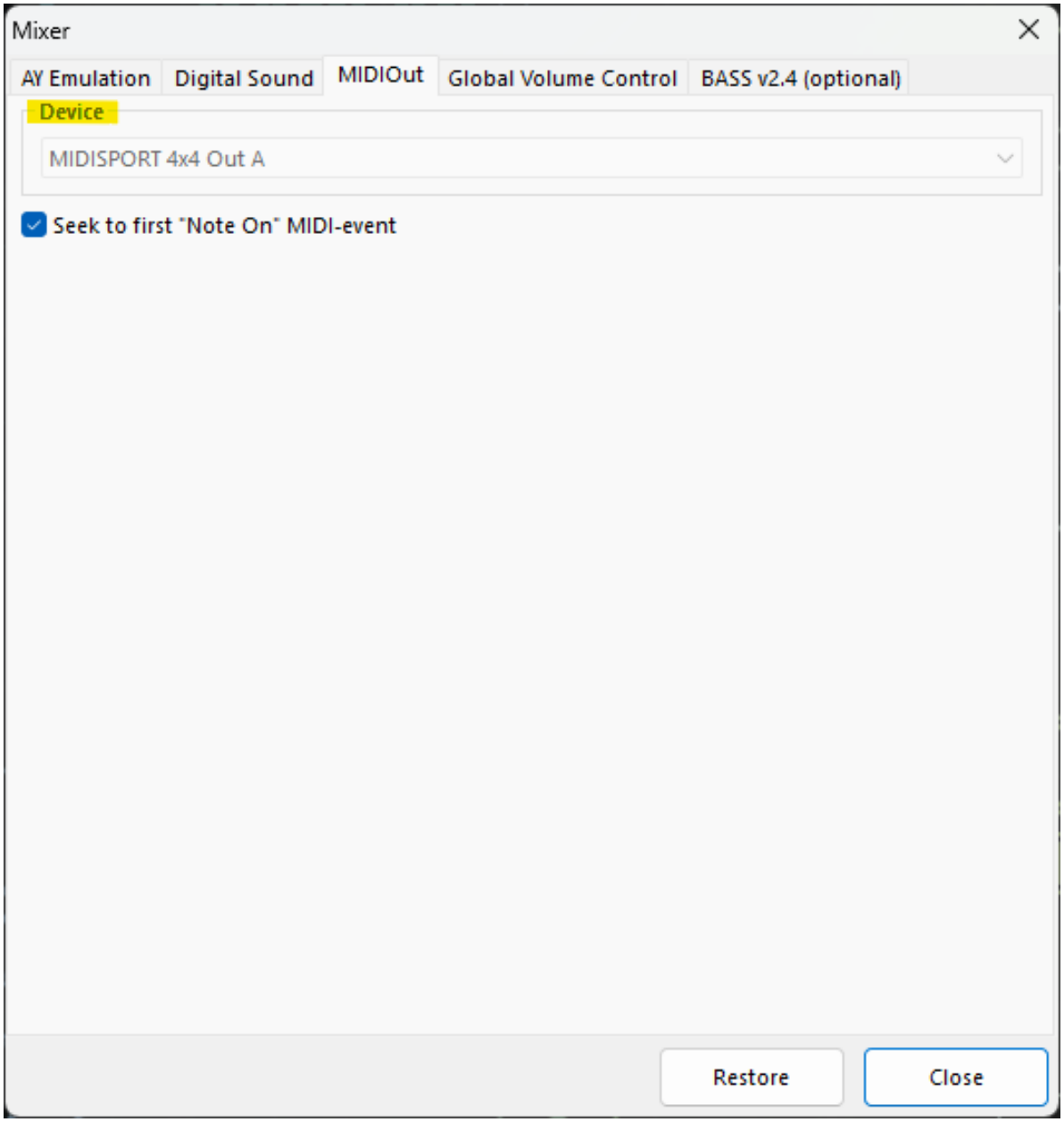
In the last tab, “MIDIOut,” the MIDI interface to be used must still be configured. All other options can be ignored:



It should also be mentioned that MIDI transmission is already reaching its limits here, and this is noticeable even with just a few songs (fortunately only a few) containing a lot of simultaneous data.

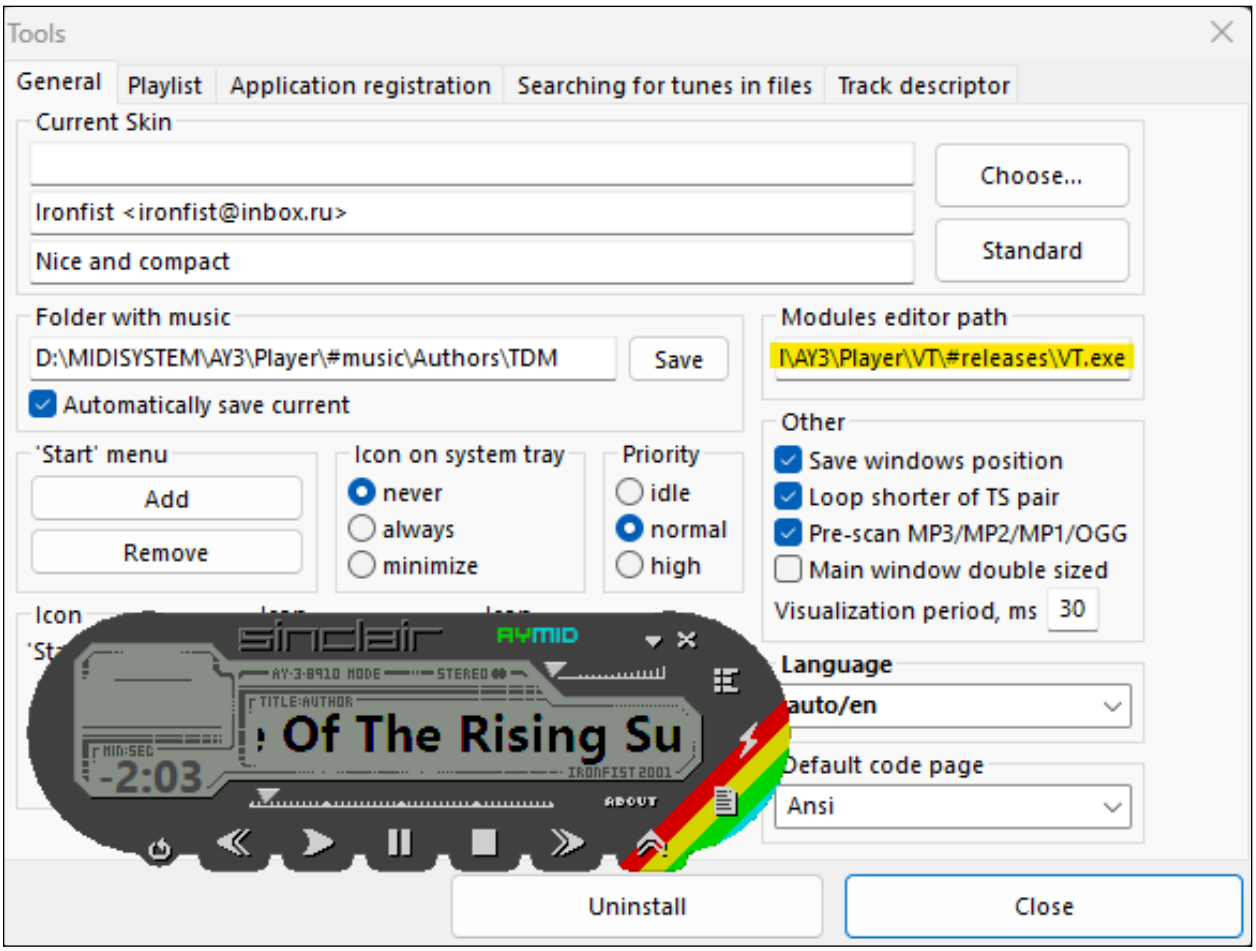
When the player is started, the AY3 automatically switches to **remix mode** and immediately displays the incoming data on the device. If the AYMID Console is active, you can track the transmission of data:

To **exit** the remix mode on the AY3 device, stop Ay Emul and hold down the **data knob** for **3 seconds**. After a progress bar appears, the AY3 will switch back to the synth engine.

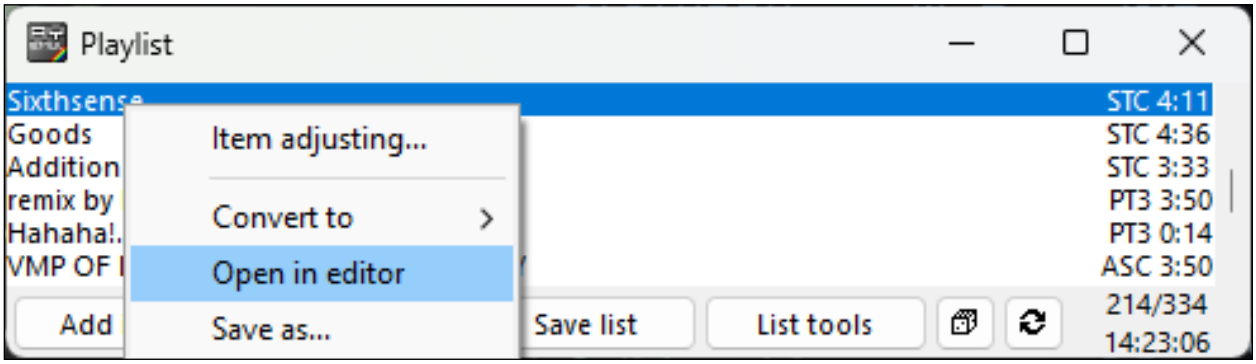
Composing & Editing

If, in addition to simply playing songs, you also want to compose songs yourself directly on the AY3, or just want to take a look inside or even modify the songs, you can use the **Vortex Tracker II** with AYMID support, which was originally developed by the same author as AY Emul (*Sergey Bulba*).

You can even link this tracker to AY Emul so that you can open a song directly in the playlist and edit it in VT II. To do this, the **"Modules editor path"** to your VT.exe must be configured in AY Emul in the **Tools**:



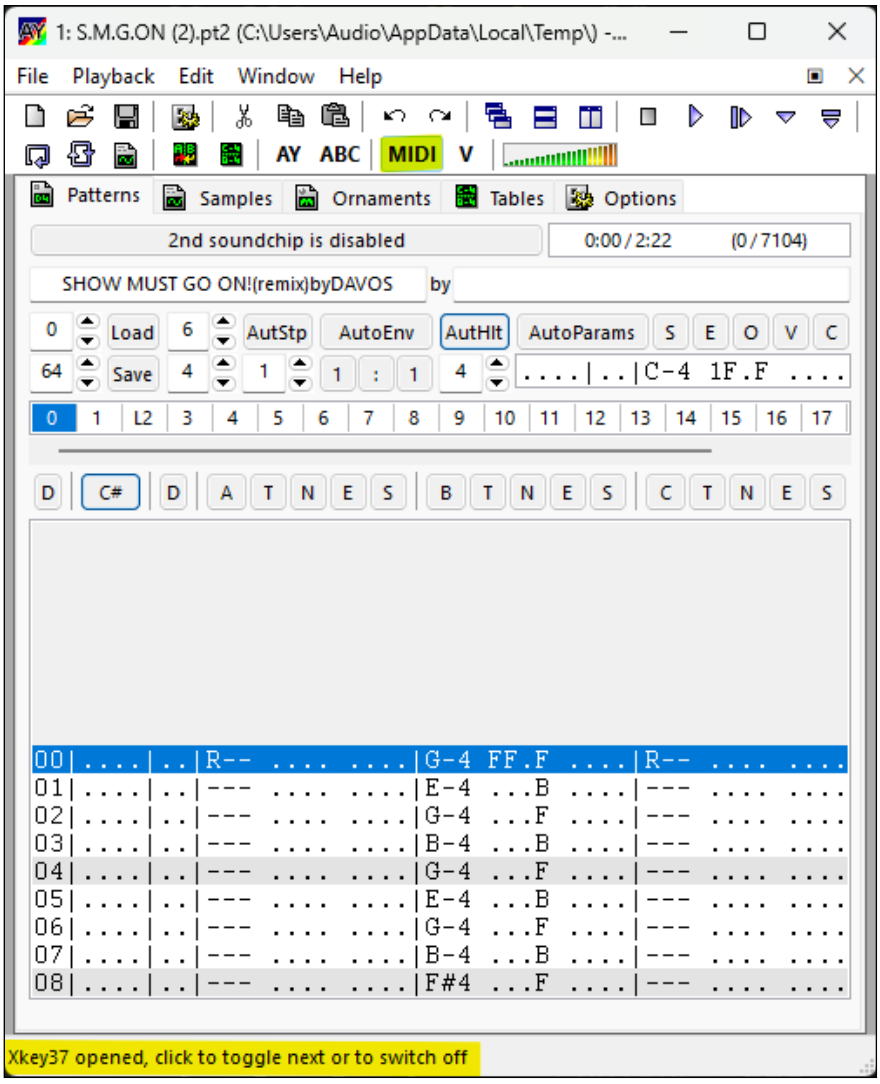
Next, you can select a song from the playlist with right mouse click and select "**Open in editor"** from the context menu, as shown in the following screenshot:



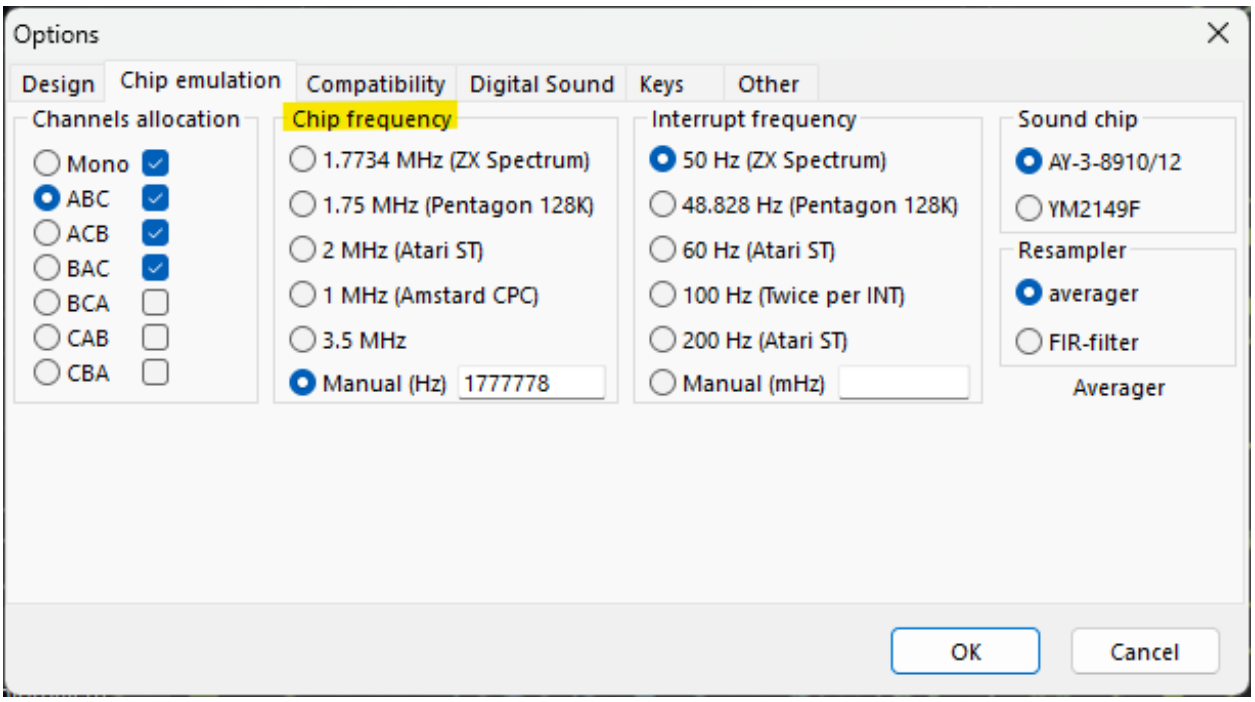
If linked correctly, the **Vortex Tracker II** will open as follows. First, you must set up your MIDI devices (input and output) correctly once.

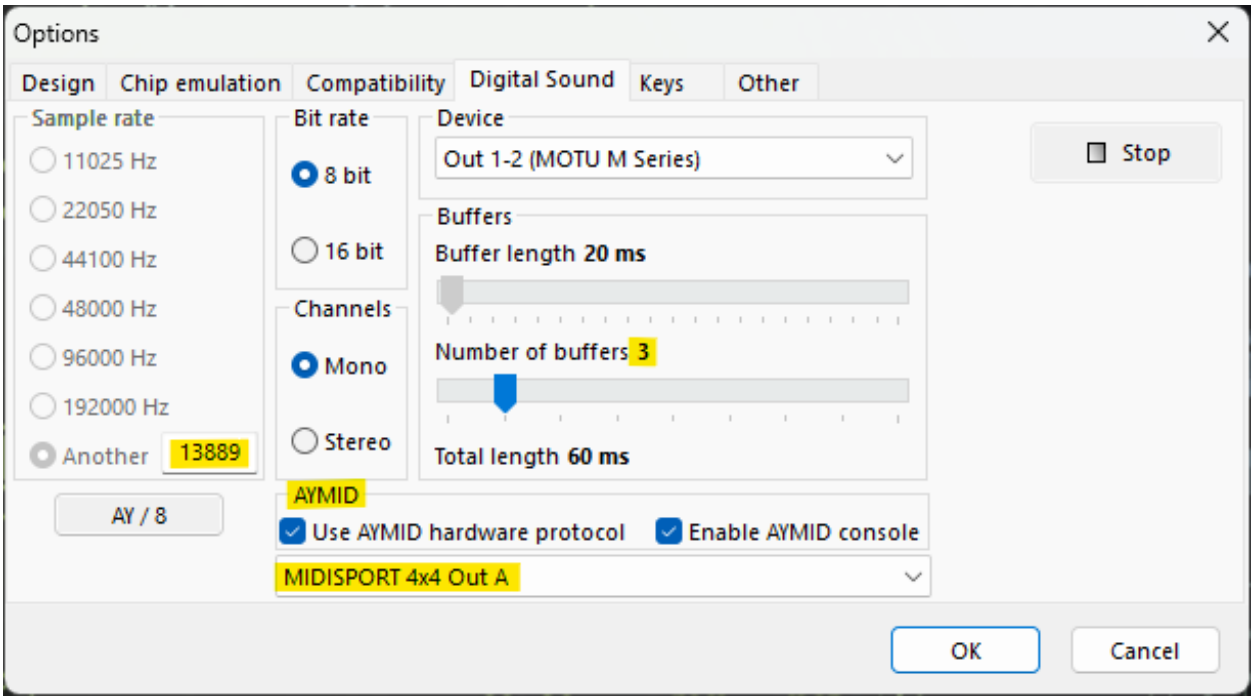
To receive notes via an external keyboard, click the **MIDI** button several times until your device appears in the status bar.

Next, you need to open the **Options dialog** to configure the MIDI out device to communicate with the AY3:

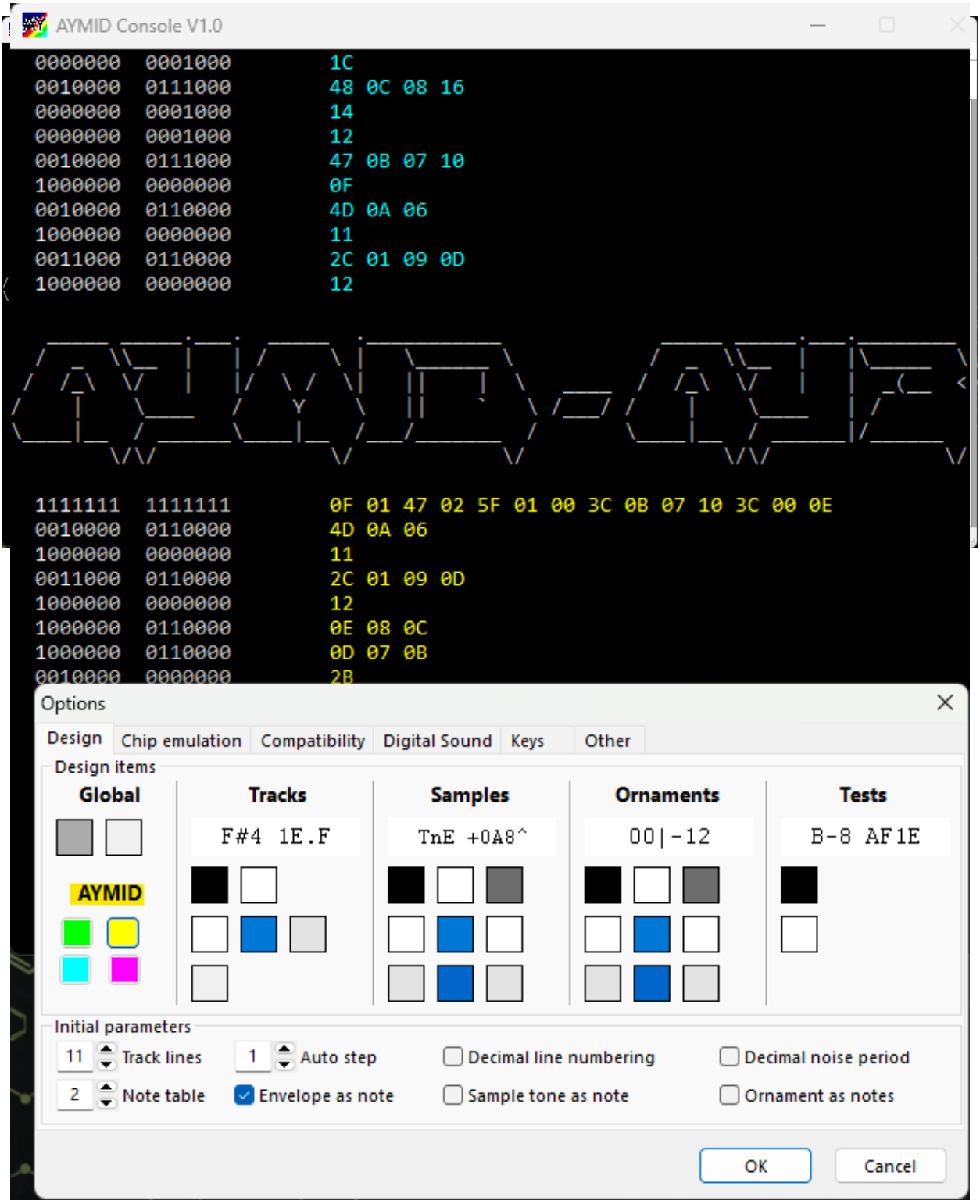


There, you must set the **chip frequency** according to the AY3 (**1.77** or **2 Mhz**) and enable the **AYMID hardware protocol** and your **MIDI** device in the "Digital Sound" tab, as well as optionally activating the AYMID console. Unlike AY Emul, the number of buffers must be set to **3** *(keep it short to avoid any visual delays).*





Once everything is configured, the Vortex Tracker should now look like this and is now ready to play the songs on your AY3 device:



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To understand how the Vortex Tracker II works in more detail, it is helpful to read the Tracker manual.txt in the Documents folder and also take a look at the following links (as long as they are still available online):

[1] Manual for Vortex Tracker II by Garvalf
http://garvalf.online.fr/index.php?page=articles_vortex_tracker.en

[2] Chipmusic.org Forum – Vortex Tracker II Tutorial
https://chipmusic.org/forums/topic/27/vortex-tracker-ii-tutorial/

[3] MSX.org Forum - Vortex Tracker Program
https://www.msx.org/forum/development/msx-development/vortex-tracker-program?page=1

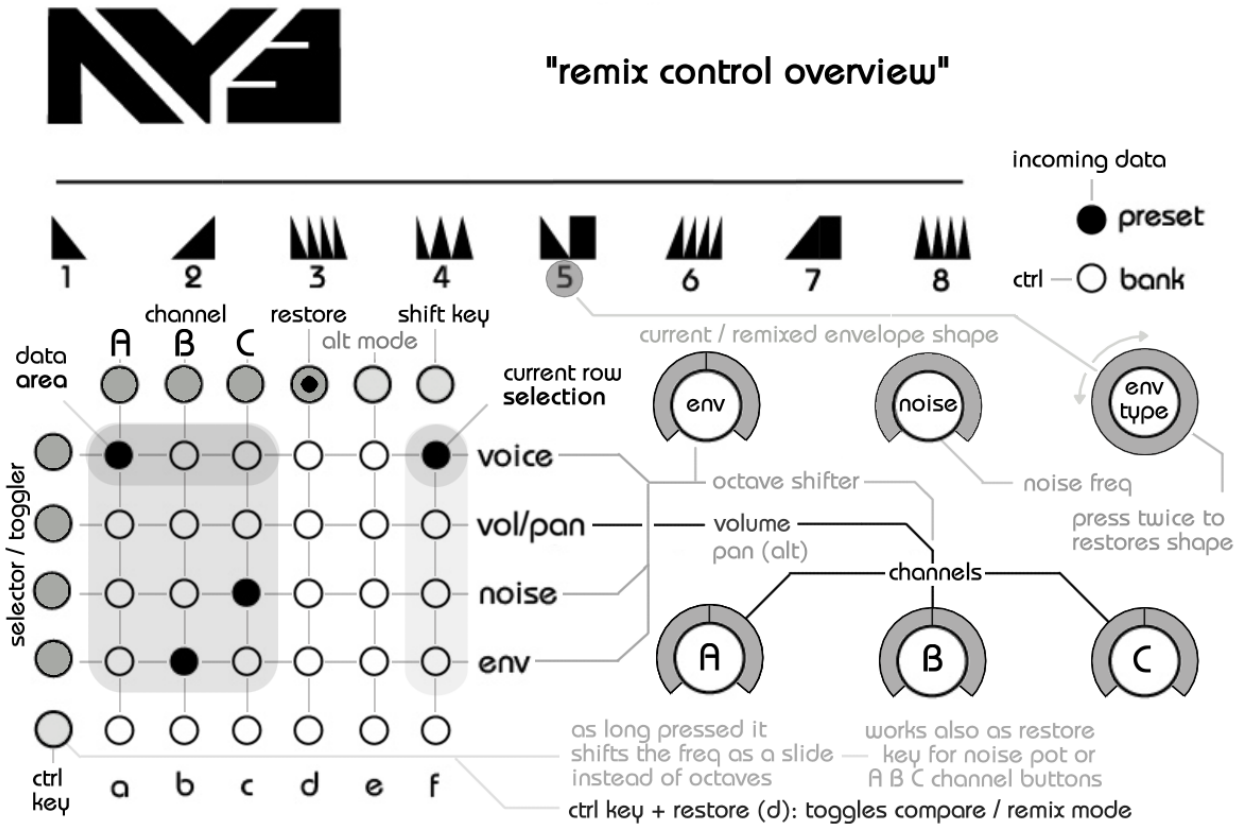
[4] Vortex Tracker II Effects Commands
https://battleofthebits.com/lyceum/View/Vortex+Tracker+II+Effects+Commands/

Note that you can change the **color** of the **console output** in the options to differentiate it from the AY emulator.

Remixing

Actually, playback and remixing cannot be separated, but there are so many modifiers that it definitely deserves its own chapter here.

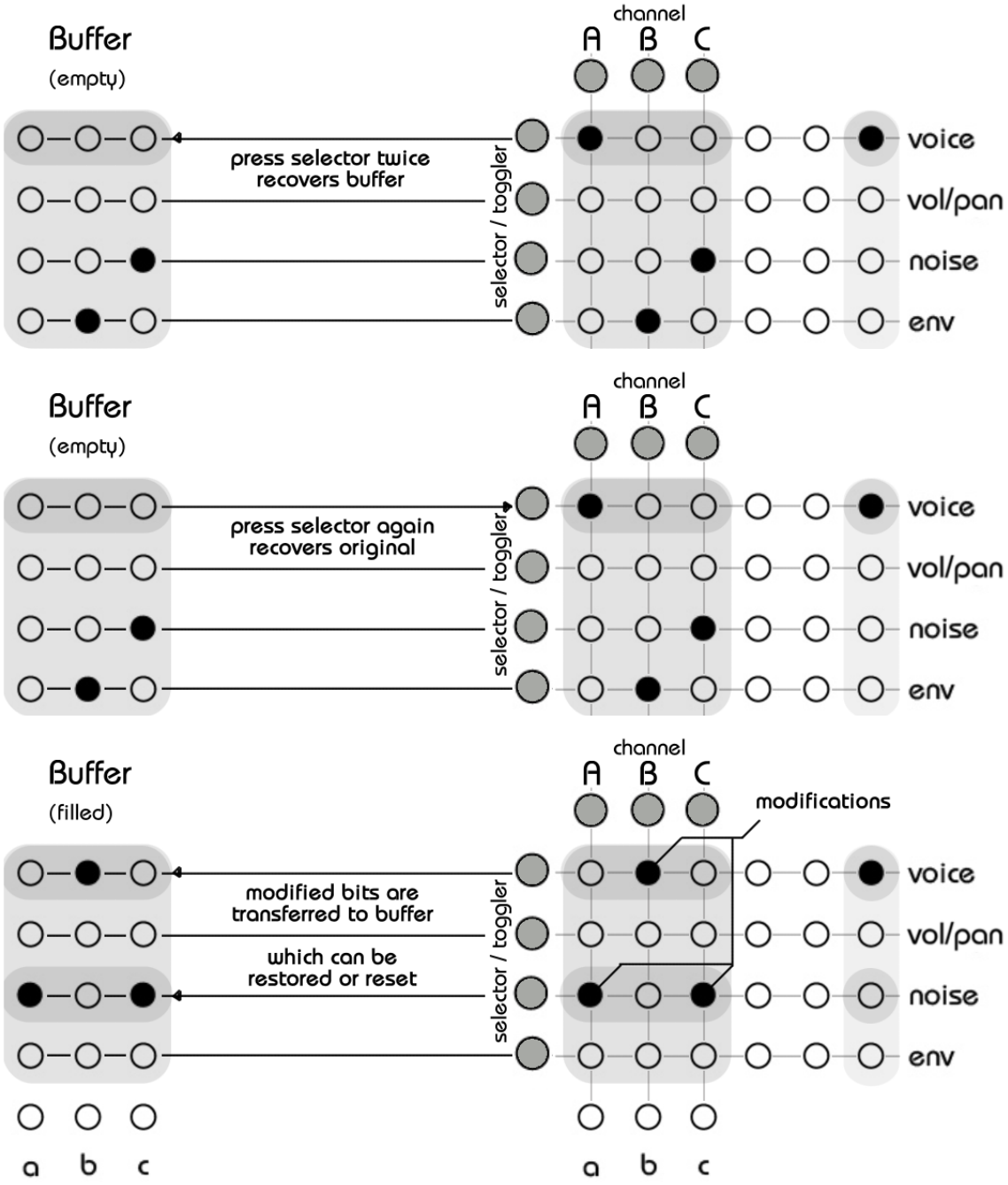
Since there are not too many buttons but many possibilities, almost every button has a dual function or a certain logic to operate. The following illustration shows the LED area for incoming data on the left and the areas to operate around it:



It's normal to feel a bit lost when using it for the first time — but don't panic. The most important button to remember is the **'d' button**, which **resets all** remix parameters and continues playing the song in its original form.

Take a look about the connections above. A usual workflow is to **select** a **specific row** of the data area (voice, vol/pan, noise, env) on the left side and then start to toggle the bits for the corresponding channel via A B or C buttons.

When **selecting rows**, it is important to note that if a row has already been selected (pressed twice), this action will **toggle** the bits in the entire row between their original and the muted state. If individual bits have already been modified, they will toggle back and forth between their original and the remixed state.



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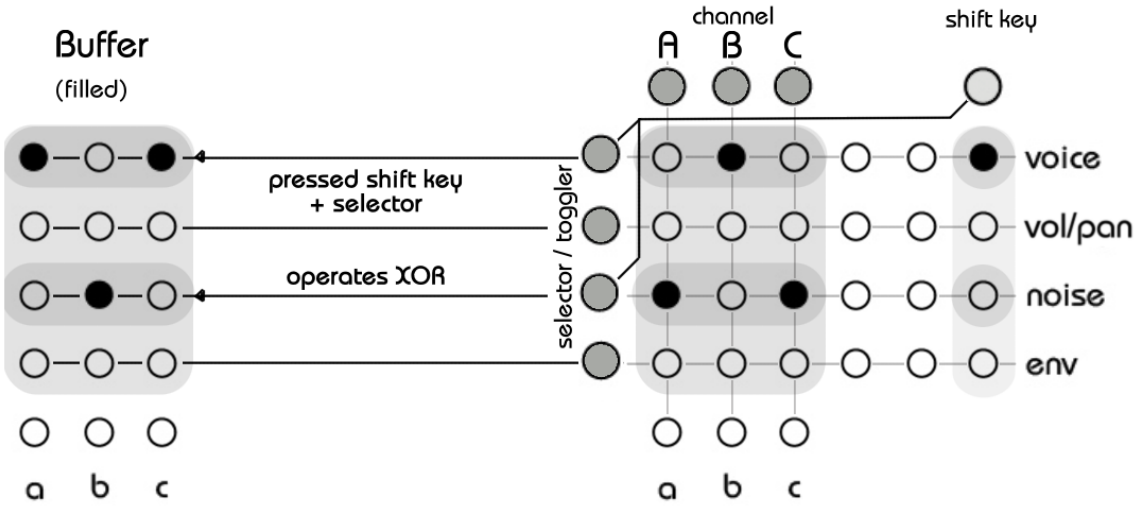
If the **shift key** is held down while pressing the selector buttons, the bits of the row are also toggled, but by means of an **XOR** operation.



Note: This toggling process works by means of a double buffer, which is repeatedly accessed or directly overwritten when changes are made. Please also note that parameters are not switched on and off immediately (even if it feels that way), but modifying the bits always applies to the next incoming data!

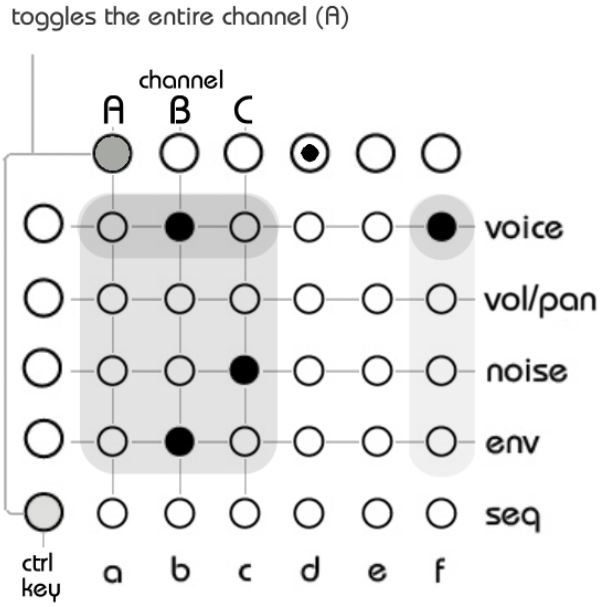
A little easier to understand is the right side of the panel. The data encoder and potentiometers work identically for all selected rows (except for the selection in **row 2: vol/pan**). The first upper potentiometer changes the octave of the envelope frequency, and the three lower ones change it for the tones of channels A, B, and C. Only the noise parameter can be finely adjusted for its frequency using the second upper potentiometer.

If the **ctrl key** is held down while these potentiometers are turned, it shifts the frequency as a slide instead of stepping through the octaves. For the noise pot, holding down the ctrl key and turn it to restore the frequency.

With selected **row 2**, the volume is attenuated with the lower potentiometers starting **at half** of the potentiometer's working range. This is confirmed by the corresponding LED for channels A, B, or C lighting up.

The data encoder can select a different envelope type (shape). This only happens once you turn the data encoder and then confirm the new shape by pressing the data knob. If you press the twice, it will switch back to the incoming shape.

If the **ctrl key** is pressed simultaneously with one of the 3 channel buttons, this action, similar to that for the rows (described above), switches the bits for the entire channel between their original and muted states. If individual bits have already been changed, they are switched back and forth between their original and newly mixed states.



There are two further modes that need to be described in more detail: **alt mode** and **compare mode**.

alt mode

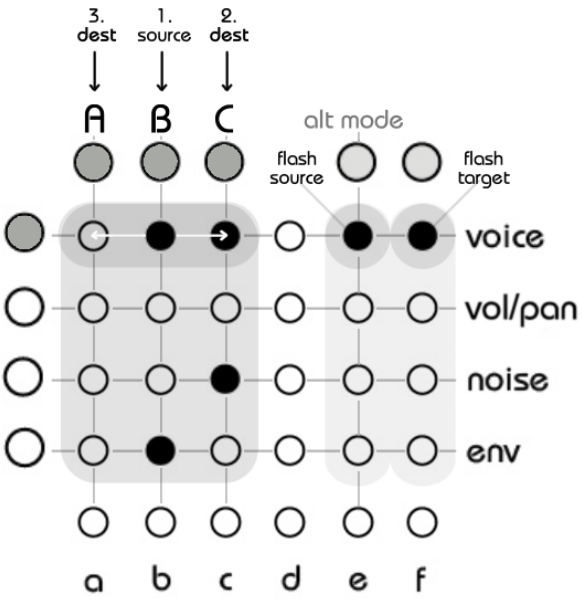
The alternative mode (please do not think of an alt key) can be enabled and disabled using the “e” key. The alt mode **highlights** the **selector cursor** in the column infront and it gives the impression that two points move up and down in unison when you select the rows.

The alternative mode enables two special types of parameter linking during playback: **voice snatcher** (eats its way through the voices) and **pitch snapper** (envelope occupies the pitch of an running voice).

Within the **vol/pan** row (labelled by lfo/arp), the voice can be placed in the **stereo field** for channel a, b and c. *Note: This is done by calculation, not via the audio path, and the toggle actions always refer to the volume.*

voice snatcher

It is possible to **link** two or even three voices together by using the alt mode in **row 1**. The first selected voice is always the **source**, and each subsequent selection is the **target**. In principle, the pitch of the source voice is copied to the target and the respective “enable” bits are transferred - but **twisted**!



The assignment is made using the buttons **a**, **b**, or **c**, which no longer toggle bits but rather describe the selection of source and target. If you are in alt mode and both cursors are flashing at normal speed, neither source nor target is set. If you now select voice 1 (a) then this voice is set as the source and the first cursor at the end of the row flashes wildly, listening to its incoming data for transmission. If you now select voice 2 (b) or 3 (c) then the next channel is marked as the target, and the second cursor begins flashing wildly while waiting for the data to be transferred. If both cursors are flashing as if processing, it means something has been linked. The assignments can be detached by repeatedly pressing the voices.

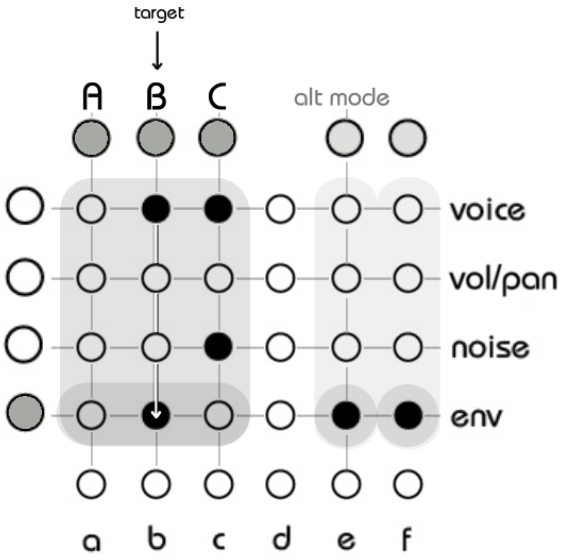
The result is sometimes acceptable and sometimes not. In addition, there are relatively many possibilities, as the order in which the channels are set in relation to each other plays a role. This can cause a shuffle effect, the erasure of voices, or rhythmic behavior. Pitch transmission plays a special role in connection with active envelope on the target channels.

pitch snapper

The pitch snapper **links** the envelope to a running voice and takes over the frequency there. First, the same channel is searched, then the next channels, until a frequency can be assigned to the envelope.

The workflow is similar to the voice snatcher, except that the **env** row must be selected beforehand. Then the **bit** can be **toggled** for channel **a**, **b**, or **c** (regardless of whether one was ever set on this channel), but this time it can be assigned loose and regardless of order. The pitch snapper does not link the voices to each other; rather, the voices now target the envelope directly. Since there is only one envelope that can be addressed by all voices, you should start with a single activation.

The frequency of the envelope is adjusted to the frequency of the first voice found for the active slots. It is now a good idea to take a look at the current (preferably repetitive) **shape** or to adjust it, and it is worth shifting the **octave** of the envelope frequency with the first upper potentiometer in order to be able to tune the envelope tone even better.

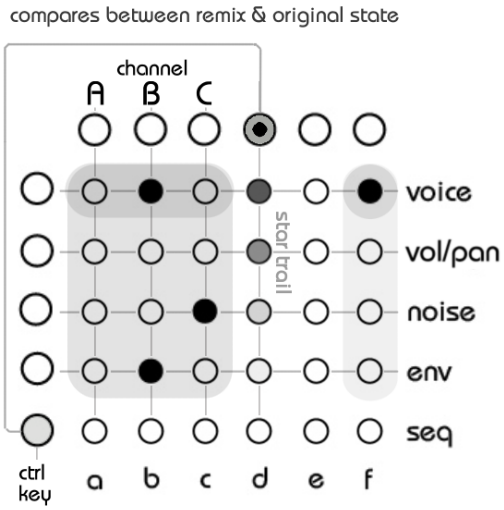


Not every channel is suitable, but it is relatively easy to activate the envelope that is not present in the song but can take over the sound of the voices.

As long as you use repetitive shapes, the result can be a fading effect, a wah-wah effect, or singing along with the voices you capture.

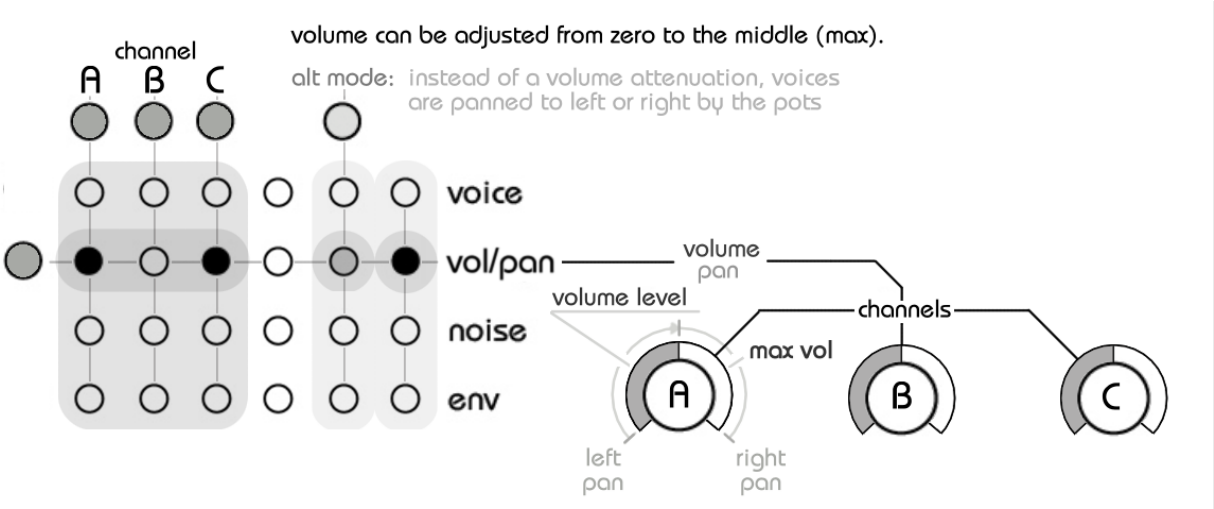
compare mode

In compare mode, you can make a direct comparison to the original, or take a break while you're remixing, and then dive back into the remix setup. To do this, simply hold down the **ctrl key** and press the **restore** (d) button. In this case, it doesn't discard all your remix parameters, but switches to a clean sound. A star trail of incoming data is clearly visible in the fourth column, indicating that active compare mode is enabled. Press again to restore the remix.



volume / panorama

Since this topic has been somewhat neglected so far and the selected **row 2** is handled differently from all other rows, here is an overview of how to modify volume and panorama. The volume can be reduced from the middle of the three channel pots. In contrast, panning is controlled by the active **alt mode**, which shifts the voice to the left or right across the full range. The LEDs appear as soon as changes have been made.



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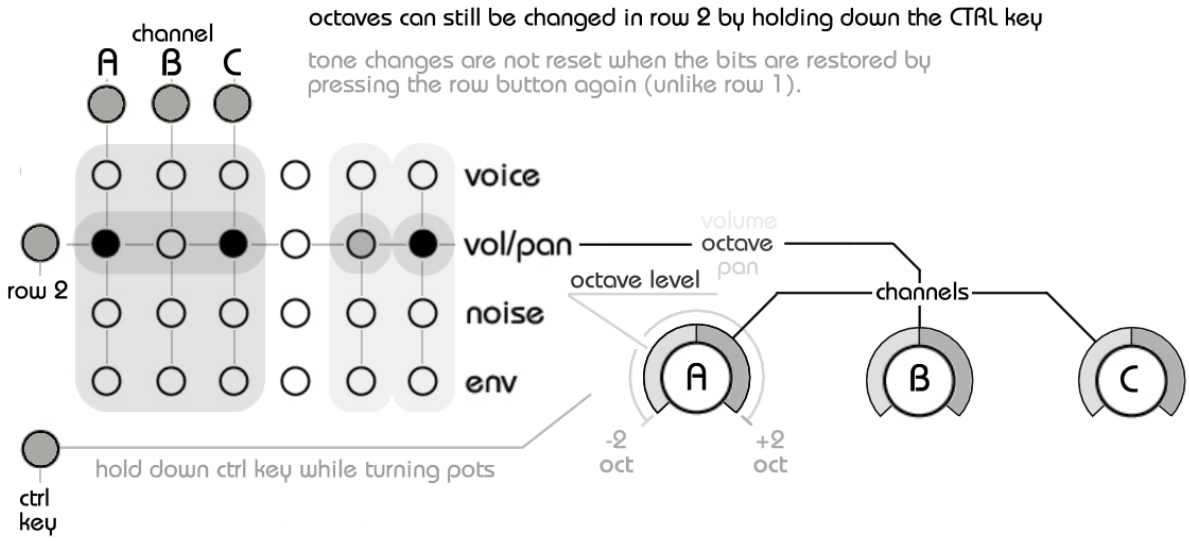
octave shifting in row 2

If you've read this far, you've probably noticed that when row 2 is active, the potentiometers for channels A, B, and C can no longer be used for octave shifting, even though this is where they would be most useful.

Row 2 is ideal for completely muting sounds and noises via amplifier register bits, or for continuously increasing or decreasing the volume, or to perform a panning for individual voices with potentiometers. However, if you now want to change the octaves of one of the three channels, you must explicitly switch to another row.

For this reason, the octave shifter can also be reactivated with the **ctrl key** from firmware **version 4.2** onwards. Unlike row 1, toggling the row 2 does not reset the tone offset. This makes row 2 a special, but it is the most compact way to perform remixes by changing versatile parameters.

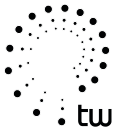


noise pot behaviour

Since **version 4.4**, the noise pot operates in **relative mode** by default. This means that incoming noise frequencies are shifted relative to the original.
In contrast, when in staying in **alt mode**, the frequency is set **absolutely**.

remix hotkey overview

special	key	limited	action
	seq		ctrl key
	e		alt mode
	f		shift key
	a-c		toggle enable bit of a channel
ctrl	a-c		toggle the entire channel (mute/restore; remix/restore)
alt mode	a-c	voice	voice snatcher (first = source; next = target)
alt mode	a-c	env	pitch snapper (any target)
	voice		select row or toggle voices (mute/restore; remix/restore)
	lfo/arp		select row or toggle volumes (mute/restore; remix/restore)
	noise		select row or toggle noises (mute/restore; remix/restore)
	env		select env or toggle envs (mute/restore; remix/restore)
shift	voice		select row or toggle voices (toggle by xor operation)
shift	lfo/arp		select row or toggle volumes (toggle by xor operation)
shift	noise		select row or toggle noises (toggle by xor operation)
shift	env		select env or toggle envelopes (toggle by xor operation)
	d		restore all
ctrl	d		toggle compare/remix mode
	speed pot		change envelope octave (-2 / +2)
ctrl	speed pot		slide envelope frequency
	depth pot		change noise frequency
ctrl	depth pot		restore noise frequency
	detune pot		change A octave (-2 / +2)
ctrl	detune pot		slide A frequency
alt mode	detune pot		pan voice A (left / right)
	glide pot		change B octave (-2 / +2)
ctrl	glide pot		slide B frequency
alt mode	glide pot		pan voice B (left / right)
	env/seq pot		change C octave (-2 / +2)
ctrl	env/seq pot		slide C frequency
alt mode	env/seq pot		pan voice C (left / right)
	data enc		select envelope shape (flash)
	data knob		activate selected shape; press again to restore original



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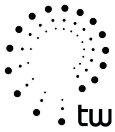
Midi implementation

Midi Message	Range	Result
Note On/Off CH1	**1-127**	**Unison/Poly Voice**
Note On/Off CH2	1-127	AY3#1, Voice1
Note On/Off CH3	1-127	AY3#1, Voice2
Note On/Off CH4	1-127	AY3#1, Voice3
Note On/Off CH5	1-127	AY3#2, Voice1
Note On/Off CH6	1-127	AY3#2, Voice2
Note On/Off CH7	1-127	AY3#2, Voice3
Note On/Off CH8	1-127	Polyphonic mode
Note On/Off CH9	1-127	Noise on/off AY3#1, Voice1
Note On/Off CH10	1-127	Noise on/off AY3#1, Voice2
Note On/Off CH11	1-127	Noise on/off AY3#1, Voice3
Note On/Off CH12	1-127	Noise on/off AY3#2, Voice1
Note On/Off CH13	1-127	Noise on/off AY3#2, Voice2
Note On/Off CH14	1-127	Noise on/off AY3#2, Voice3
Control CC#2	0-127	Lfo/arp speed
Control CC#3	0-127	Lfo/arp depth
Control CC#6	0-127	Detune amount
Control CC#7	0-127	Glide Amount
Control CC#8	0-127	Sequencer Speed
Control CC#9	0-127	Noise Frequency Chips 1+2
Control CC#10	0-127	Noise Frequency Chip 1
Control CC#11	0-127	Noise Frequency Chip 2

Midi Message	Range	Result
Control CC#12	0-127	Tune, Voice1
Control CC#13	0-127	Tune, Voice2
Control CC#14	0-127	Tune, Voice3
Control CC#15	0-127	Tune, Voice4
Control CC#16	0-127	Tune, Voice5
Control CC#17	0-127	Tune, Voice6
Control CC#18	0-127	Volume, Voice1
Control CC#19	0-127	Volume, Voice2
Control CC#20	0-127	Volume, Voice3
Control CC#21	0-127	Volume, Voice4
Control CC#22	0-127	Volume, Voice5
Control CC#23	0-127	Volume, Voice6
Control CC#24	0-63=off 64-127=on	Enable/Disable Voice1
Control CC#25	0-63=off 64-127=on	Enable/Disable Voice2
Control CC#26	0-63=off 64-127=on	Enable/Disable Voice3
Control CC#27	0-63=off 64-127=on	Enable/Disable Voice4
Control CC#28	0-63=off 64-127=on	Enable/Disable Voice5
Control CC#29	0-63=off 64-127=on	Enable/Disable Voice6
Control CC#30	0-63=off 64-127=on	Enable/Disable Noise1
Control CC#31	0-63=off 64-127=on	Enable/Disable Noise2
Control CC#32	0-63=off 64-127=on	Enable/Disable Noise3
Control CC#33	0-63=off 64-127=on	Enable/Disable Noise4
Control CC#34	0-63=off 64-127=on	Enable/Disable Noise5
Control CC#35	0-63=off 64-127=on	Enable/Disable Noise6



Midi Message	Range	Result
Control CC#36	0-63=off 64-127=on	Enable/Disable lfo/arp Voice1
Control CC#37	0-63=off 64-127=on	Enable/Disable lfo/arp Voice2
Control CC#38	0-63=off 64-127=on	Enable/Disable lfo/arp Voice3
Control CC#39	0-63=off 64-127=on	Enable/Disable lfo/arp Voice4
Control CC#40	0-63=off 64-127=on	Enable/Disable lfo/arp Voice5
Control CC#41	0-63=off 64-127=on	Enable/Disable lfo/arp Voice6
Control CC#42	0-63=off 64-127=on	Enable/Disable env Voice1
Control CC#43	0-63=off 64-127=on	Enable/Disable env Voice2
Control CC#44	0-63=off 64-127=on	Enable/Disable env Voice3
Control CC#45	0-63=off 64-127=on	Enable/Disable env Voice4
Control CC#46	0-63=off 64-127=on	Enable/Disable env Voice5
Control CC#47	0-63=off 64-127=on	Enable/Disable env Voice6
Control CC#48	0-63=off 64-127=on	Enable/Disable seq Voice1
Control CC#49	0-63=off 64-127=on	Enable/Disable seq Voice2
Control CC#50	0-63=off 64-127=on	Enable/Disable seq Voice3
Control CC#51	0-63=off 64-127=on	Enable/Disable seq Voice4
Control CC#52	0-63=off 64-127=on	Enable/Disable seq Voice5
Control CC#53	0-63=off 64-127=on	Enable/Disable seq Voice6
Control CC#54	0-7	Lfo/arp shape
Control CC#55	0-7	Env shape Chip1
Control CC#56	0-7	Env shape Chip2

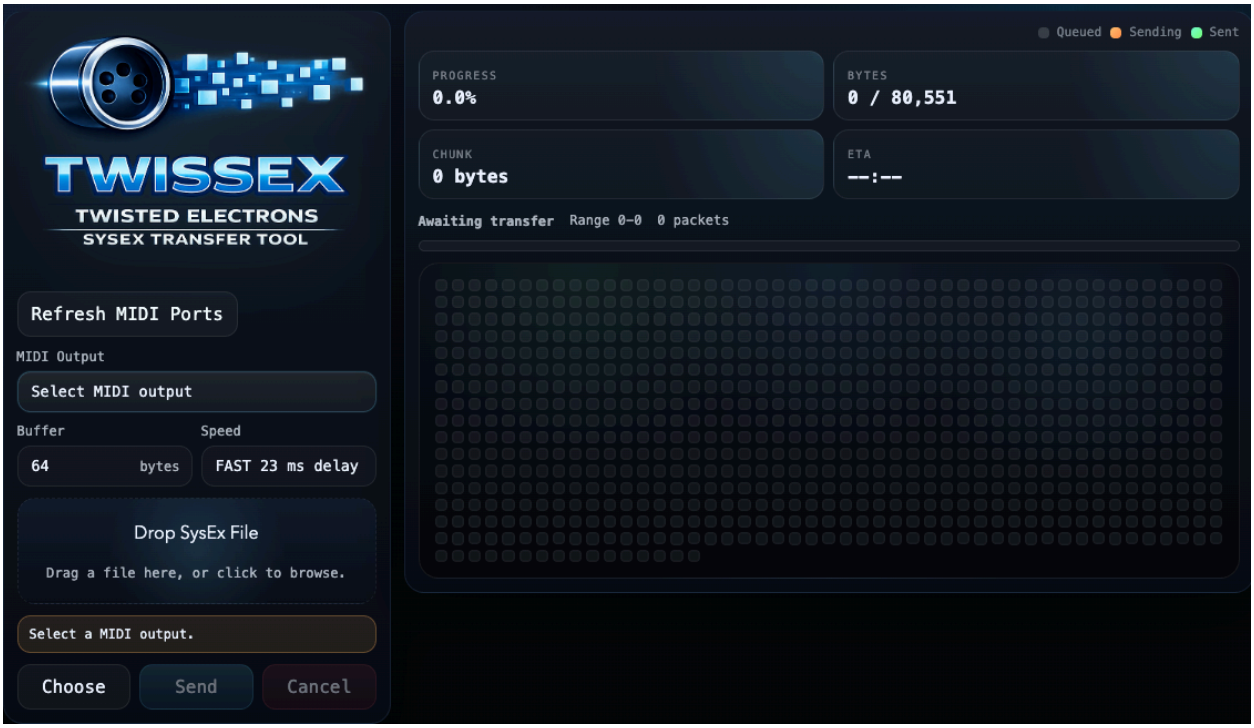
Firmware updating

The AY3 supports firmware updates via midi system exclusive messages (Sysex). To enter update mode aka Bootloader:

- Unplug the unit's power cord
- Hold the data knob down while plugging the unit power back in

Three bright stripes will show on the LED matrix indicating that bootloader mode is active. Now you are ready to send the Sysex to the AY3 via your computer.

Browser (webmidi)



The easiest way to flash the firmware onto the device is to use the in-house TWISSEX tool. This requires a webMIDI-compatible browser such as Chrome, or another browser with a working webMIDI extension.

https://twisted-electrons.com/tool/TWISSEX/

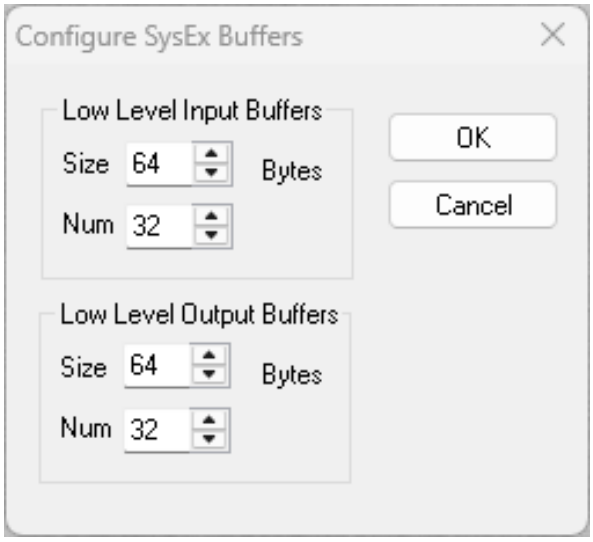
twisted electrons

Pc

On Windows, you can also choose the MIDI-OX or MIOS Studio programmes as an alternative to the TWISSEX browser tool. These are free and very useful apps!

MIDI-OX *(http://www.midiox.com/)*

1. In the Sysex window, choose Command > Window > Load File and navigate the location where you stored the file.
2. Choose Command Window > Send Sysex
3. In the Sysex window, choose Command > Window > Load File and navigate the location where you stored the file.
4. Choose Command Window > Send Sysex
5. Wait until the end, until the AY3 has rebooted

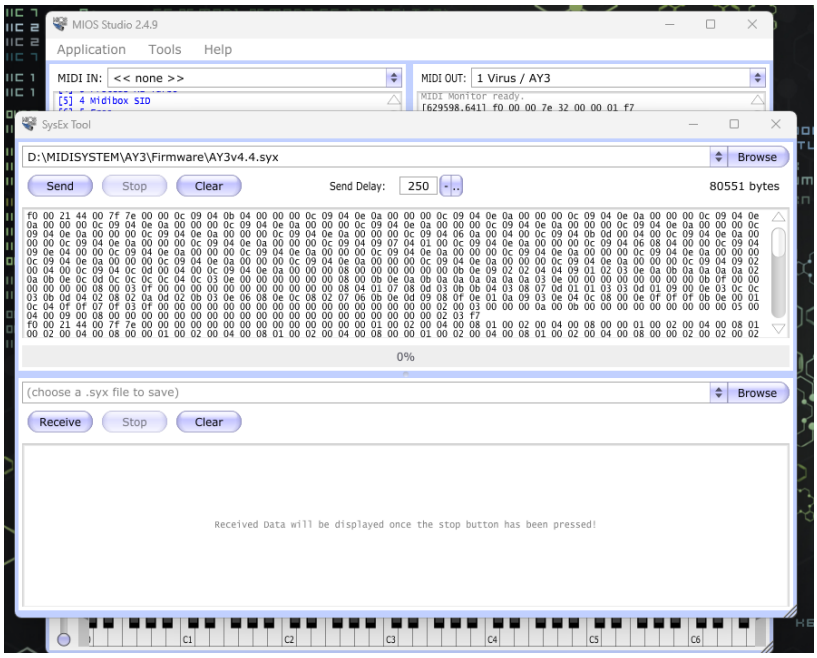


IMPORTANT: the buffer settings must be number = 32 and size = 64 bytes for the output buffers to avoid transfer corruptions, (thanks Joel for pointing this out)

NOTE: Since the introduction of MIDI 2.0 services in Windows 11, we have noticed that midi-ox is occasionally unable to send sysex messages. We therefore recommend using a different tool, such as MIOS Studio 2.0, which also supports the uploading of Sysex messages.

MIOS-Studio 2.0 *(https://www.ucapps.de/mios_studio.html)*

1. Choose your MIDI OUT device on the right side, leave MIDI IN empty
2. Open SysEx Tool from Menubar
3. Open Firmware File & set a safe send delay of 250 ms
4. Press "Send" Button
5. Wait until the end, until the AY3 has rebooted



Mac

For a mac, we recommend SysEx Librarian. It is also free!

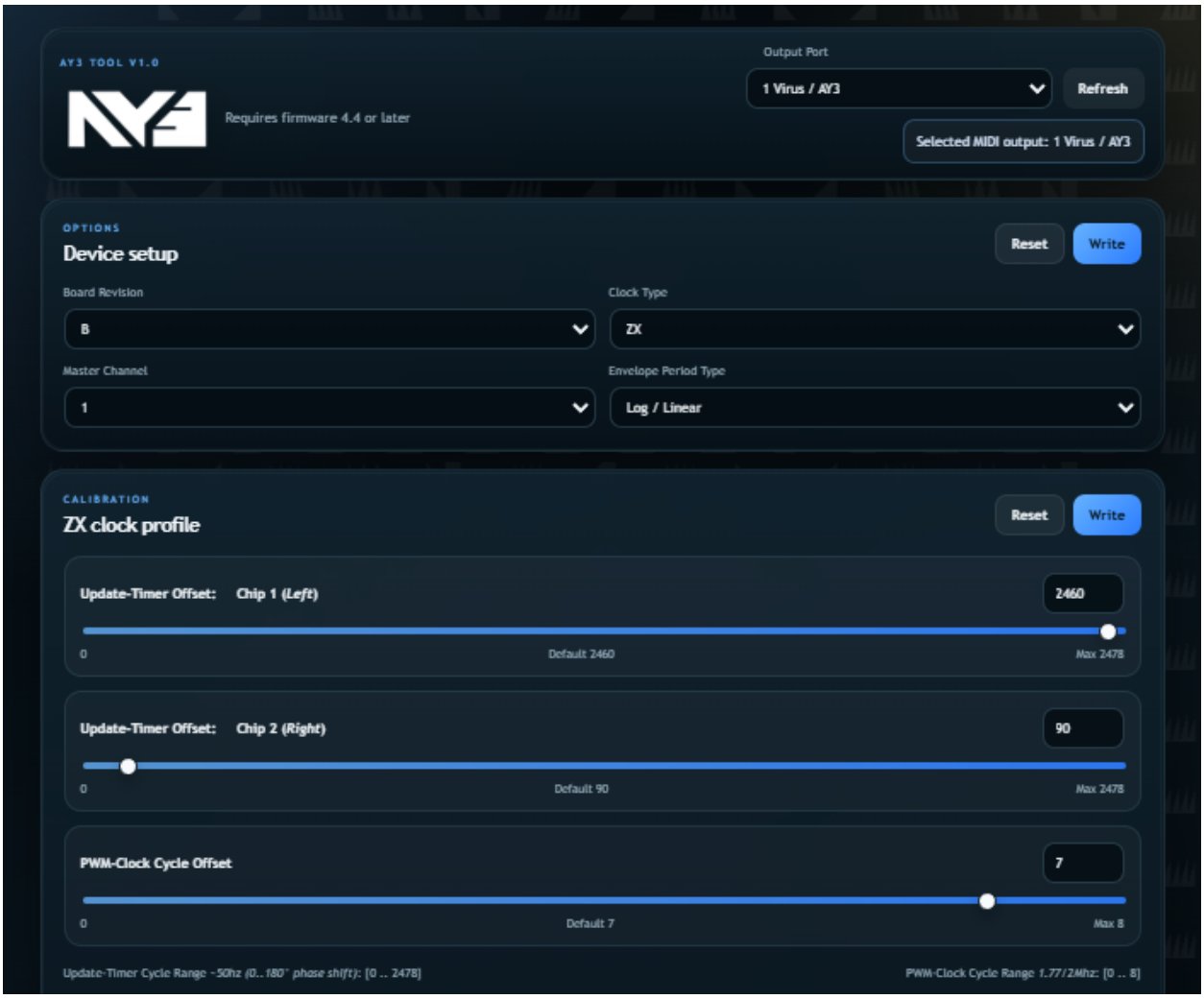
1. Launch SysEx Librarian.
2. Select your MIDI interface in the dropdown menu at the top (if it's not already selected)
3. Drag the MIDI SysEx file from the Finder into the frame of SysEx Librarian (if it's not already in there).
4. Select it with the mouse.
5. Click Play.

During upload, the LED bars will flash and fill the matrix from left to right, then your AY3 will boot into the new software.

AY3-Tool - Setup & Calibration

Since firmware **version 4.4**, it has been possible to synchronise the timers for the clock and the chips. All of this can be done using the AY3 tool, as well as any configuration that would otherwise be adjusted using a startup button combination on the device.

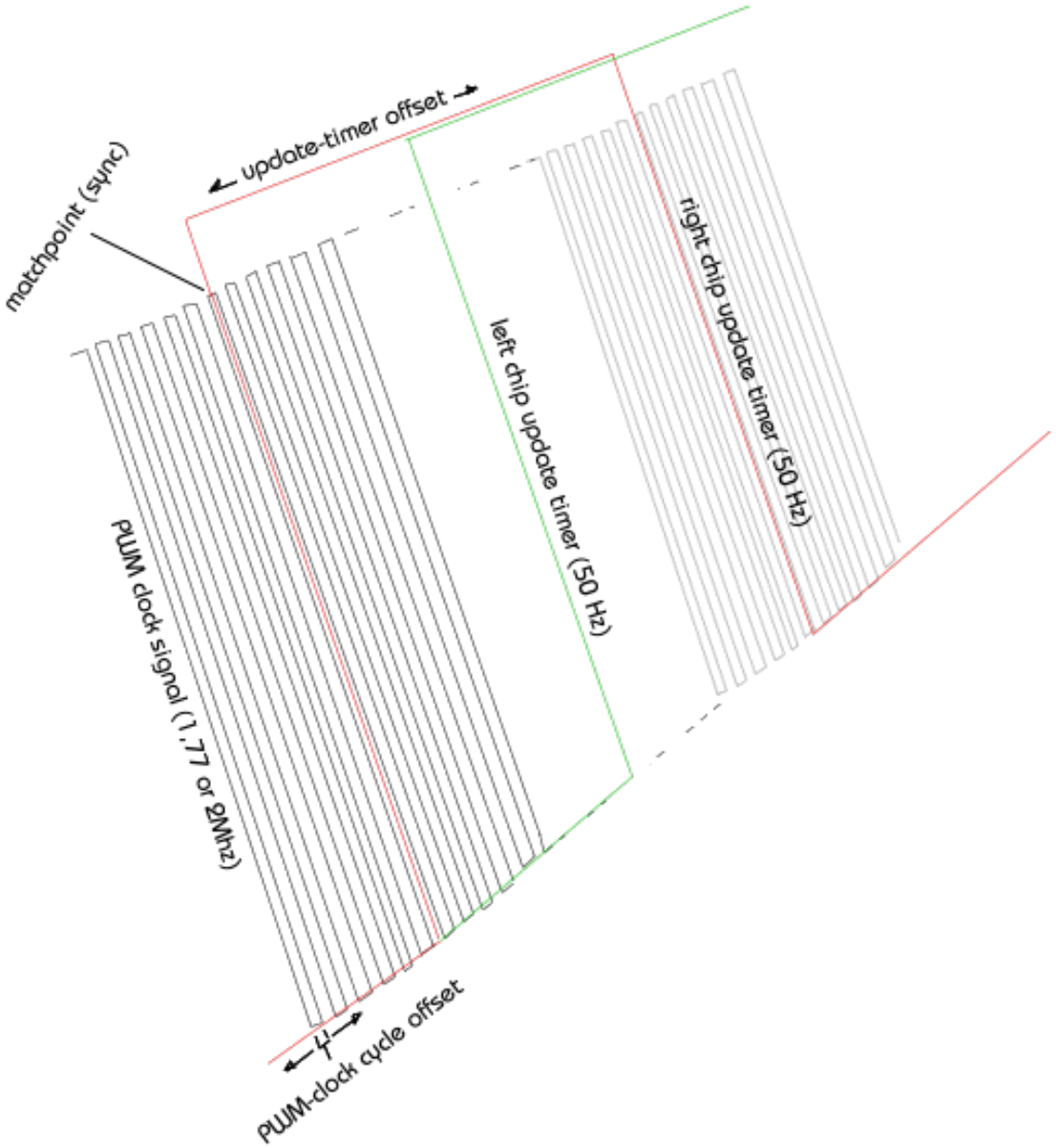
However, for calibration purposes, the boards (especially the newer) generally do not need to be tuned if the behavior is due to the processor itself and not to variations between models of the same chip. The firmware is already set to the optimal settings by default. The tool simply provides a way to make these adjustments.



twisted electrons

To use the tool and find out more about configuration & calibration, go to:
https://www.twisted-electrons.com/tool/AY3/

The following diagram illustrates, in broad terms, the behaviour of a chip operated by a PWM clock, which must be precisely synchronised to the clock edges to avoid clicking noises or discrepancies. In contrast to the clock, the two update timers have a coarse resolution, which only allows synchronisation every nth step – meaning that it doesn't improve with every step, but that a synchronisation for a single step can be found following a specific pattern. You then need to test whether this also fits well with the other two parameters.



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Thanks goes too...

Jouni Paulus
..for his invented ASID protocol,
whose mechanics form the base for AYMID

Thomas Jansson
..for the wonderful remix machine on TherapSID,
what AY3 remix part is based on

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but above all for providing the sources
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for the transmission of the AYMID protocol

Yerzmyey
..for its powerful sound,
which we use to demonstrate the power of machine

rechner7
..for testing various devices equipped
with different chips

by
Alex & Rio