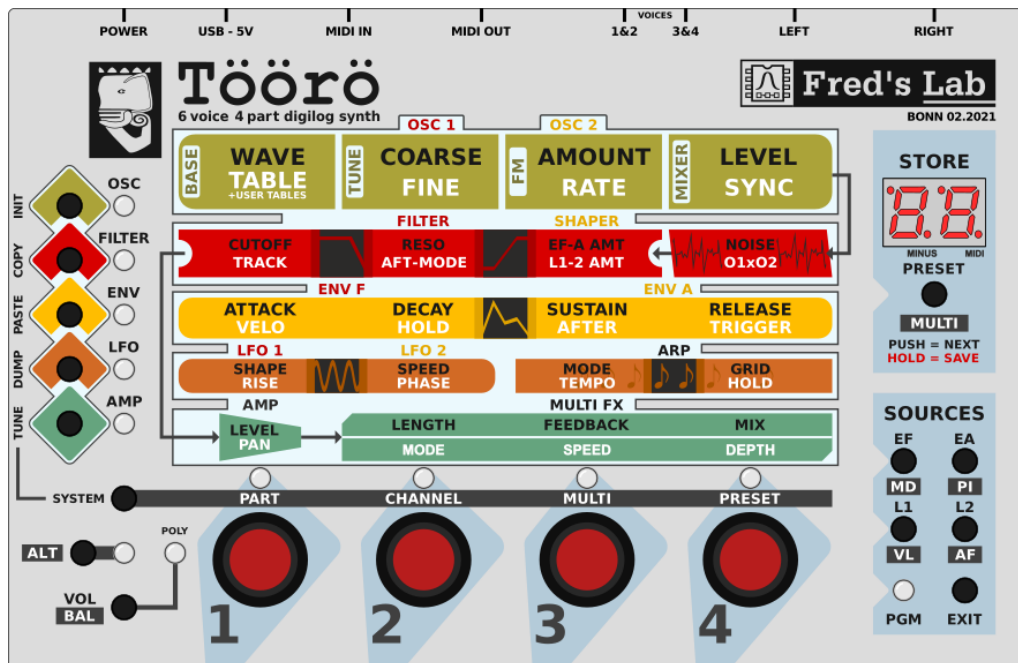


# TÖÖRÖ module

## User and service Manual

Revision 1.2 EN - 31/01/2024  
for Firmware V1.60 - 18/08/2024



FRÉDÉRIC MESLIN / FRED'S LAB

January 31, 2024

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## Introduction

**Thank you very much for purchasing the Töörö!**

This is the second multitimbral synthesizer from Fred's Lab and our best attempt at hybrid polyphonic synthesis.

By carefully blending analog and digital technologies, mixing 1970's and 2020's electronics and pouring it in a compact and rugged package, the Töörö was born.

With its 6 characterful voices, the wild FL A847 filters and an advanced delay on board, the Töörö has high sonic potential, just release it and create!

**Love from Germany**

Fred, from Fred's Lab

## Legal notices

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### **Support requests**

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[support@fredslab.net](mailto:support@fredslab.net)

or per post, using the previously mentioned company address.

For each support request, please include the instrument model, serial number and a precise description of the problem encountered with a maximum of details and supporting elements for a quick resolution.

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- Normal product wear-out
- Damages caused by failure to observe the rules of use
- Damages due to negligence of the user
- Products having been modified or repaired by the user or a third person

More information about product warranty can be found in the **General Terms and Conditions of Sale document** available at:

<https://fredslab.net/en/terms.html>

## Special Thanks

I would like to thank the following persons for their contributions to this project:

- Panel and logo designs: Serge Beauchamp
- Kickstarter communication / Press kit: Alex Theakston
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- User manual: Oliver Rockstedt
- Audio demos: Laurent Pelletier, Fabien Labonde

And Fanny & Neal Homberger for their continuous support and their regular contributions.

This project has been made possible through the financial support from the Kickstarter Backers.

## Precautions

Before plugging in the **Töörö!** and go **rocking the World**, have a sit and read this precautions through:

- Always use the device in a dry and warm environment
- Never drop the device or expose to too much pressure or vibration
- Never spill liquids or bath the device in beer
- Never clean the device with an aggressive solvent
- Only use certified USB power adapters to power the device
- Never wiggle the plugs to disconnect the cords
- Never connect the line outputs to the power outputs of an amplifier
- Only modify the unit at your own risk!

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**The Töörö!** used in conjunction with headphones and speaker systems can produce **very loud sounds** in a wide range of frequencies.

Human hearing is **very sensitive** and can be damaged quickly. So watch out your hears and those of your audience!

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## 1 Presentation

The **Töörö** is a 6-voice polyphonic, 4-part multi-timbral, hybrid "digilog" MIDI sound module.

- **Polyphonic** means it can play several notes at the same time.
- **Multi-timbral** means it can play several instruments at the same time.
- **Digilog** means the sound is created using audio algorithms and then converted into the analog domain for further processing.
- **MIDI sound module** means it needs a MIDI controller to generate sound.

### 1.1 What is MIDI?

**MIDI** stands for **Musical Instrument Digital Interface**.

It is a technical standard allowing music instruments to communicate and be used in concerto. It defines a protocol, messages, a digital interface and cables / connectors formats. A MIDI connection carries notes, controller changes, clocks and various configuration data.

The **Töörö** is a hybrid instrument. It initially computes the sounds using mathematical models and algorithms, executed by a powerful ARM micro-processor, which are then converted into analog domain and shaped by an **FL A847** low-pass filter.

### 1.2 Remarks on polyphony

The 6-voice polyphony is the **absolute maximal** number of notes that can be played at the same time. If you try to play more notes simultaneously, the older voices will be muted and reused for newer notes. This mechanism is called "voice-stealing" and will result in audio artifacts or parts of your music not being played when triggered. In order to avoid it, keep in mind the module limitations while composing your music.

## 2 Requirements

To play with the **Töörö** you need:

- **An audio system** with line-level inputs
- **A MIDI controller**, a sequencer or a computer
- **A USB power source**

### 2.1 An audio system

can be a HiFi stereo system, a power mixing desk connected to speakers or a pair of active speakers.

## 2.2 A MIDI controller

can be any master keyboard, wind controller, surface... that sends MIDI notes. You can also attach the instrument to a hardware or software MIDI sequencer. It can run on a computer, a laptop or a tablet/smartphone. You may need a dedicated external MIDI interface or just use the USB connection.

## 2.3 A USB power source

can be a USB host, a power bank or a USB wall adapter/charger. Never use cheap USB chargers that can be very noisy.

## 2.4 Remarks on USB noise

If you keep hearing irritating hum and noise when the **Tööro** is connected via USB, you may experience a **USB ground loop problem**. Fortunately, there are several solutions to overcome this problem.

### Solution 1:

- Use another USB power source (power bank or wall adapter)
- Connect the instrument to the computer with a MIDI DIN cable

### Solution 2:

- Use a **USB galvanic isolator**



Example: Olimex USB-ISO module

<https://www.olimex.com/Products/USB-Modules/USB-ISO>

MIDI DIN connections are, by design, prevented from ground loop problems. It is the preferred solution to avoid these annoying issues.

## 3 Instrument Setup

### Step 1: Audio

Connect the **Töörö** line-level outputs (left & right) to your audio system inputs using two 6.35mm unbalanced jacks.

### Step 2: MIDI

Connect the **Töörö** MIDI DIN input (MIDI IN) to your MIDI compatible controller or sequencer/computer using a MIDI DIN cable.

**or**

Connect the USB port (USB - 5V) to your computer, laptop, tablet or smartphone.

### Step 3: Power

If not already done in the previous step, connect the **Töörö** power input (USB - 5V) to your power source of choice.

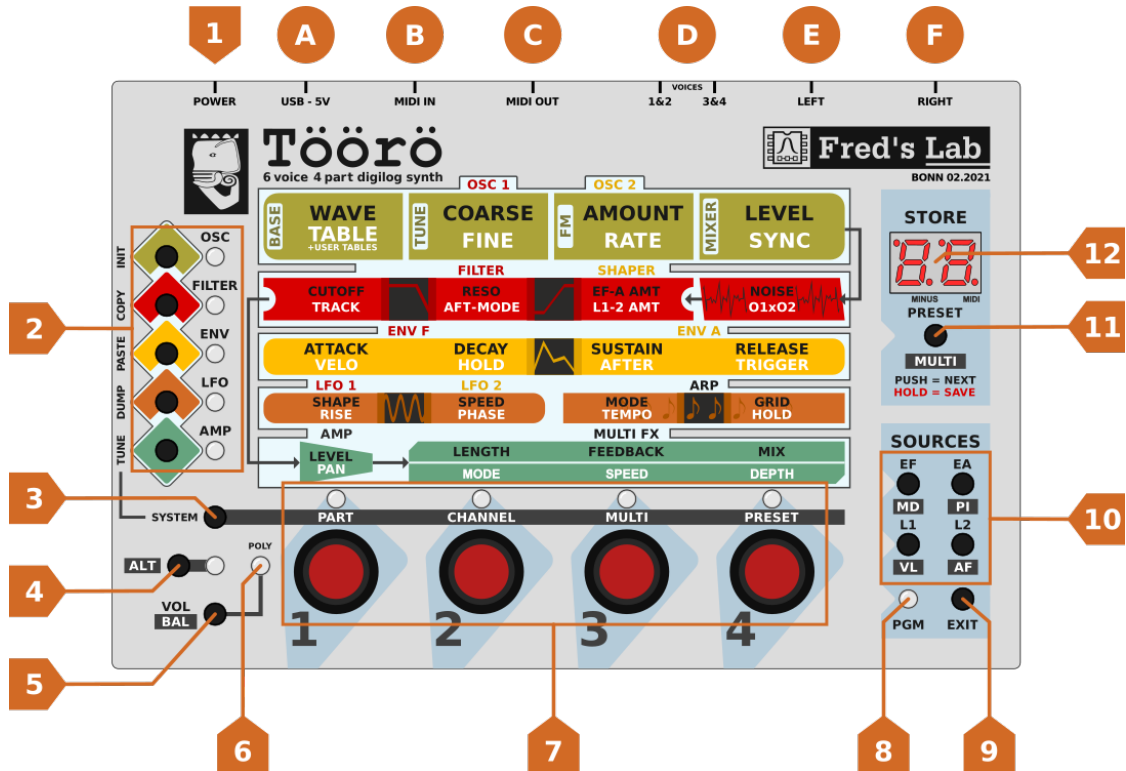
Press the power switch on the rear panel to power up the **Töörö**.

### Step 4: Audio system

Switch on you audio system, adjust the volume and play some notes!

## 4 Instrument Operation

Once the instrument is properly installed and you can hear some sounds when playing notes, let's have a good look at its panel:



### 4.1 Connectors

#### (A) USB - 5V

This is the USB-B connector for both power and MIDI over USB function. It must be attached to a source to power up the **Tööro**.

#### (B) MIDI IN

This is the MIDI DIN input connector for a MIDI compatible controller or sequencer. It should be attached to a MIDI DIN output connector of an other device.

#### (C) MIDI OUT

This is the MIDI DIN output connector to be connected to a sequencer, computer or subsequent machines. All incoming messages that are not parsed by the **Tööro** are forwarded to this output.

#### (D) VOICES 1&2 / 3&4

These are separate TRS jacks hardwired to voices 1-4 for individual processing. Signal of voices 1/3 will appear on the tip, voices 2/4 on the ring of the connector. Note that the voices are not cut from the main outputs when a cable is plugged in.

**ⓔ ⓕ LEFT & RIGHT**

These are the main outputs to be connected to a mixing desk, audio interface or power speaker system.

**4.2 Controls & Indicators****① Power Switch**

Switches the power on or off.

**② Module Buttons & LEDs**

Selects the module edited by the parameter encoders. Pressing the same buttons several times cycles through all available modules of a section. The LED color shows which module is currently selected corresponding to the panel labeling.

**③ SYSTEM Button**

Allows access to the advanced functions. This button is used in conjunction with the parameter encoders and the module buttons.

**④ ALT Button & LED**

Used to access the alternate functions and synthesis parameters labelled in inverse printing. Pressing this button toggles between normal and alternate mode. Alternate mode is indicated with the LED lit.

**⑤ VOL/BAL Button**

Holding this button while turning one of the encoders sets the volume or balance for a part. In normal mode, volume is set. To set the balance, enable the alternate mode via the **ALT** button.

**⑥ POLY LED**

If lit, the currently selected part is in polyphonic mode. Otherwise, the part is set to monophonic mode. Double-click the **VOL/BAL** button to toggle the mode.

**⑦ Parameter Encoders & LEDs**

Changes the value of sound or system parameters.

**⑧ PGM LED**

Indicates if modulation matrix programming mode is enabled.

**⑨ EXIT Button**

Exits matrix programming mode and returns to normal operation. Also, holding the **EXIT** button and pressing the **PRESET** button reloads the currently saved preset / multi (depending on **ALT**), discarding all modifications made.

**10 Sources Buttons**

Enters matrix programming mode and selects the source to modulate a sound parameter. If alternate mode is enabled via the **ALT** button, a second set of sources can be selected and assigned.

**11 PRESET/MULTI Button**

Loads and saves presets and multis. Pressing the button momentary, loads the next preset. Holding the button down for more than one second will save the current preset or multi with all its modifications.

**12 7-segment Display**

Shows the current preset or multi number. While editing a parameter, the display will show its current value for some time. To indicate negative parameter values, the dot after the first digit will be lit. Also, when MIDI data is received, the dot after the second digit will flash. When selecting a module for editing, the display will briefly indicate which module is edited.

**4.3 Editing Parameters**

To edit parameters, use the 4 encoders at the bottom row of the **Töörö**. Which parameters are currently edited, depends on the selection of the module via the **module buttons**, if alternate mode is enabled via the **ALT** button or the **SYSTEM** button is held down.

**4.3.1 Parameter LEDs**

The LEDs above the encoders give a rough idea about the parameters value by showing different colors and brightness:

- When a parameter is set to 0, the LED is off.
- Unipolar parameters start with yellow for smaller values, blending into red on higher values.
- On bipolar parameters, negative values are shown in green, positive values are shown in red.

Color blind users should instead rely on the values shown on the display when turning the encoders.

**4.3.2 Parameter Display**

Whenever a parameter is changed via an encoder, the display shows its current value for a short time and then changes back to the preset or multi number.

To show the values in full resolution on the 2-digit display, most numeric parameters of the **Töörö** are shown as hexadecimal values. Negative values are indicated by a dot after the first digit.



Hex: -0x2A  
Decimal: -42



Hex: 0x43  
Decimal: 67

## 5 Preset & Multi Management

The **Töörö** is a multi-timbral device that can store 100 presets and 10 multis. All memory locations can be overwritten by the user, so the factory patches can be overwritten.

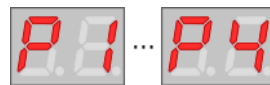
An important concept to understand is that there is no separation between preset and multi mode, the **Töörö** always operates in multi mode.

- A preset is a single sound with a set of parameters for oscillators, filter, shaper, LFOs, envelopes, amplifier, arpeggiator and modulation matrix.
- For operations on presets, the alternate mode must be disabled. Make sure that the **ALT** LED is not lit.
- A multi is a set that references 4 presets as parts, a mixer with volume and balance, the MIDI channel settings and an fx section.
- For operations on multis, the alternate mode must be enabled. Make sure that the **ALT** LED is lit.

### 5.1 Selecting a Part

Before selecting or editing a preset, it is important to select the part currently edited. By default, part 1 is selected.

Press and hold the **SYSTEM** button. Then use the first parameter encoder labelled **PART** to select the part. The display will show **P1..P4** while the encoder is turned.

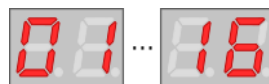


Part selection 1..4

### 5.2 Setting the MIDI Channel

You can set a separate MIDI channel for each part to receive notes and other messages from an external keyboard, computer or sequencer. In addition, **omni mode** can be selected to receive MIDI data from all channels.

Press and hold the **SYSTEM** button. Then use the second parameter encoder labelled **CHANNEL** to select the midi channel. The display will show **01..16** or **OM** while the encoder is turned.



Channel 1..16



Omni mode

**Note:** when omni mode is selected, channel 1 is used to transmit parameter changes.

### 5.3 Triggering MIDI Panic

If the MIDI transmission gets interrupted, due to connection reliability problems or software issues, the notes being played can get stuck and then continue to play endlessly. This unwanted behavior is also applicable to specific **MIDI Controller Changes** which are supposed to revert to a default value, after being used, such as the modwheel controller.

In this event, a double press on the **EXIT** button will trigger the **MIDI Panic** function, instantly muting all notes playing, resetting the MIDI Controllers to their default values and finally emptying the **Multi FX** audio buffer.

### 5.4 Selecting a Preset

There are 2 ways to select a preset:

- Press the **PRESET** button to increment the preset number by one.
- Press and hold the **SYSTEM** button. Then use the fourth parameter encoder labelled **PRESET** to increment or decrement the preset number.



Preset selection 0..99

### 5.5 Saving a Preset

#### 5.5.1 Overwriting the Current Preset

To save an edited preset onto the current memory location, press and hold down the **PRESET** button until the display starts to blink. When the button is released, the preset will be saved, replacing the data stored previously.

#### 5.5.2 Saving a Preset to a Different Memory Location

Saving a preset to a different location can be done by copy & paste utilizing a temporary buffer.

- Press and hold the **SYSTEM** button. Then press the **Module button** labelled **FILTER**. This button also has a secondary vertical label **COPY** left to it.
- The preset is now stored inside a temporary buffer.
- Select the destination preset to be overwritten as described above under *Selecting a Preset*.
- Press and hold the **SYSTEM** button. Then press the **Module button** labelled **ENV**. This button also has a secondary vertical label **PASTE** left to it.
- The preset previously stored in the temporary buffer is now recalled.
- Press and hold down the **PRESET** button until the display starts to blink. When the button is released, the preset will be saved.



## 5.6 Copying Presets

Presets can be copied to another location via copy & paste in a similar way as described above under *Saving a Preset to a Different Memory Location*.

## 5.7 Initializing a Preset

To initialize a preset, press and hold the **SYSTEM** button and then press the **Module button** labelled **OSC**. This button also has a secondary vertical label **INIT** left to it. Initializing resets all sound parameters to their default values.

## 5.8 Dumping a Preset via Sysex

Preset data can only be dumped over USB MIDI to be stored on an external computer or sequencer.

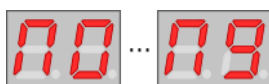
To dump a preset over USB MIDI, press and hold the **SYSTEM** button and then press the **Module button** labelled **LFO**. This button also has a secondary vertical label **DUMP** left to it.

You can dump back a preset from your computer or sequencer at any time. The **Töörö** will process any received dump without any prerequisites.

## 5.9 Selecting a Multi

There are 2 ways to select a multi:

- When alternate mode is selected via the **ALT** button, the multis can be cycled through by pressing the **PRESET** button repeatedly.
- Press and hold the **SYSTEM** button. Then use the third parameter encoder labelled **MULTI** to increment or decrement the multi number.



Multi selection M0..M9

## 5.10 Saving a Multi

First, make sure that alternate mode is enabled via the **ALT** button.

### 5.10.1 Overwriting the Current Multi

To save a multi onto the current memory location, press and hold down the **PRESET** button until the display starts to blink. When the button is released, the multi will be saved, replacing the data stored previously.

### 5.10.2 Saving a Multi to a Different Memory Location

Saving a multi to a different location can be done by copy & paste utilizing a temporary buffer.

- Press and hold the **SYSTEM** button. Then press the **Module button** labelled **FILTER**. This button also has a secondary vertical label **COPY** left to it.
- The multi is now stored inside a temporary buffer.
- Select the destination multi to be overwritten as described above under *Selecting a Multi*.
- Press and hold the **SYSTEM** button. Then press the **Module button** labelled **ENV**. This button also has a secondary vertical label **PASTE** left to it.
- The multi previously stored in the temporary buffer is now recalled.
- Press and hold down the **PRESET** button until the display starts to blink. When the button is released, the multi will be saved.

### 5.11 Copying Multis

Multis can be copied to another location via copy & paste in a similar way as described above under *Saving a Multi to a Different Memory Location*.

### 5.12 Initializing a Multi

To initialize a multi, while in alternate mode, press and hold the **SYSTEM** button and then press the **Module button** labelled **OSC**. This button also has a secondary vertical label **INIT** left to it. Initializing resets all multi parameters to its default values.

- Part 1 will be set to preset **00** on MIDI channel 1.
- Part 2 will be set to preset **01** on MIDI channel 2.
- Part 3 will be set to preset **02** on MIDI channel 3.
- Part 4 will be set to preset **03** on MIDI channel 4.
- Volume is set to maximum for all parts.
- Balance is set to center for all parts.
- The FX mix level is set to minimum / disabled

### 5.13 Dumping a Multi via Sysex

Multi data can be dumped over USB MIDI to be stored on an external computer or sequencer.

To dump a multi over USB MIDI, while in alternate mode, press and hold the **SYSTEM** button and then press the **Module button** labelled **LFO**. This button also has a secondary vertical label **DUMP** left to it.

You can dump back a multi from your computer or sequencer at any time. The **Töörö** will process any received dump without any prerequisites.

**Important:** keep in mind that multi data does not contain any information about the sound parameters. You have to transfer these separately via preset dumps.

## 6 Preset Parameters

### 6.1 Overview

Töörö overall preset structure

PRESET																																																																												
<ul style="list-style-type: none"> <li>•NAME <i>Name of the Preset in 32 ASCII characters</i></li> <li>•TUNE <i>Master tuning in cents</i></li> <li>•BENDRANGE <i>Pitch bend range in semitones</i></li> <li>•USERTABLE <i>Wave references for user tables 1 &amp; 2</i></li> </ul>	<table border="1"> <thead> <tr> <th colspan="2">OSC</th> </tr> </thead> <tbody> <tr> <td>•WAVE <i>Position in the wave table from 0 to 4</i></td> <td>•TABLE <i>Wave table selection T1-T8, user, random per note, random per chord</i></td> </tr> <tr> <td>•COARSE <i>Coarse pitch tuning -36 to +36 semitones</i></td> <td>•FINE <i>Fine pitch tuning -100 to +100 cents</i></td> </tr> <tr> <td>•FM AMOUNT <i>Amount of phase modulation from the FM operator</i></td> <td>•FM RATE <i>Rate of the FM operator based on oscillator pitch</i></td> </tr> <tr> <td>•LEVEL <i>Oscillator output level</i></td> <td>•SYNC <i>Time scaling of waveforms</i></td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">FILTER</th> </tr> </thead> <tbody> <tr> <td>•CUTOFF <i>Cutoff frequency of LP filter</i></td> <td>•TRACK <i>Pitch tracking of the cutoff</i></td> </tr> <tr> <td>•RESO <i>Amount of resonance</i></td> <td>•AFTERTOUCH <i>Influence of MIDI aftertouch</i></td> </tr> <tr> <td>•ENV. 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Notes:

- The preset name is only accessible by Sysex messages.
- The **Tune** and **Band Range** parameters are only accessible via Sysex and MIDI CC messages.

### 6.2 Voice Mode

Each preset of the **Töörö** can be played in monophonic or polyphonic mode. To toggle the mode, double-click the **VOL/BAL** button. If polyphonic mode is selected, the **POLY** LED is lit.

In monophonic mode, each part is played by a single dedicated voice. The voice number corresponds to the part number, e.g. part 1 uses voice 1, part 2 uses voice 2 etc. This way, each part appears as a separate signal at the **Voices Outputs**, so it can be processed and mixed individually.

In monophonic mode, note priority is "last played" for new notes, and "highest" for re-triggered notes.

### 6.3 Oscillators



The **Tööro** has two identical wavetable oscillators that build the heart of the sound engine. Each oscillator generates a blended waveform that is determined by the content of the selected wavetable. In addition, FM modulation and auto-sync is possible within a single oscillator to produce alterations of the harmonic content.



To access the oscillators parameters, press the **OSC** module button. If you press the button more than once, the selection will cycle between Osc 1 and Osc 2. The LED color indicates which oscillator is selected:



In addition, the display will show the selected oscillator briefly:



In normal mode, the **Wave**, **Coarse Tune**, **FM Amount** and **Level** parameters can be edited via the first and second encoder. To edit the **Table**, **Fine Tune**, **FM Rate** and **Sync** parameters, alternate mode has to be enabled via the **ALT** button.

#### 6.3.1 Wave

Sets the play position inside the selected wavetable. You can modulate this parameter via the modulation matrix in order to bring movement into your sound.




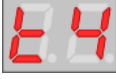

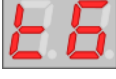




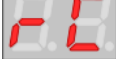
#### 6.3.2 Table

This parameter selects the wavetable that is used by the oscillator. In conjunction with the **Wave** setting, it is the most important control to define the basic tone.

Each wavetable consists of a combination of 4 waveforms that are blended to create a smooth transition. The following 16 waveforms are available to build these combinations:

- Sawtooth
- Square
- Triangle
- Sine
- Blue Noise
- Brown Noise
- Metal overtones
- Bell like
- Double Saw
- Double Square
- Organ,
- Prime numbers
- Formant A
- Formant E
- Formant O
- Grin

There are 8 factory wavetables and one user wavetable to choose from:

	Basic	Sawtooth → Square → Triangle → Sine
	Bright	Blue Noise → Brown Noise → Metal Overtones → Bell-like
	Full	Double Saw → Double Square → Organ → Prime Numbers
	Formants	Formant A → Formant E → Formant O → Grin
	Mix 1	Sawtooth → Organ → Bell-like → Formant E
	Mix 2	Triangle → Grin → Sine → Blue Noise
	Mix 3	Formant A → Brown Noise → Formant O → Prime Numbers
	Mix 4	Metal Overtones → Double Square → Bell-like → Double Saw
	User	Free combination of waveforms
	Random per Note	Random combination generated on each played note
	Random per Chord	Random combination generated on each played chord

Each oscillator has its own user table. It is initialized with the content of *Basic* for **Osc 1** and *Bright* for **Osc 2**.

There are two ways to change the content of the user wavetable:

- By sending a sysex command that configures the entries.
- By selecting the *Random per note* or *Random per Chord* wavetable and switch back to the *User* setting. Doing so will keep the last randomly generated combination. You can repeat this method several times until you are satisfied with the result.

### 6.3.3 Coarse Tune

Sets the pitch of the oscillator in semitones within a +/-3 octave range.

### 6.3.4 Fine Tune

Sets the fine pitch of the oscillator. It covers a range of +/-100 cents of a semitone.

### 6.3.5 FM Amount

The FM feature offers a phase modulation that uses the selected wave as carrier and a sine wave as modulator. This parameter sets the amount of modulation that is applied to the carrier.

### 6.3.6 FM Rate

Sets the frequency of the modulator sine wave for the phase modulation. The frequency is based on note pitch, using the following ratios:

- For negative values:  $freq / (1 - rate / 16)$
- For positive values:  $freq * rate / 4$

### 6.3.7 Level

Sets the mix level of the oscillator's output.

### 6.3.8 Sync

This parameter sets the auto-sync feature. It sounds like hard-sync and works by shorting and scaling the waveform, while keeping the note original pitch. A range of 1 to 15 waveform cycles can be set for the sync feature.

## 6.4 Extra



This module offers two additional signal sources that can be mixed with the oscillators before being routed to the shaper.



To access the extra parameters, press the **FILTER** module button. If you press the button more than once, the selection will cycle between filter and shaper. The extra module's parameters are accessible in both cases.

In normal mode, the **Noise Level** can be edited via the fourth encoder. To edit the **Ringmodulator Level**, alternate mode has to be enabled via the **ALT** button.

### 6.4.1 Noise Level

Sets the mix level of the white noise generator's output.

### 6.4.2 Ringmodulator Level

Sets the mix level of the ring modulator. The ring modulator multiplies the output of the two oscillators and generates a signal that contains the sum and the difference of the source signals. You can use this to get metallic timbres.

## 6.5 Filter



This module is one of the main sound-shaping components of the **Töörö** and is built upon a discret analog design, the FL A847 optocoupled resonant filter. It offers a 12db/octave low-pass with a unique sound.



To access the filter parameters, press the **FILTER** module button. If you press the button more than once, the selection will cycle between filter and shaper. The LED color indicates which module is selected:



In addition, the display will show the selected module briefly:



Filter



Shaper

Make sure that the filter module is selected.

In normal mode, the **Cutoff**, **Resonance** and **Env F Amount** parameters can be edited via the first, second and third encoder. To edit the **Pitch Tracking**, **After-touch Amount** and **LFO 1 Amount** parameters, alternate mode has to be enabled via the **ALT** button.

### 6.5.1 Cutoff

The cutoff frequency sets the point at which the signal is split into two bands. Frequencies below that point will remain unaffected, while frequencies above will be attenuated progressively.

### 6.5.2 Resonance

In a resonant filter, frequencies around the cutoff point can be emphasized. This is what this parameter is for. The more the value is increased, the more the sound will get a nasal character that will turn into a ringing at higher settings. When fully raised, the filter will run into self-oscillation, producing a tone with a pitch tuned to the cutoff frequency.

### 6.5.3 Env F Amount

Determines how much the filter envelope (Env F) affects the cutoff frequency. Use this to shape the harmonic content over time in order to make your sound feel more alive.

### 6.5.4 LFO 1 Amount

Sets the amount of LFO 1 modulation on the cutoff frequency.



**6.5.5 Pitch Tracking**

This parameter allows the cutoff frequency to follow the pitch of the played notes. The effective pitch is calculated from the note number but also includes any modulation via the pitch wheel. The reference note number where modulation is unaffected is 36. The range of this parameter reaches from -200% to +200%. A setting of *10* in the display corresponds to a tracking of +100%, making the cutoff frequency follow the notes on the keyboard.

**6.5.6 Aftertouch Amount**

Sets the amount of modulation that is applied by the keyboard aftertouch.

## 6.6 Shaper



The shaper is a module located right after the mixer stage and allows additional processing before the signal is routed to the analog filter. It offers a multimode filter that can be configured as low-pass, band-pass or high-pass.



To access the shaper parameters, press the **FILTER** module button. If you press the button more than once, the selection will cycle between filter and shaper. The LED color indicates which module is selected:



In addition, the display will show the selected module briefly:



Filter



Shaper

Make sure that the shaper module is selected.

In normal mode, the **Cutoff**, **Resonance** and **Env A Amount** parameters can be edited via the first, second and third encoder. To edit the **Pitch Tracking**, **Mode** and **LFO 2 Amount** parameters, alternate mode has to be enabled via the **ALT** button.

### 6.6.1 Cutoff Frequency

Sets the frequency at which the separation between pass band and attenuation band takes place.

- In low-pass mode, all frequencies above the cutoff frequency are attenuated.
- In band-pass mode, the cutoff frequency can be seen as center frequency. A band around this center frequency is kept unaffected, while the rest outside will be attenuated.
- In high-pass mode, all frequencies below the cutoff frequency are attenuated.

### 6.6.2 Resonance

- In low-pass or high-pass mode, this parameter creates an adjustable "bump" that accentuates the frequencies around the cutoff frequency.
- In band-pass mode, it adjusts the size of the band around the center frequency.

### 6.6.3 Env A Amount

Determines how much the amplifier envelope (Env A) affects the cutoff frequency. Use this to achieve a natural progression of the filter that corresponds to the volume of the signal.

### 6.6.4 LFO 2 Amount

Sets the amount of LFO 2 modulation on the cutoff frequency.

### 6.6.5 Pitch Tracking

This parameter allows the cutoff frequency to follow the pitch of the played notes. The effective pitch is calculated from the note number but also includes any modulation via the pitch wheel. The reference note number where modulation is unaffected is 36. The range of this parameter reaches from -200% to +200%. A setting of 10 in the display corresponds to a tracking of +100%, making the cutoff frequency follow the notes on the keyboard.

### 6.6.6 Mode

Switches between low-pass, band-pass and high-pass mode.



Low-pass

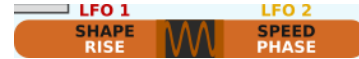


Band-pass



High-pass

## 6.7 LFOs



The **Töörö** has 2 independent LFOs that can be used for various modulation purposes.



To access the LFO parameters, press the **LFO** module button. If you press the button more than once, the selection will cycle between LFO 1 and LFO 2. The LED color indicates which LFO is selected:

● LFO 1      ● LFO 2

In addition, the display will show the selected LFO briefly:



LFO 1

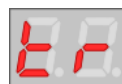


LFO 2

In normal mode, the **Shape** and **Speed** parameters can be edited via the first and second encoder. To edit the **Rise** and **Phase** parameters, alternate mode has to be enabled via the **ALT** button.

### 6.7.1 Shape

This parameter sets the waveform generated by the LFO.



Triangle



Ramp up, rising sawtooth



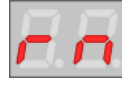
Ramp down, falling sawtooth



Square



M-shaped wave



Random steps, Sample &amp; hold



Slew, like random but smoothed steps for continuous output



Amplitude modulation, product of a triangle wave and the other LFOs output

### 6.7.2 Speed

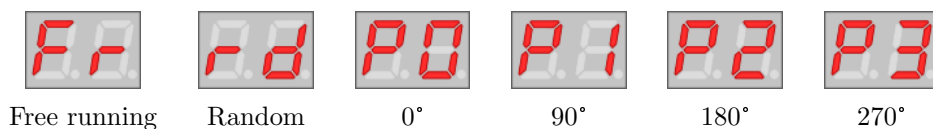
The speed parameter sets the LFO frequency. It covers a large range from 20 seconds up to 250Hz. The lower settings can be used for very slow, nearly unnoticeable movements, whereas the faster settings allow the LFO to be used as an additional FM audio source.

### 6.7.3 Rise

Sometimes it's not desirable to have the LFO at its full modulation after a note is played, but gradually fading it in. This is what the rise parameter does. It allows you to ramp up the modulation depth slowly up to 18 seconds.

### 6.7.4 Phase

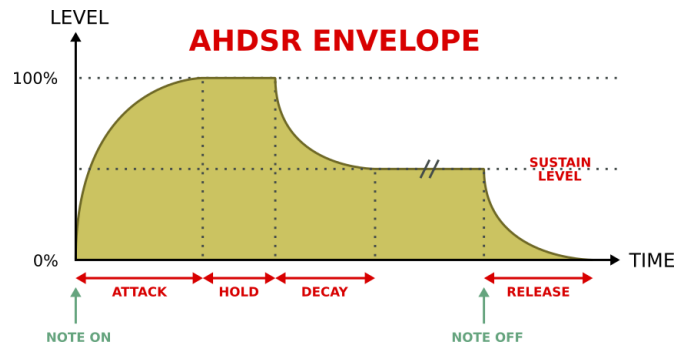
The LFO can either be free-running or starting at a certain phase position after a note is played. A free running LFO is very interesting in mono mode and when using arpeggio, as it allows a continuous progression of parameters for notes played in a sequence. A key-synced LFO allows to get more predictable results. Additionally, there is a random phase setting that is especially useful at low speeds.



## 6.8 Envelopes



The **Töörö** has 2 independent envelopes that are designated for filter and amplifier modulation in first place, but can also be used for other modulation purposes. In addition to the standard ADSR-type envelopes, the **Töörö** offers an additional hold stage on both envelopes after the attack. Also, the sustain level can be modulated via aftertouch. The envelope times cover a range from 1ms to 18s for all parameters.



To access the envelope parameters, press the **ENV** module button. If you press the button more than once, the selection will cycle between filter envelope (Env F) and amplifier envelope (Env A). The LED color indicates which envelope is selected:



In addition, the display will show the selected envelope briefly:



Env F



Env A

In normal mode, the **Attack**, **Decay**, **Sustain** and **Release** parameters can be edited via the encoders. To edit the **Velocity**, **Hold**, **Aftertouch** and **Trigger** parameters, alternate mode has to be enabled via the **ALT** button.

### 6.8.1 Attack Time

Sets the time to rise the envelope signal from 0 to the maximum value after the envelope is triggered.

### 6.8.2 Decay Time

Sets the time required by the envelope signal to fall from the maximum to the sustain level.

### 6.8.3 Sustain Level

Sets the destination level that is reached at the end of the decay stage.

#### 6.8.4 Release Time

Sets the time to fall from the sustain level to 0 after the trigger is released.

#### 6.8.5 Velocity Amount

This parameter allows to control the overall modulation amount of the envelope via the note velocity. If set to 0, velocity has no effect on the envelope depth. If set to higher values, the amount of velocity sensitivity gradually increases.

#### 6.8.6 Hold Time

The **Tööro**'s envelopes have an additional hold stage, whose time can be controlled by this parameter. Setting its value to 0 completely disables the hold stage and the envelope works like a normal ADSR envelope. Increasing the parameter, introduces a hold time after the attack stage where the signal is kept at maximum before the decay stage is entered.

#### 6.8.7 Aftertouch Amount

To offer more control over the sustain stage, its level can be modulated via aftertouch. This parameter defines how much the sustain level is affected by the aftertouch amount. If set to 0, aftertouch has no effect and sustain works in a normal way. On higher settings, the sustain is increasingly affected by the keyboard aftertouch.

#### 6.8.8 Trigger Mode

The trigger mode sets the behaviour of the envelope when a new note is started while it is still running on a previous note.



Always restart from the attack stage with level 0.



Never retrigger. Stay at whatever level/stage it was before the voice was reused.



Continue. Always restart in the attack stage using the last level.

The **Never** and **Continue** modes are especially useful in mono mode or when a lot of voice stealing is happening. In these cases they allow less static playing schemes.

## 6.9 Amplifier



The amplifier is the last module in the chain before the signal is routed to the parts mixer. It allows you to set the overall preset volume and panorama position.



Press the module button **AMP** to access the parameters of the amplifier.

The display will show the selected module briefly:



Amplifier

In normal mode, the **Level** can be edited via the first encoder. To edit the **Pan**, alternate mode has to be enabled via the **ALT** button.

### 6.9.1 Level

Sets the overall volume. Use this parameter to match a preset against the others to prevent large jumps in volume when switching presets.

### 6.9.2 Pan

Sets the position of the sound in the stereo field.



## 6.10 Arpeggiator



The arpeggiator is a module that allows the creation of melodic patterns from chords or single notes.



Press the module button **LFO** to access the parameters of the arpeggiator. If you press the button more than once, the selection will cycle between LFO 1 and LFO 2. The arpeggiator's parameters are accessible in both cases.

In normal mode, the **Mode** and **Grid** parameters can be edited via the third and fourth encoder. To edit the **Tempo** and **Hold** parameters, alternate mode has to be enabled via the **ALT** button.

### 6.10.1 Mode

The mode parameter enables the arpeggiator and sets the order and the range of the generated notes.

The following table shows the possible modes as well as an example of generated notes when a C major chord (C3 | E3 | G3) is played.

	Off	C3   E3   G3 (no change)
	Up	C3 → E3 → G3
	Down	G3 → E3 → C3
	Random	(random order)
	Up 2	C3 → C4 → E3 → E4 → G3 → G4
	Down 2	G3 → G4 → E3 → E4 → C3 → C4
	Up 4	C3 → C4 → C3 → C4 → E3 → E4 → E3 → E4 → G3 → G4 → G3 → G4
	Down 4	G3 → G4 → G3 → G4 → E3 → E4 → E3 → E4 → C3 → C4 → C3 → C4

### 6.10.2 Grid

This parameter determines the note value and the gate length of the generated notes.

The displayed value shows the number of clock ticks between each note. Because MIDI clock operates with a rate of 24ppq (pulses per quarter), a value of 24 refers to a quarter note.

The following table shows the relationship between the display and the note value:

Display value	Note value
48	1/2
32	1/2 triplet
24	1/4
16	1/4 triplet
12	1/8
8	1/8 triplet
6	1/16
3	1/32
2	1/32 triplet
1	1/64 triplet

The gate length of the notes is always equivalent to 50% of the note value.

**Note:** to modify the perceived gate length, make use of the envelope hold and decay parameters.

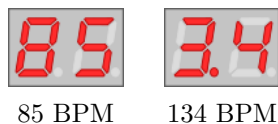
### 6.10.3 Tempo

There are two ways to set the base tempo for the arpeggiator:

- **Free-running:** the tempo is set manually, using this parameter.
- **Synchronized:** the tempo is set automatically, using MIDI clock (USB or DIN).

The **Töörö** automatically switches to **synchronized** mode if an external clock is received and reverts back to the **free running** mode when no other clock source is available.

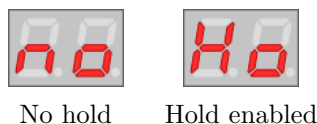
The display always shows the last two digits of the BPM value. If the tempo is set above 100 BPM, a dot is shown after the first digit:



### 6.10.4 Hold

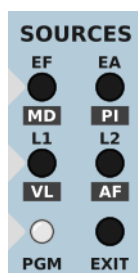
The hold function allows the arpeggiator to continue its sequence after all notes are released.

- When hold is disabled, notes are only generated when at least one note is pressed.
- With hold enabled, the arpeggiator starts when the first note is received. The generated sequence continues to play after all notes are released. It will then change as soon as a new note or chord is played.



**Note:** in hold mode, the arpeggiator always stays in sync with the MIDI timing. New sequences of notes are only started on the grid. In normal mode, sequences starts immediately when notes are entered.

## 6.11 Modulation Matrix



The **Töörö** offers a modulation matrix with 8 sources. Each source can only modulate one destination. To assign the modulation sources to the different destinations, the matrix programming mode has to be entered.

### 6.11.1 Entering the Matrix Programming Mode

To enter matrix programming mode, press one of the **Sources** buttons on the right side of the panel. Use the **ALT** button before to access the secondary sources. The **PGM** LED will now be lit.

### 6.11.2 Programming a Modulation Assignment

These are the steps to program a modulation assignment:

- Enter the *Matrix Programming Mode* by pressing one of the sources buttons. Use the **ALT** button before if you want to use one of the alternate sources.
- The display will now indicate the selected modulation source.
- Select the module that should be modulated via the **Module** buttons.
- In order to program a modulation for a parameter that is accessible in alternate mode, make sure that the alternate mode is enabled via the **ALT** button.
- Turn the encoder that corresponds to the parameter that should be modulated.

At the end of this chapter, you'll find some examples how to program a modulation in detail.

### 6.11.3 Replacing a Modulation Assignment

Programming a new assignment on a modulation source will replace the previous one.

### 6.11.4 Clearing a Modulation Assignment







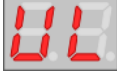

Hold down the **EXIT** and press one of the **Sources** buttons to clear any assignment for that modulation source.

### 6.11.5 Exiting the Matrix Programming Mode

The matrix programming mode can be exited at any time via the **EXIT** button. If no modulation assignment is edited for some seconds, the programming mode is also left automatically.

### 6.11.6 Modulation Sources

The following modulation sources can be used:

	Env F (Filter envelope)
	Env A (Amplifier envelope)
	LFO 1
	LFO 2
	Mod wheel
	Pitch (note number & pitch wheel)
	Note velocity
	Aftertouch

### 6.11.7 Modulation Destinations

The following parameters can be used as modulation destinations:

Module	Parameters
Oscillators	Wave, Pitch, FM Amount, FM Rate, Sync, Level
Extra	Noise, Ring Modulation
Filter	Cutoff, Resonance
Shaper	Cutoff, Resonance
LFO	Speed
Amplifier	Level, Pan

### 6.11.8 Default Assignments

After initializing a preset, some mappings are pre-assigned with a modulation amount of 0. By sending the appropriate MIDI CCs, you can control the modulation amount for these default mappings.

Source	Target
Env F	Osc 1 Sync
Env A	Osc 1 FM Amount
LFO 1	Osc 1 Wave
LFO 2	Ring Modulation
Mod wheel	Filter Cutoff
Pitch	Osc 2 Sync
Velocity	Osc 1 Wave
Aftertouch	LFO 1 Speed

Furthermore, there is a default assignment for vibrato via mod wheel. Whenever the modulation amount of the mod wheel is set to 0 or modulation is disabled, a default modulation of LFO 2 to master pitch is applied and its intensity is controlled by the mod wheel.

#### 6.11.9 Example 1: Applying LFO 1 Modulation on Osc 1 Pitch

- Make sure that the **ALT** LED is off. If not, press the **ALT** button to disable the alternate mode.
- Press the **L1/VL** button in the sources section.
- The display will now show *L1* to indicate LFO 1 as modulation source.
- Press the **OSC** module button once or twice until the corresponding LED is lit in red and the display shows *O1* briefly.
- Turn the second encoder to set the modulation amount for the **Coarse** parameter.
- Press the **EXIT** button in the sources section or wait a few seconds to exit the programming mode automatically.

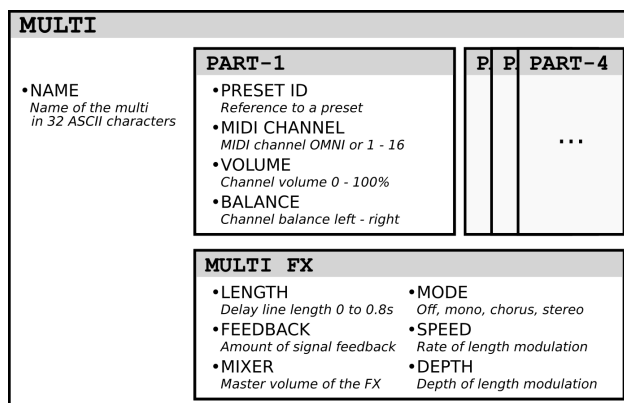
#### 6.11.10 Example 2: Applying Pitch Modulation on Amplifier Pan

- Make sure that the **ALT** LED is on. If not, press the **ALT** button to enable the alternate mode.
- Press the **EA/PI** button in the sources section.
- The display will now show *PI* to indicate pitch as modulation source.
- Press the **AMP** module button. The display will show *AM* briefly.
- Press the **ALT** button again to select the alternate parameters for modulation. The **ALT** LED will be lit now.
- Turn the first encoder to set the modulation amount for the **Pan** parameter.
- Press the **EXIT** button in the sources section or wait a few seconds to exit the programming mode automatically.

## 7 Multi Parameters

### 7.1 Overview

Töörö overall multi structure



Note: The multi name is only accessible by Sysex messages.

### 7.2 Parts Mixer

The parts mixer allows to control the volume and balance of all parts. The four encoders correspond to the part number.

- Make sure that alternate mode is disabled to set the volumes or enable it to set the balances via the **ALT** button.
- Press and hold the **VOL/BAL** button.
- Turn the encoder that corresponds to the part to change the value.
- The LEDs above the encoders will show an optical representation of the value by their brightness and color.

## 7.3 Multi FX

MULTI FX			
DLY	LENGTH	FEEDBACK	MIX
CHO	MODE	SPEED	DEPTH

The **Tööro** offers time-domain effects that are based on the repetition of the original signal at different intervals. The delay time of each effect can be modulated by an internal LFO. The effects are applied to all parts of the multi with the same intensity.



Press the module button **AMP** to access the parameters of the multi fx.

In normal mode, the **Length**, **Feedback** and **Mix** parameters can be edited via the second, third and fourth encoder. To edit the **Mode**, **Speed** and **Depth** parameters, alternate mode has to be enabled via the **ALT** button.

### 7.3.1 Length

Sets the delay time and therefore the frequency of the repetitions. The range of this parameter covers a span from a few milliseconds up to 780ms. Depending on the setting, you can get results in a wide range from thickening the sound with barely noticeable delays up to rhythmic patterns.

### 7.3.2 Feedback

The feedback parameter controls the amount of repetitions that are generated. When set to maximum, infinite repetitions are generated, allowing drones and lush ambient sounds.

### 7.3.3 Mix

This parameter sets the level of the effect signal that is mixed with the dry signal. The level of the dry signal is not affected by this setting.

### 7.3.4 Mode

This parameter chooses which effect is being used:



No effect



Mono delay



Chorus / Flanger



Stereo delay

- The mono delay repeats the original signal a defined number of times. The repetitions are progressively degraded, they lose their loudness, dynamic precision and some of their frequency content.
- Although the chorus/flanger effect does not feel like a delay, it uses the same ground principles. The repetitions are closer and modulated, the perceived effect is a constant variation of the sound spectrum giving it a thicker character. This effect has multiple uses, try to experiment with different settings!
- The stereo delay is very similar to the mono delay. The essential difference is the repetitions come first from the left channel and then from the right channel and so on. It gives a nice stereo image to the sound.

**7.3.5 Speed**

Sets the speed of the modulation that is applied to the delay time. It covers a range from 16s to 6Hz.

**7.3.6 Depth**

Sets the amount of modulation that is applied to the delay time.



## 8 Filter Tuning

The **Töörö** contains an analog FL A847 filter for each voice. According to the nature of analog components, each voice will have slightly different sound. In order to minimize these variations, the filter can be tuned via an automated procedure.

- Wait at least 15 minutes after the **Töörö** has been powered up. This is to ensure that all internal components are working at their desired operation temperature.
- Turn down the volume on your attached audio system or disconnect the output jacks. While the tune procedure is running, some high pitched tones will be generated at high output levels that could damage your speakers and hearing.
- Press and hold the **SYSTEM** button. Then press the module button labelled **AMP**. This button also has a secondary vertical label **TUNE** left to it.
- The tune procedure is now started and will take about 2 minutes to proceed. While running, the display will show some screens that represent the individual steps.
- After the tuning is done, the display will return to show the preset number again.

## 9 MIDI MPE Mode

### 9.1 What is MIDI MPE?

**MPE** stands for **MIDI Polyphonic Expression**, it is a MIDI Standard unlocking a new level of expressive possibilities when playing electronic instruments.

Using MPE and a compatible controller, musicians gain the ability to articulate each note individually, along **3 separate axis** (Pitch, Aftertouch and CC74). This offers an unprecedented way to add many nuances to one's play style, as it is often done intuitively with acoustic instruments.

### 9.2 Enabling MPE Mode

To benefit from the MPE functionalities, Töörö's firmware must be updated to at least the **version 1.60**. In **MPE Mode**, the **MIDI LED** state on the 7-segment display is inverted, indicating valid incoming MIDI data by going off.

There are two ways to commute the Töörö to MPE Mode:

#### 9.2.1 Basic MPE Mode

Hold the **EXIT** switch while power up, this sets up the **Basic MPE Mode**.

This mode consists in a **single MPE Zone**, the lower one, with MIDI channel 1 being the **Master Channel** and MIDI channels from 2 to 16 being available **Member Channels**. This enables the attached MPE controller to allocate up to 15 virtual voices (there are still 6 physical voices). The **Pitch Bend** range of all member channels is automatically set to +/- 48 semitones and the one of the master channel to +/- 2 semitones.

This basic configuration will work fine in most cases. The Preset selected on Part 1 is used to reproduce the sound of the notes. To revert back to the **Multitimbral mode**, simply power the machine off and on again.

### 9.2.2 Advanced MPE Mode

**Advanced MPE Mode** can only be enabled by sending the required **MIDI NRPN** messages to configure the MPE zones. These cannot be edited from the **Töörö** user interface, the MPE controller must send out the desired configuration according to the MPE specifications. Töörö software accepts NRPN 0 (Pitch bend range) & NRPN 6 (MPE zone configuration) for this purpose.

Please refer to the documentation of your MPE controller to know how to define and transfer an appropriate MPE configuration.

**Remark:** On the **Töörö**, the Multitimbral and MPE Modes are exclusive! It is not possible to use the MPE functionality on a couple of MIDI member channels while having the remaining parts using some unattributed MIDI channels. At best bi-timbral usage can be made when operating in 2-zones configuration.

## 10 Firmware Update

To benefit from new features (and potential bug-fixes), the internal firmware of the **Töörö** can be re-programmed. Updates should only be performed when absolutely necessary and the procedure steps and recommendations should be strictly followed.

In order to check which version of the firmware is currently installed, the display will show the version number briefly right after the **Töörö** is powered on.

**Important:** Failing to observe the update procedure may simply **brick your device!** Therefore, please proceed carefully.

To update your **Töörö** instrument to the **latest firmware revision**, please refer to the appropriate update documentation and read the following tutorials at:

<https://fredslab.net/en/tooro-module.php>

## 11 Restoring the Factory Presets

To restore the factory presets, maintain the **PRESET** button pressed at startup until the display shows **FS** for "Factory Setting".

**Remark:** The first 40 presets slots will be overwritten. Make sure to backup the previous content if needed.

## 12 Specifications

Here you will find all technical data concerning the **Tööro**.

### 12.1 Sound Engine

#### 12.1.1 General

- Number of parts: 4
- Maximal polyphony: 6 voices
- MIDI channel selection, overall volume and panning settings per part

#### 12.1.2 Oscillators

Two 12bit digital oscillators with:

- Waveform morphing
- Factory and user tables
- Additional sine modulator for linear through zero phase modulation
- Auto-sync feature (hardsync)

Additional sources:

- White noise
- Ring modulation of both oscillators

#### 12.1.3 Filter

FL A847 optocoupler based 12dB/octave low-pass filter with self-oscillation and saturation.

#### 12.1.4 Shaper

Digital multimode filter with low-pass, band-pass and high-pass.

#### 12.1.5 Envelopes

Two ADSR envelopes with additional hold stage and multiple triggering options.

#### 12.1.6 LFOs

Two complex LFOs with various waveforms and AD envelope.

#### 12.1.7 Arpeggiator

MIDI-syncable arpeggiator with multiple modes and patterns.

### 12.1.8 DCA

Digitally controlled attenuator with volume and panning control.

### 12.1.9 Multi FX

Effect types:

- Mono modulated delay
- Stereo chorus / flanger
- Stereo modulated line

## 12.2 Memory

- 100 user presets
- 10 user multis

## 12.3 Line Outputs

- -10dBu (single voice) /  $0.25V_{RMS}$  /  $0.7V_{pkpk}$
- +20dBu (full scale) /  $7.7V_{RMS}$  /  $20V_{pkpk}$
- Impedance DC  $1k\Omega$ , AC  $0\Omega$  ( $f < 30kHz$ )

## 12.4 Audio Resolution

- 44kHz, 12Bit

## 12.5 Master Clocks

- MCU: 80MHz
- USB: 48MHz
- OSCs: 792kHz

## 12.6 Power

- USB bus power +5V +/-5%
- 350mA (maximum)

## 12.7 Connectors

- 2 line-level unbalanced 6.35mm jacks (mix left & right)
- 2 instrument-level 3.5mm jacks for separate voice outputs (for voice 1-4 only)
- 1 MIDI in DIN jack
- 1 MIDI out DIN jack
- 1 USB type B socket (for power and MIDI over USB)

**12.8 User Interface**

- 4 encoders
- 14 tactile switches
- Dual digit 7-segment hexadecimal display
- 12 leds
- 1 power switch

**12.9 Dimensions & Weight**

- 160mm x 100mm x 60mm (unit)
- 350 grams (unit)

**12.10 Mechanics**

- Aluminum industrial enclosure
- 4 rubber feet

**12.11 Accessories**

- Quickstart guide
- USB cable 1m

## 13 MIDI Implementation

### 13.1 Channel Voice Messages

**Channel Voice Messages** are used to send basic music events to one specific channel or part. They consists in 3 bytes: the **status** byte, followed by two **data** bytes. Here follows the list of supported messages.

#### 13.1.1 Note Off

Stops the playback of a note.

```
Byte: 0    1    2
Data: 0x8c note velo
      c    = MIDI channel (0 - 15)
      note = MIDI note (0 - 127)
      velo = note velocity (0 - 127)
```

#### 13.1.2 Note On

Starts the playback of a note.

```
Byte: 0    1    2
Data: 0x9c note velo
      c    = MIDI channel (0 - 15)
      note = MIDI note (0 - 127)
      velo = note velocity (1 - 127)*
```

\* Note: a velocity of 0 corresponds to a Note off event.

#### 13.1.3 Polyphonic Aftertouch

Polyphonic aftertouch / pressure

```
Byte: 0    1    2
Data: 0xAc note value
      c    = MIDI channel (0 - 15)
      note = MIDI note
      value = aftertouch value
```

#### 13.1.4 Controller Change

Modifies a specific sound parameter value of the given channel (= part).

```
Byte: 0    1    2
Data: 0xBc index value
      c    = MIDI channel (0 - 15)
      index = controller number (see the CC list)
      value = controller value* (see the CC list)
```

\* Note: internal parameter values are represented in 10 bit format.

Since MIDI CCs can only transmit 7 bit values, values transmitted are internally interpolated and smoothed.

### 13.1.5 Program Change

Selects the current *preset*.

Byte: 0 1  
 Data: 0xCc preset  
       c = MIDI channel (0 - 15)  
       preset = preset number (0 - 99)

### 13.1.6 Channel Aftertouch

Controls the pressure level of the given channel (= part) notes.

Byte: 0 1 2  
 Data: 0xDc value  
       c = MIDI channel (0 - 15)  
       value = Pressure value (0 - 127)

### 13.1.7 Pitch Bend

Increases or decreases the pitch of the given channel (= part) notes.

Byte: 0 1 2  
 Data: 0xEc least most  
       c = MIDI channel (0 - 15)  
       least = least significant 7bit of 14bit bend value\*  
       most = most significant 7bit of 14bit bend value\*

\* Note: bend value is centered around 0x4000 = 0 cents.

## 13.2 System Real Time Messages

**System Real Time Messages** are used to send high-priority messages relative to music timing and sequences.

### 13.2.1 Clock Start

Start all parts arpeggiators if enabled.

Byte: 0  
 Data: 0xFA

### 13.2.2 Clock Continue

Re-start all parts arpeggiators if enabled.

Byte: 0  
 Data: 0xFB

### 13.2.3 Clock Stop

Stop all parts arpeggiator.

Byte: 0

Data: 0xFC

### 13.2.4 Clock Tick

Synchronizes the MIDI master clock of the sound module. A tick corresponds to 1/24th of a quarter note.

Byte: 0

Data: 0xF8

### 13.2.5 Active Sensing

Ensure the MIDI connection is working.

Once first sent, **active sensing** messages must be sent to the module periodically. If the module stops receiving **active sensing** messages for an extended period of time, it will automatically perform a **all sounds off**.

Byte: 0

Data: 0xFE



### 13.3 MIDI CC Assignments

**Controller Change Messages** are used to alter sound parameters of a given channel. They allow more musical expressivity by adjusting the sound character while playing or allow the editing of the part parameters from an extended/remote MIDI interface or a computer software (sequencer or preset editor).

The messages consist of 3 bytes: the **status** byte, followed by the **control number** byte and then terminated by the **control value** byte. Here's the list of supported messages:

Section	Parameter	CC Number
General	Modwheel	1
Preset	Osc 1 Wave	70
	Osc 1 Coarse	21
	Osc 1 FM Amount	22
	Osc 1 Level	23
	Osc 1 Table	24
	Osc 1 Fine	25
	Osc 1 FM Rate	26
	Osc 1 Sync	27
	Osc 2 Wave	77
	Osc 2 Coarse	31
	Osc 2 FM Amount	32
	Osc 2 Level	33
	Osc 2 Table	34
	Osc 2 Fine	35
	Osc 2 FM Rate	36
	Osc 2 Sync	37
	Extra Noise	78
	Extra Ring	79
	Env A Attack	73
	Env A Decay	40
	Env A Sustain	41
	Env A Release	72
	Env A Velo	43
	Env A Hold	42
	Env A After	44
	Env A Trigger	45
	Env F Attack	46
	Env F Decay	47
	Env F Sustain	48
	Env F Release	49
	Env F Velo	51
	Env F Hold	50
	Env F After	52
	Env F Trigger	53

<b>Section</b>	<b>Parameter</b>	<b>CC Number</b>
Preset	Filter Resonance	71
	Filter Cutoff	74
	Filter Env F Amount	54
	Filter Track	55
	Filter After	56
	Filter LFO 1 Amount	57
	Shaper Cutoff	75
	Shaper Resonance	76
	Shaper Env A Amount	58
	Shaper Track	59
	Shaper Mode	60
	Shaper LFO 2 Amount	61
	LFO 1 Shape	102
	LFO 1 Speed	103
	LFO 1 Rise	104
	LFO 1 Phase	105
	LFO 2 Shape	106
	LFO 2 Speed	107
	LFO 2 Rise	108
	LFO 2 Phase	109
	Arp Mode	110
	Arp Grid	111
	Arp Tempo	112
	Arp Hold	113
	Amp Level	80
	Amp Pan	81
	Modulation Env F	17
	Modulation Env A	18
	Modulation LFO 1	19
	Modulation LFO 2	20
	Modulation Mod Wheel	87
	Modulation Pitch	88
	Modulation Velocity	89
	Modulation Aftertouch	90
	Tune Range	85
	Bend Range	86
Multi	Level	07
	Balance	10
	Sustain Pedal	64
	FX Mix	91
	FX Feedback	12
	FX Length	14
	FX Depth	93
	FX Mode	13
FX Speed	15	

Section	Parameter	CC Number
System	All Sounds Off	120
	Reset All Controllers	121
	All Notes Off	123
	Omni Off	124
	Omni On	125
	Mono Mode	126
	Poly Mode	127

## 14 Sysex Implementation

**Sysex or System Exclusive Messages** are lengthier MIDI messages used to transfer, save and load preset and multi parameters. Two types of messages exist: **requests** and **dumps**.

**Requests** are sent to the music instrument to ask for the dump of a specific preset or multi.

**Dumps** are sent by the instrument in response to the reciprocal request or are sent to the instrument to replace a specific preset or multi. Dumps previously requested can be sent back without any alteration, to restore a previous memory configuration.

### 14.1 Requests

#### 14.1.1 Multi Request

Request a specific multi from the memory.

```
Byte: 0   1   2   3
Data: 0xF0 0x01 0xMI 0xF7
      0xF0 = Sysex start
      0x01 = Service 1 => "Multi request"
      0xMI = Multi id (0-9 = memory slot, 0x7F = multi edit buffer)
      0xF7 = Sysex end
```

#### 14.1.2 Preset Request

Request a specific preset from the memory.

```
Byte: 0   1   2   3
Data: 0xF0 0x02 0xPI 0xF7
      0xF0 = Sysex start
      0x02 = Service 2 => "Preset request"
      0xPI = Preset id (0-99 = memory slot, 0x70-0x73 = Part 1-4)
      0xF7 = Sysex end
```

#### 14.1.3 Preset Parameter Request

Request a specific preset parameter from the memory.

```
Byte: 0   1   2   3   4   5
Data: 0xF0 0x03 0xPI 0xIDL 0xIDH 0xF7
      0xF0 = Sysex start
      0x03 = Service 3 => "Preset parameter request"
      0xPI = Preset id (0x70-0x73 = Part 1-4)
      0xIDL = Parameter id (lower 7 bits)
      0xIDH = Parameter id (higher 7 bits)
      0xF7 = Sysex end
```

See *Preset Dump* parameters table for IDs.

#### 14.1.4 Multi Parameter Request

Request a specific multi parameter from the memory.

```
Byte: 0   1   2   3   4   5
Data: 0xF0 0x04 0x00 0xIDL 0xIDH 0xF7
      0xF0 = Sysex start
      0x04 = Service 4 => "Multi parameter request"
      0x00 = Reserved, set to 0
      0xIDL = Parameter id (lower 7 bits)
      0xIDH = Parameter id (higher 7 bits)
      0xF7 = Sysex end
```

See *Multi Dump* parameters table for IDs.

## 14.2 Dumps

### 14.2.1 Multi Dump

Multi dump. Sysex is 104 bytes long.

Byte: 0 1 2 n 103

Data: 0xF0 0x11 0xMI ... 0xF7

0xF0 = Sysex start

0x11 = Service 17 => "Multi dump"

0xMI = Multi id (0-10 = memory slot, 0x7F = current edit buffer)

... data (100 bytes)

0xF7 = Sysex end

Data is packed, see *Data Packing* section for details.

ID	Index	Length	Description
0	0	2	Preset ID Part 1
1	2	2	Preset ID Part 2
2	4	2	Preset ID Part 3
3	6	2	Preset ID Part 4
4	8	2	MIDI Channel Part 1
5	10	2	MIDI Channel Part 2
6	12	2	MIDI Channel Part 3
7	14	2	MIDI Channel Part 4
8	16	2	Volume Part 1
9	18	2	Volume Part 2
10	20	2	Volume Part 3
11	22	2	Volume Part 4
12	24	2	Balance Part 1
13	26	2	Balance Part 2
14	28	2	Balance Part 3
15	30	2	Balance Part 4
16	32	2	FX Length
17	34	2	FX Feedback
18	36	2	FX Mix
19	38	2	FX Mode
20	40	2	FX Speed
21	42	2	FX Depth
22	44	2	Version
23	46	2	Flags (internal)
24	48	32	Name

### 14.2.2 Preset Dump

Preset dump. Sysex is 264 bytes long.

Byte: 0 1 2 n 263

Data: 0xF0 0x12 0xPI ... 0xF7

0xF0 = Sysex start

0x12 = Service 18 => "Preset dump"

0xPI = Preset id (0-99 = memory slot, 0x70-0x73 = Part 1-4)

... data (260 bytes)

0xF7 = Sysex end

Data is packed, see *Data Packing* section for details.

<b>ID</b>	<b>Index</b>	<b>Length</b>	<b>Description</b>
0	0	2	Osc 1 Wave
1	2	2	Osc 1 Coarse
2	4	2	Osc 1 FM Amount
3	6	2	Osc 1 Level
4	8	2	Osc 1 Table
5	10	2	Osc 1 Fine
6	12	2	Osc 1 FM Rate
7	14	2	Osc 1 Sync
8	16	2	Osc 2 Wave
9	18	2	Osc 2 Coarse
10	20	2	Osc 2 FM Amount
11	22	2	Osc 2 Level
12	24	2	Osc 2 Table
13	26	2	Osc 2 Fine
14	28	2	Osc 2 FM Rate
15	30	2	Osc 2 Sync
16	32	2	Extra Noise
17	34	2	Extra Ring
18	36	2	Shaper Cutoff
19	38	2	Shaper Resonance
20	40	2	Shaper Env A Amount
21	42	2	Shaper Track
22	44	2	Shaper Mode
23	46	2	Shaper LFO 2 Amount
24	48	2	Filter Cutoff
25	50	2	Filter Resonance
26	52	2	Filter Env F Amount
27	54	2	Filter Track
28	56	2	Filter After
29	58	2	Filter LFO 1 Amount
30	60	2	Env F Attack
31	62	2	Env F Decay
32	64	2	Env F Sustain
33	66	2	Env F Release
34	68	2	Env F Velo
35	70	2	Env F Hold
36	72	2	Env F After
37	74	2	Env F Trigger
38	76	2	Env A Attack
39	78	2	Env A Decay
40	80	2	Env A Sustain
41	82	2	Env A Release
42	84	2	Env A Velo
43	86	2	Env A Hold
44	88	2	Env A After
45	90	2	Env A Trigger

<b>ID</b>	<b>Index</b>	<b>Length</b>	<b>Description</b>
46	92	2	LFO 1 Shape
47	94	2	LFO 1 Speed
48	96	2	LFO 1 Rise
49	98	2	LFO 1 Phase
50	100	2	LFO 2 Shape
51	102	2	LFO 2 Speed
52	104	2	LFO 2 Rise
53	106	2	LFO 2 Phase
54	108	2	Arp Mode
55	110	2	Arp Grid
56	112	2	Arp Tempo
57	114	2	Arp Hold
58	116	2	Amp Level
59	118	2	Amp Pan
60	120	2	Env F Amount
61	122	2	Env F Target
62	124	2	Env A Amount
63	126	2	Env A Target
64	128	2	LFO 1 Amount
65	130	2	LFO 1 Target
66	132	2	LFO 2 Amount
67	134	2	LFO 2 Target
68	136	2	Wheel Amount
69	138	2	Wheel Target
70	140	2	Pitch Amount
71	142	2	Pitch Target
72	144	2	Velo Amount
73	146	2	Velo Target
74	148	2	After Amount
75	150	2	After Target
76-79	152	8	Osc 1 Waves
80-83	160	8	Osc 2 Waves
84	168	2	Tune
85	170	2	Version
86	172	2	Bend Range
87	174	2	Flags (internal)
88	176	32	Name



### 14.2.3 Preset Parameter Dump

Preset parameter dump. Sysex is 8 bytes long.

```

Byte: 0   1   2   3   4   5   6   7
Data: 0xF0 0x13 0xPI 0xIDL 0xIDH 0xVLL 0xVLH 0xF7
      0xF0 = Sysex start
      0x13 = Service 19 => "Preset parameter dump"
      0xPI = Preset id (0x70-0x73 = Part 1-4)
      0xIDL = Parameter id (lower 7 bits)
      0xIDH = Parameter id (higher 7 bits)
      0xVLL = Parameter value (lower 7 bits)
      0xVLH = Parameter value (higher 7 bits)
      0xF7 = Sysex end

```

See *Preset Dump* parameters table for IDs.

### 14.2.4 Multi Parameter Dump

Multi parameter dump. Sysex is 8 bytes long.

```

Byte: 0   1   2   3   4   5   6   7
Data: 0xF0 0x14 0x00 0xIDL 0xIDH 0xVLL 0xVLH 0xF7
      0xF0 = Sysex start
      0x14 = Service 20 => "Multi parameter dump"
      0x00 = Reserved, set to 0
      0xIDL = Parameter id (lower 7 bits)
      0xIDH = Parameter id (higher 7 bits)
      0xVLL = Parameter value (lower 7 bits)
      0xVLH = Parameter value (higher 7 bits)
      0xF7 = Sysex end

```

See *Multi Dump* parameters table for IDs.

### 14.2.5 Data Packing

Sysex payload data is packed because of the 7-bit restriction of the MIDI format.

Byte Description

```

0:  byte 0, lowest 7 bits
1:  byte 1, lowest 7 bits
2:  byte 2, lowest 7 bits
3:  byte 3, lowest 7 bits
4:  tops, top 7th bits of the 4 preceeding bytes
5:  byte 4, lowest 7 bits
6:  byte 5, lowest 7 bits
7:  byte 6, lowest 7 bits
8:  byte 7, lowest 7 bits
9:  tops, top 7th bits of the 4 preceeding bytes
...

```

Packing algorithm:

```
int length = 3;
int size = sizeof(content);
for (int i = 0; i < size / 4; i++) {
    int tops = 0;
    sysex[length++] = *data & 0x7F;
    tops |= (*data++ & 0x80) >> 7;
    sysex[length++] = *data & 0x7F;
    tops |= (*data++ & 0x80) >> 6;
    sysex[length++] = *data & 0x7F;
    tops |= (*data++ & 0x80) >> 5;
    sysex[length++] = *data & 0x7F;
    tops |= (*data++ & 0x80) >> 4;
    sysex[length++] = tops;
}
```

Unpacking algorithm:

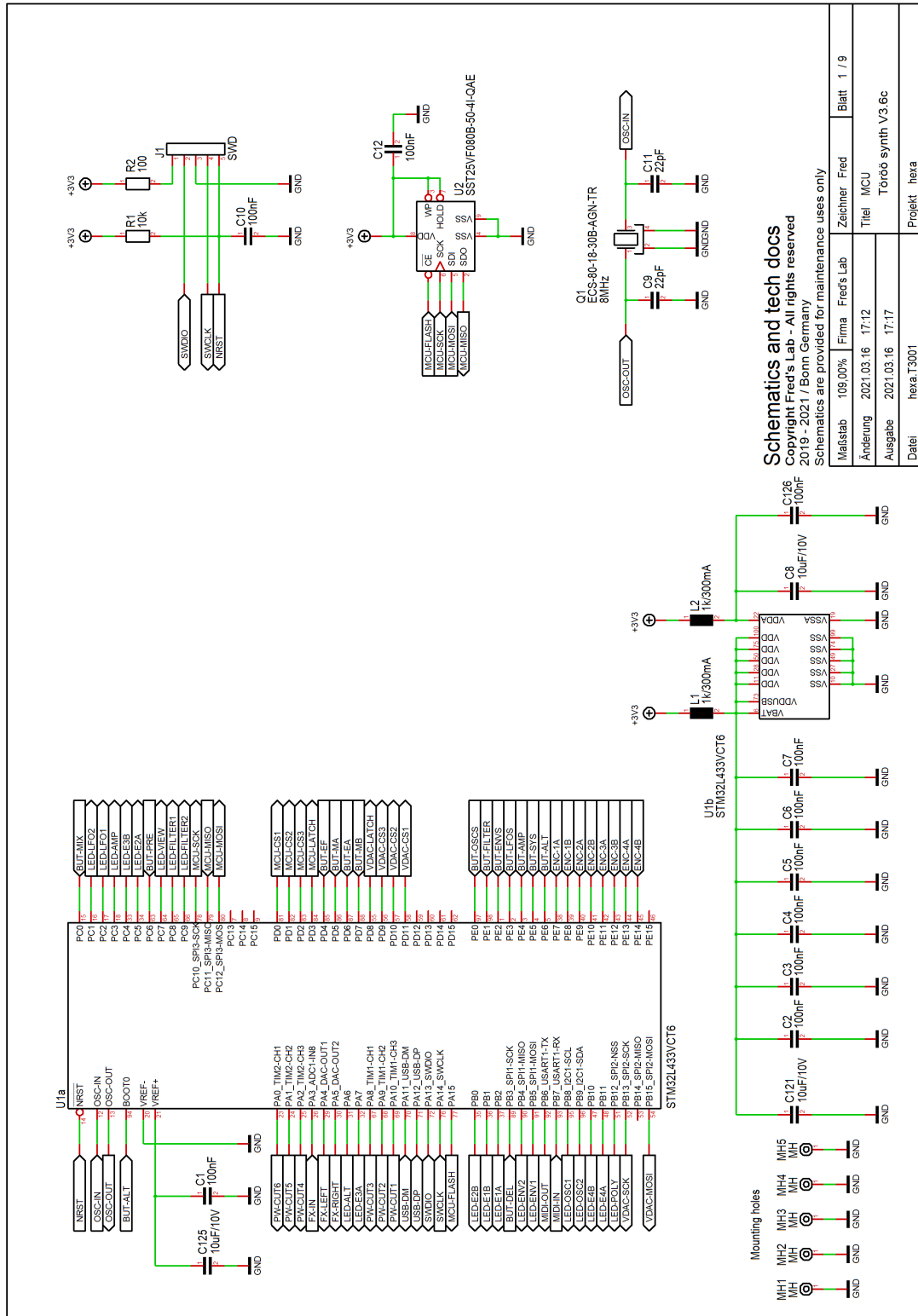
```
int cursor = 3;
int blocks = (length - 4) / 5;
for (int i = 0; i < blocks; i++) {
    int tops = sysex[cursor + 4] ;
    *data++ = sysex[cursor++] | ((tops << 7) & 0x80);
    *data++ = sysex[cursor++] | ((tops << 6) & 0x80);
    *data++ = sysex[cursor++] | ((tops << 5) & 0x80);
    *data++ = sysex[cursor++] | ((tops << 4) & 0x80);
    cursor++;
}
```

## 15 Schematics

To minimize electronic waste and ensure long product life, Fred's Lab is willing to provide all technical documents needed to repair his products. The following schematics are provided "as is" with no warranty of any kind. Any modification made to a Fred's Lab instrument immediately voids the included 3-year product warranty. Repairs must be carried out by a competent repair service. Fred's Lab stays available for the maintenance of your instruments. Do not hesitate to contact the support service for a free quote. Spare parts can directly be ordered from us.

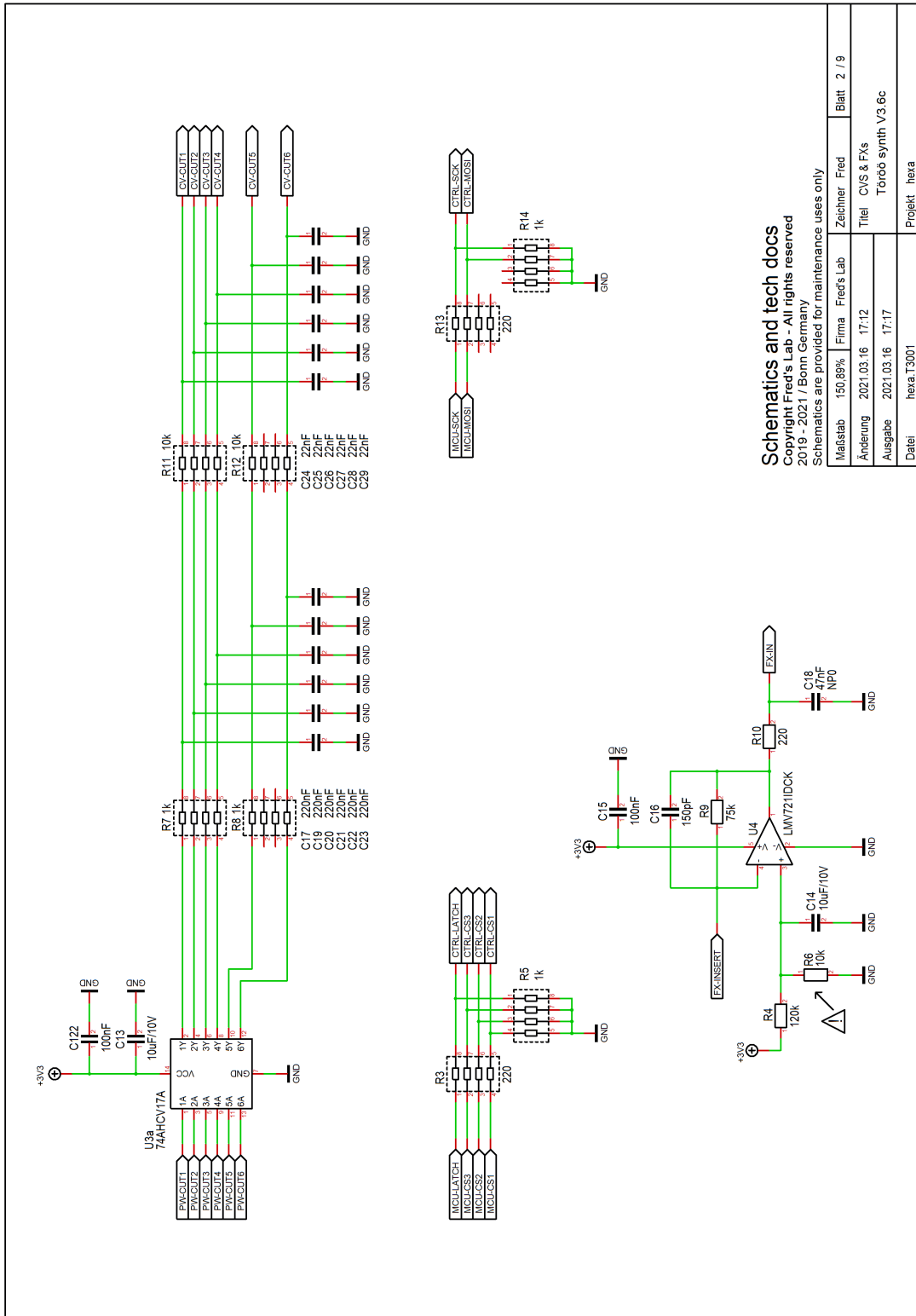
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Maßstab	109,00%	Firma	Fred's Lab	Zeichner	Fred	Blatt	1 / 9
Änderung	2021.03.16	Titel	MCU				
Ausgabe	2021.03.16	17:17	Toröb synth V3.6c				
Datei	hexa.T3001						

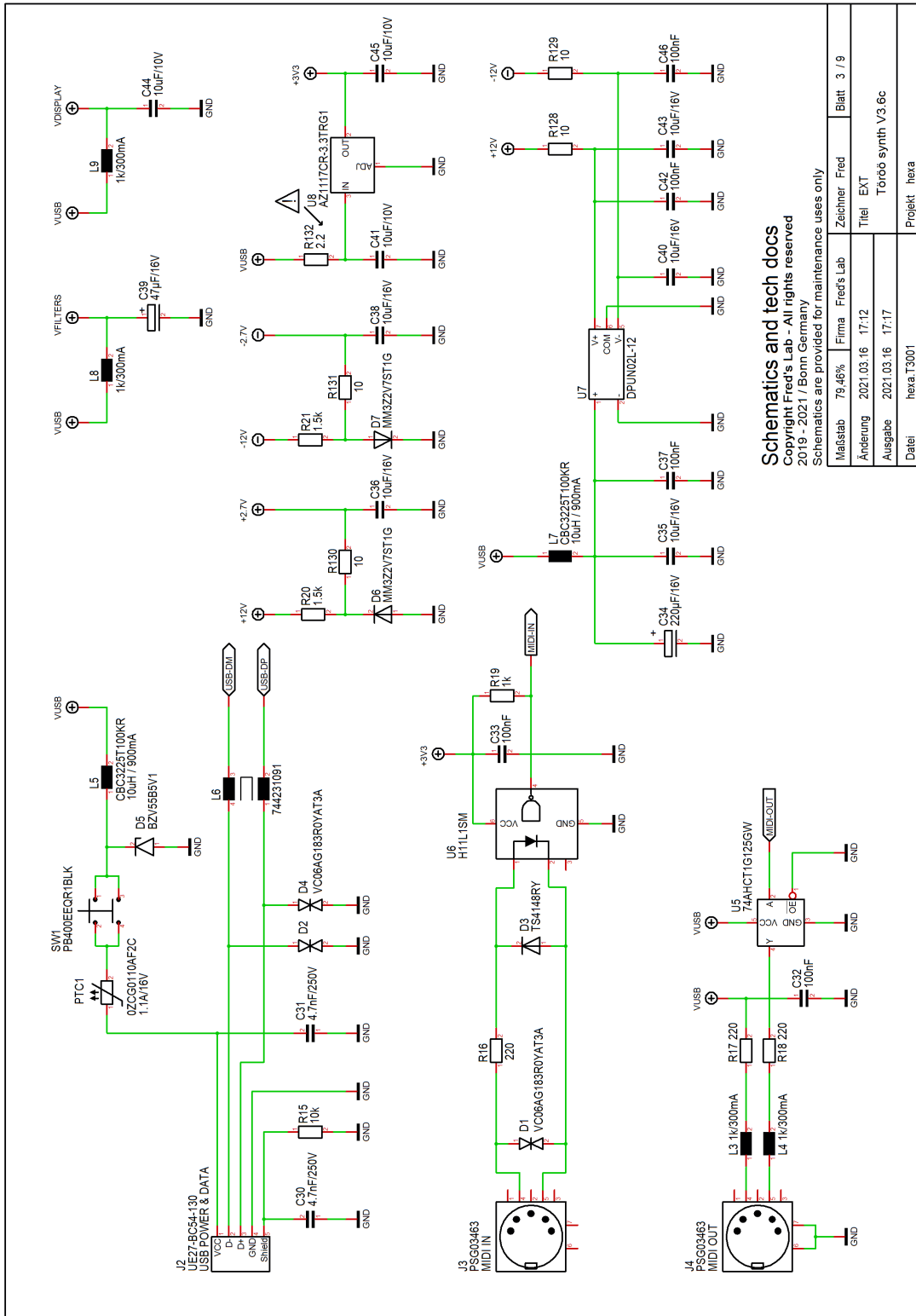


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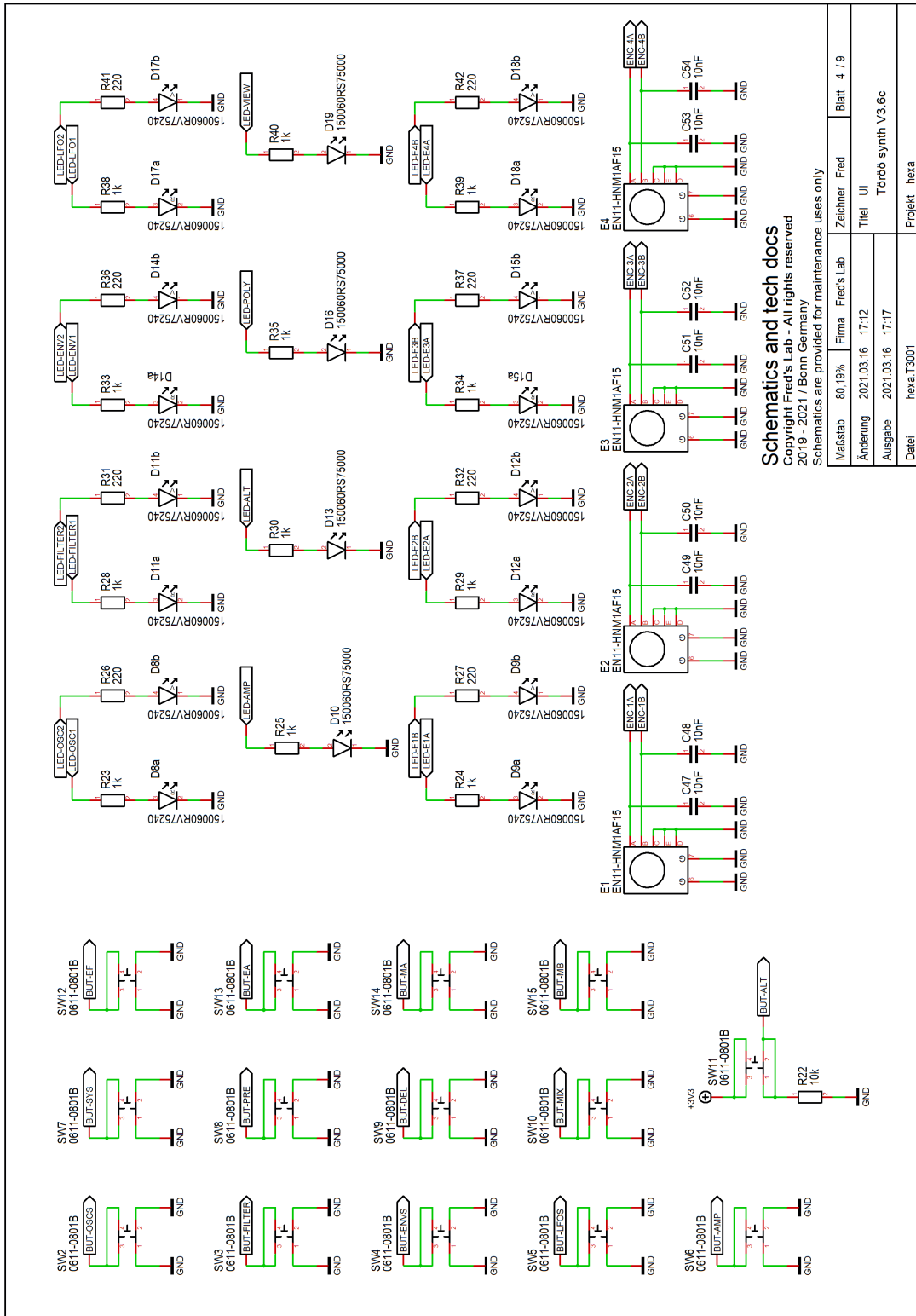
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Änderung	2021.03.16	17:12	Titel		CVS & FXs		
Ausgabe	2021.03.16	17:17	Titel		Toröb synth V3.6c		
Datel	hexa.T3001	Projekt		hexa			



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Änderung	2021.03.16	17:12	Titel		EXT	Toröb synth V3.6c	
Ausgabe	2021.03.16	17:17	Datei		hexa.T3001	Projekt	

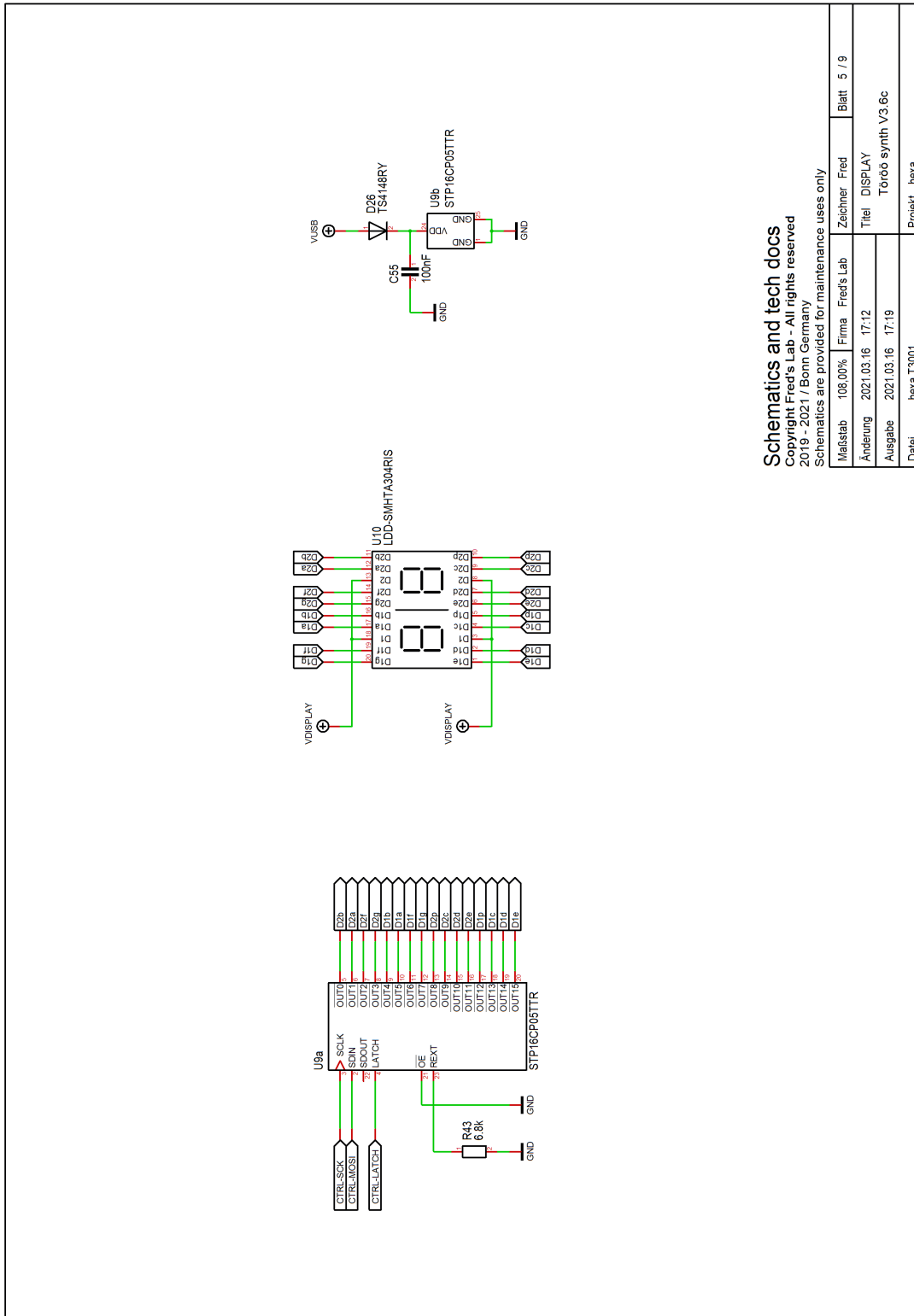


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Änderung	2021.03.16				UI	Toröb synth V3.6c	
Ausgabe	2021.03.16						
Datei	hexa.T3001						



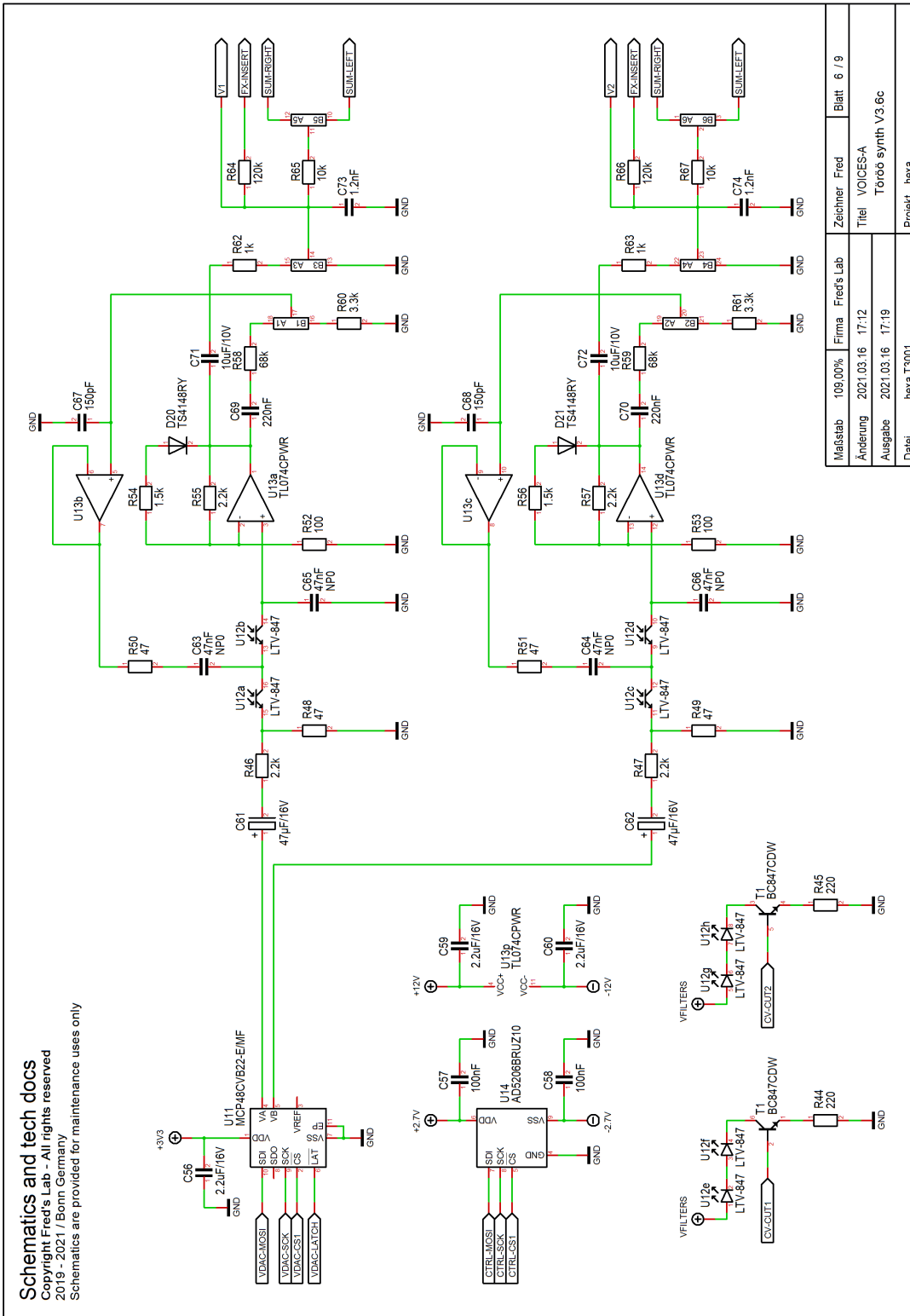
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Änderung	2021.03.16	17:12	Titel		DISPLAY		
Ausgabe	2021.03.16	17:19	Autor		Torob synth V3.6c		
Datei	hexa.T3001	Projekt					

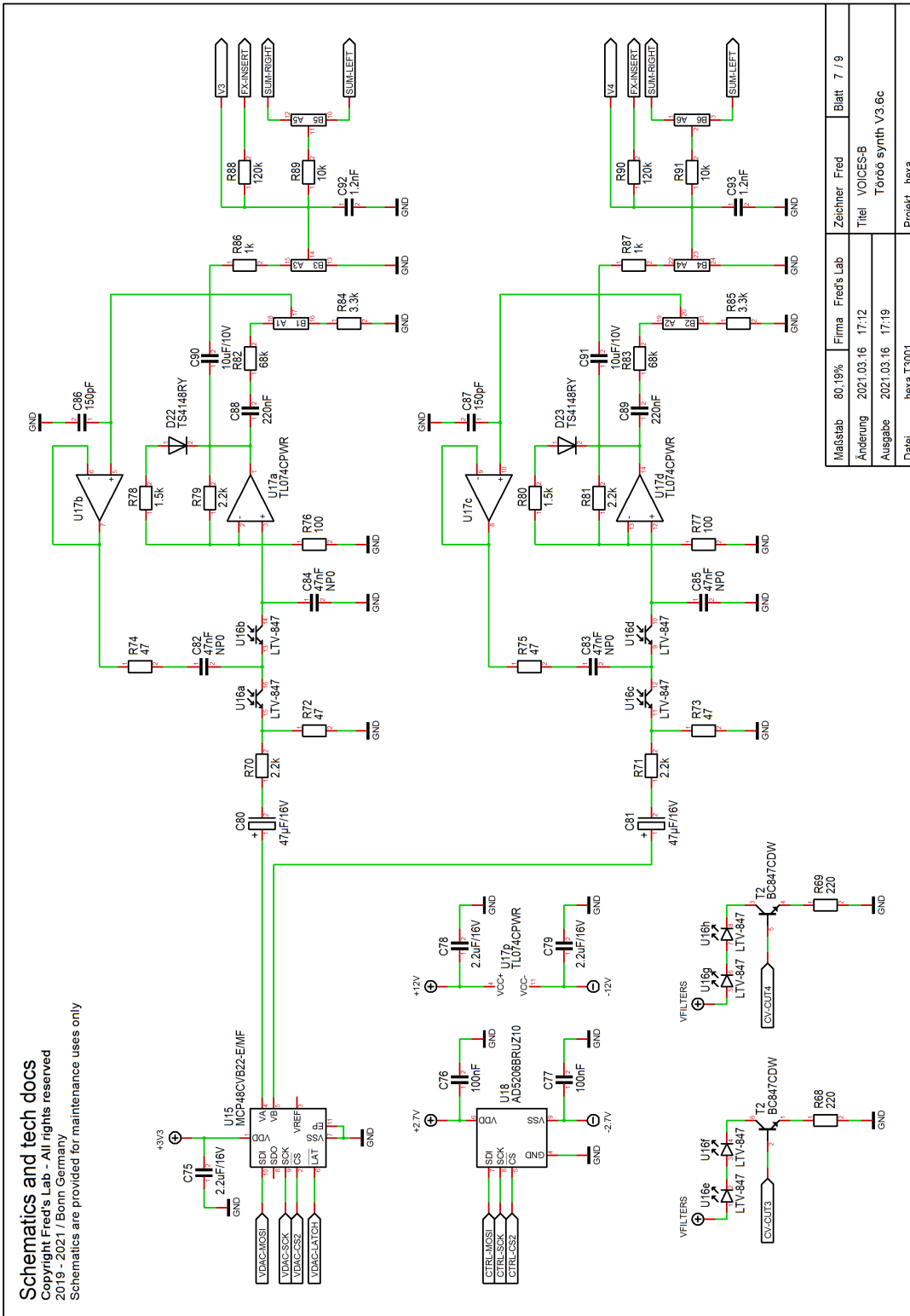


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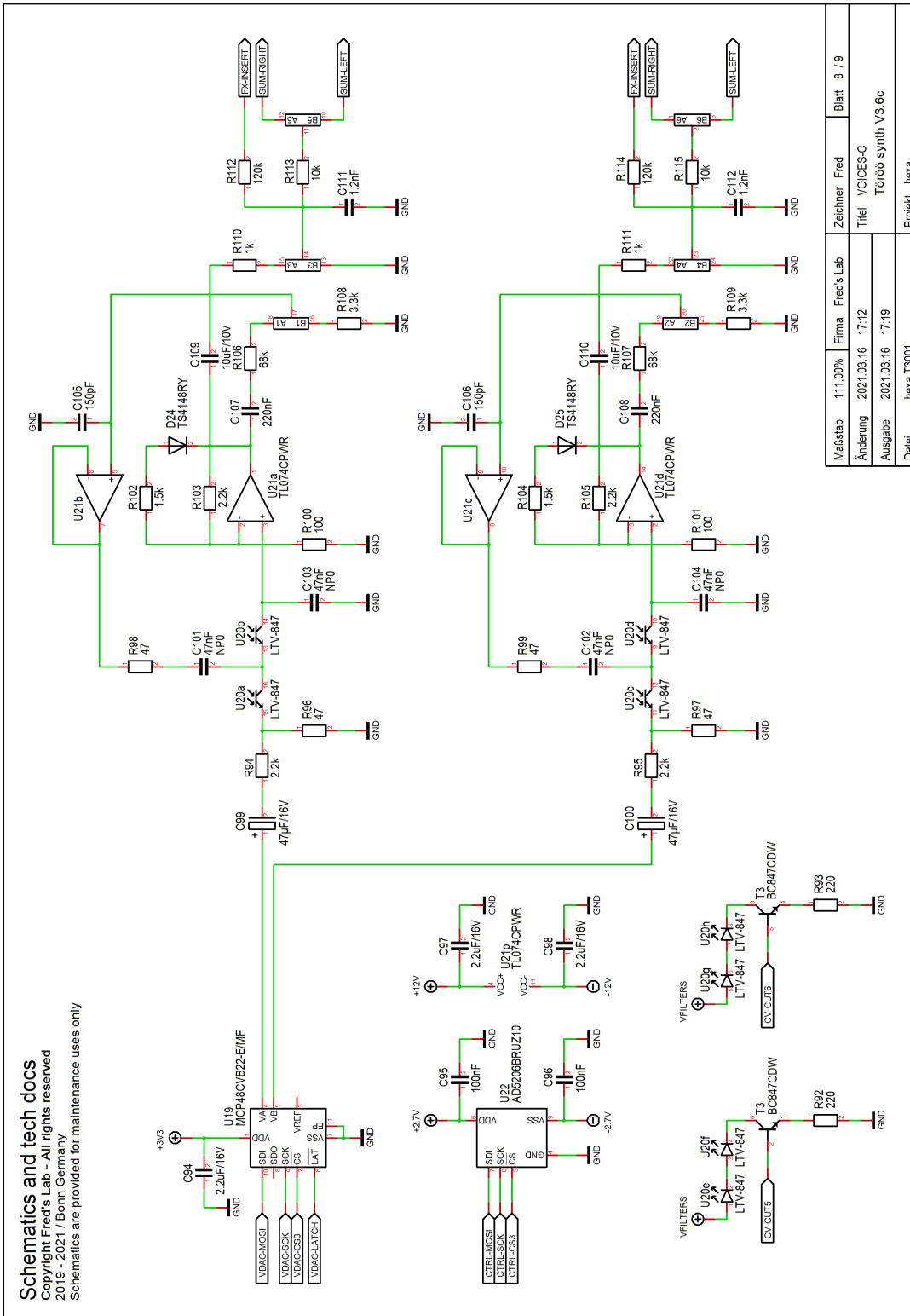


Maßstab	109,00%	Firma	Fred's Lab	Zeichner	Fred	Blatt	6 / 9
Änderung	2021.03.16	17:12	Titel		VOICES-A		
Ausgabe	2021.03.16	17:19	Projekt		Toröb synth V3.6c		
Datei	hexa.T3001						

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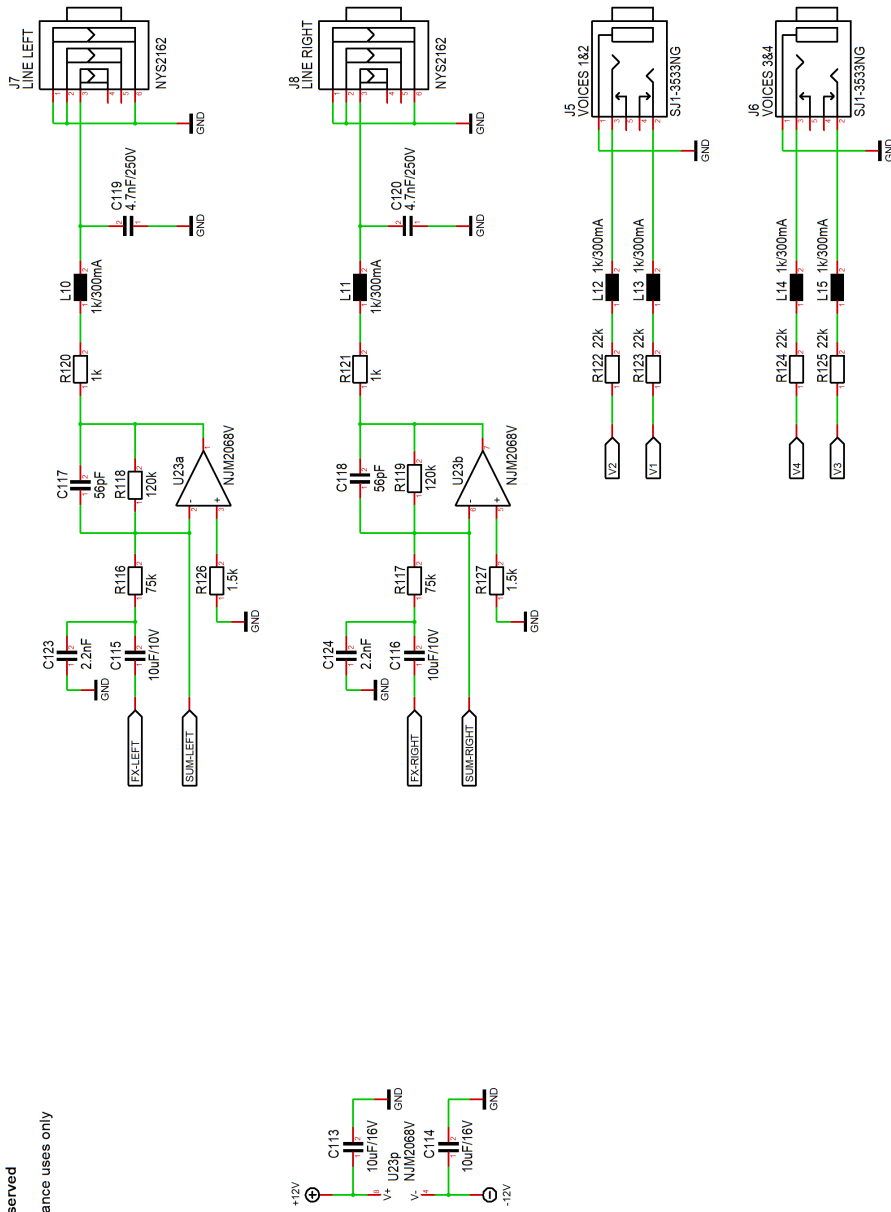


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Maßstab	111,00%	Firma	Fred's Lab	Zeichner	Fred	Blatt	8 / 9
Änderung	2021.03.16	17:12	Titel		VOICES-C	Toröb synth V3.6c	
Ausgabe	2021.03.16	17:19	Datei		hexa.T3001	Projekt	
						hexa	

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Änderung	2021.03.16	17:12	Titel		OUT		
Ausgabe	2021.03.16	17:20	Titel		Torrób synth V3.6c		
Datei	hexa.T3601	Projekt		hexa			

## 16 Norms

### 16.1 Europe: CE



#### CE DECLARATION OF CONFORMITY

1. Product unique identification:

**Töörö** analog and digital sound module  
 Belonging to the category "multimedia electronic equipment"

2. Address of the manufacturer and his authorized representative:

**Frédéric Meslin Audiogeräte**

Herwarthstraße, 20

53115 Bonn, Germany

Email: fred@fredslab.net

Telephone: +49 228 53451657 (office hours)

3. Object of the declaration:

This equipment **conforms to the following requirements:**

- EN 55032:2015 (emission), EN 55035:2017 (immunity)
- EN 61000-4-2:2009 (ESD)
- EN 61000-4-3:2006 + A1:2008 + A2:2010 (immunity)
- EN 61000-4-8:2010 (immunity)
- EN 61000-6-3 (interference)
- 2011/65/EU (ROHS 2), 2012/19/EU (WEEE)

After examinations conducted by the independent laboratory:

**Transferstelle für Elektromagnetische Verträglichkeit  
 Hochschule Koblenz**

Konrad-Zuse Straße 1

56075 Koblenz, Germany

Report: EMC Testreport 1290 / 2020 (22 July 2020)

4. Signed for and on behalf of **Frédéric Meslin Audiogeräte:**

**Frédéric Meslin**, Lead Engineer of Fred's Lab

Bonn, the 22/07/2020

A photograph of a handwritten signature in black ink on a light-colored background. Below the signature, the name "Frédéric Meslin" is printed in a simple, sans-serif font.

## 16.2 Canada: Interference Regulation

This device does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the radio interference regulation of the Canadian Department of Communications.

Cet équipement n'émet pas de bruits radiofréquence dépassant les limites applicables aux appareils numériques de la Classe B prescrites dans le règlement sur les interférences radio-électriques édicté par le Ministère Des Communications du Canada.

## 16.3 USA: FCC Information

This equipment has been verified to comply with the limits for a class B computing device, pursuant to FCC Rules. In order to maintain compliance with FCC regulations, shielded cables must be used with this equipment. Operation with non-approved equipment or unshielded cables is likely to result in interference to radio and TV reception.

**Important:** Changes and modifications made to the equipment without the approval of the manufacturer can void your authority to operate this equipment.

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help