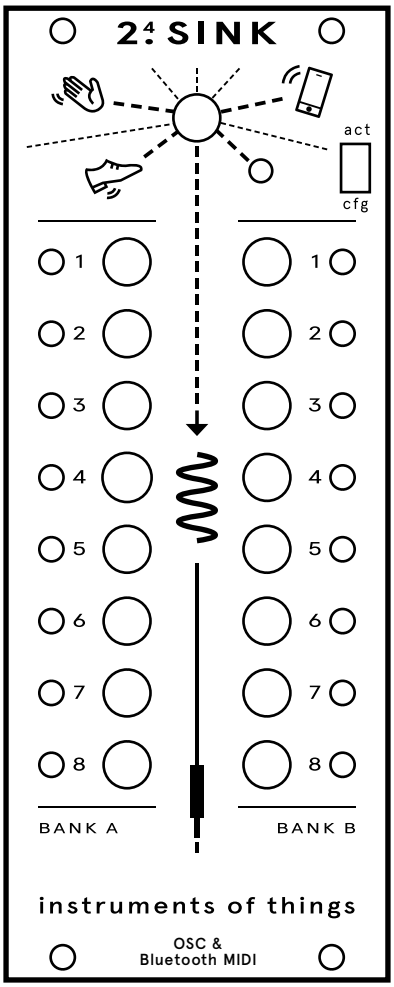
instruments of things

# 2.4SINK

## Wireless Interface for Eurorack Modular Synthesizers




**User's Manual**

Rev. A - August 2019

Thank you for choosing 2.4SINK, the first, novel Eurorack Module by Instruments of Things®, which was successfully funded on Kickstarter!

## Index

## Safety Instructions

Please follow the instructions for the use of 2.4SINK Eurorack module below to guarantee proper operation and ensure warranty from Instruments of Things®.

**Water**

2.4SINK shouldn’t be used in humid environments to avoid damaging electrical components. However, our branded Movesense® sensors are waterproof.

**Fire**

2.4SINK shouldn’t be operated in environments deceeding 0°C or exceeding 50°C.

**Transport**

To avoid mechanical damages 2.4SINK should be always transported in the original package without the antenna mounted.

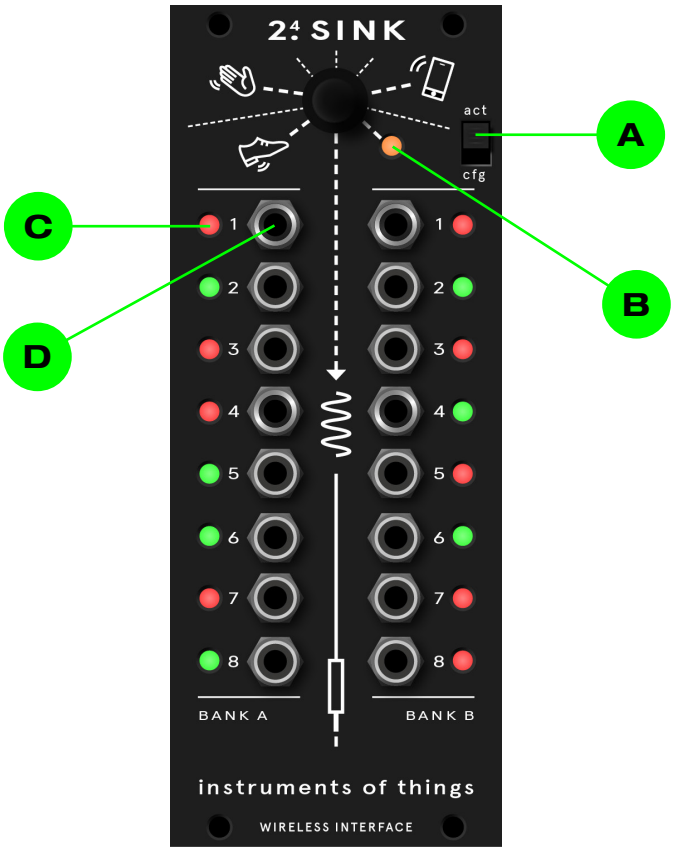
## What‘s in the Box

2.4SINK Eurorack module is shipped with a Eurorack 16 pin to 10 pin power cable, mounting screws and an antenna, which should be mounted to 2.4SINK’s front panel to achieve best performance. The antenna can be mounted without any additional tools. If Movesense® were ordered, they will be shipped with a battery.

## About 2.4SINK

2.4SINK by Instruments of Things® is a generic, wireless interface for Eurorack systems that is designed to allow novel, meaningful and experimental interactions with existing modular synthesizers. 2.4SINK supports wireless connections via Bluetooth® LE with our branded Movesense motion sensors to create highly expressive and unique stage performances, or connected via Wi-Fi (OSC) to other OSC compatible software such as Holon.ist iOS app to use environmental information like weather or heart beat as input sources for controlling arbitrary sound parameters. In addition, the 2.4SINK Eurorack module offers easy connection to wireless MIDI controllers via Bluetooth® LE MIDI, limiting any possible cable confusion to the patch cords. The open interface of the 2.4SINK module offers experimental ways of interacting, which in combination with all functionalities leads to a powerful, unprecedented Eurorack module.

## Front Panel Layout




**A** **Mode selection** is used to toggle between action mode **(act)** and configuration mode **(cfg)**. In action mode, incoming data from Wi-Fi and Bluetooth® LE is processed and written to the outputs. To achieve best performance and avoid unwanted side effects, the built-in webserver is disabled in action mode. In configuration mode, the webserver is active and 2.4SINK can be configured via any web browser.

**B** **Wireless LED** displays the current status of Wi-Fi and Bluetooth® LE.

| | On | Blinking |
|---|---|---|
| **Yellow** | N.A. | Firmware Upgrade is active |
| **Green** | Wifi Client Mode: Connected<br><br>Wifi Access Point Mode: At least one client is connected | Module is in configuration mode |

**Table 1 – Wireless LED mode**

**C** **Output bicolor** LEDs display the current voltage of the according output. At positive voltage the LED is green, at negative voltage the LED is red.

**D** **Outputs jacks** output the specific voltage. They are structured in two banks, A and B, with 8 outputs each.

## Recommended Setup

Due to the different, supported transmission protocols (e.g. Bluetooth® MIDI), 2.4SINK covers a wide range of applications. Here is a short overview:

- High precision motion control with our branded Movesense® sensors.
- Eurorack interface for wireless MIDI controllers
- Eurorack interface for mobile apps such as Lemur and Holon.ist
- Eurorack interface music software applications such as Max 4 Live
- ....

Typically, 2.4SINK is used in combination with our high precision motion sensors to create new ways of interaction with Eurorack systems or analog synthesizers.

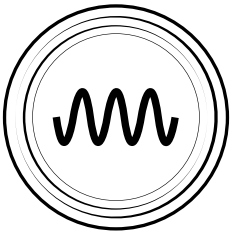
## Power Requirements

2.4SINK requires **-12V/+12V** power supply (2x5 pin connector). The red stripe of the ribbon cable must be on the - side of the connector. The power consumption on +12V is 250 mA and for -12V 30 mA.

## Branded Movesense® Sensors

Our branded Movesense® sensors are powered by a customized firmware adapted for musical applications. It includes 9 Degrees-Of-Freedom sensor fusion generating high precision roll, pitch and yaw axis from gyroscope, accelerometer and magnetometer. To avoid quantization errors (e.g. via BLE MIDI) a custom Bluetooth® LE transmission protocol supporting floating point numbers is used. If no client (i.e. 2.4SINK) is connected, the firmware goes to sleep mode to save battery power. Mapping of sensor values to outputs can be done in the web app CV configuration section. Up to 7 Movesense® sensors can be used simultaneously.

Movesense® sensors are powered with CR2025 coin cells. The coin cells can be easily replaced by opening the Movesense sensor battery slot with a small screwdriver or similar. During active state the battery lasts for more than 10 hours.



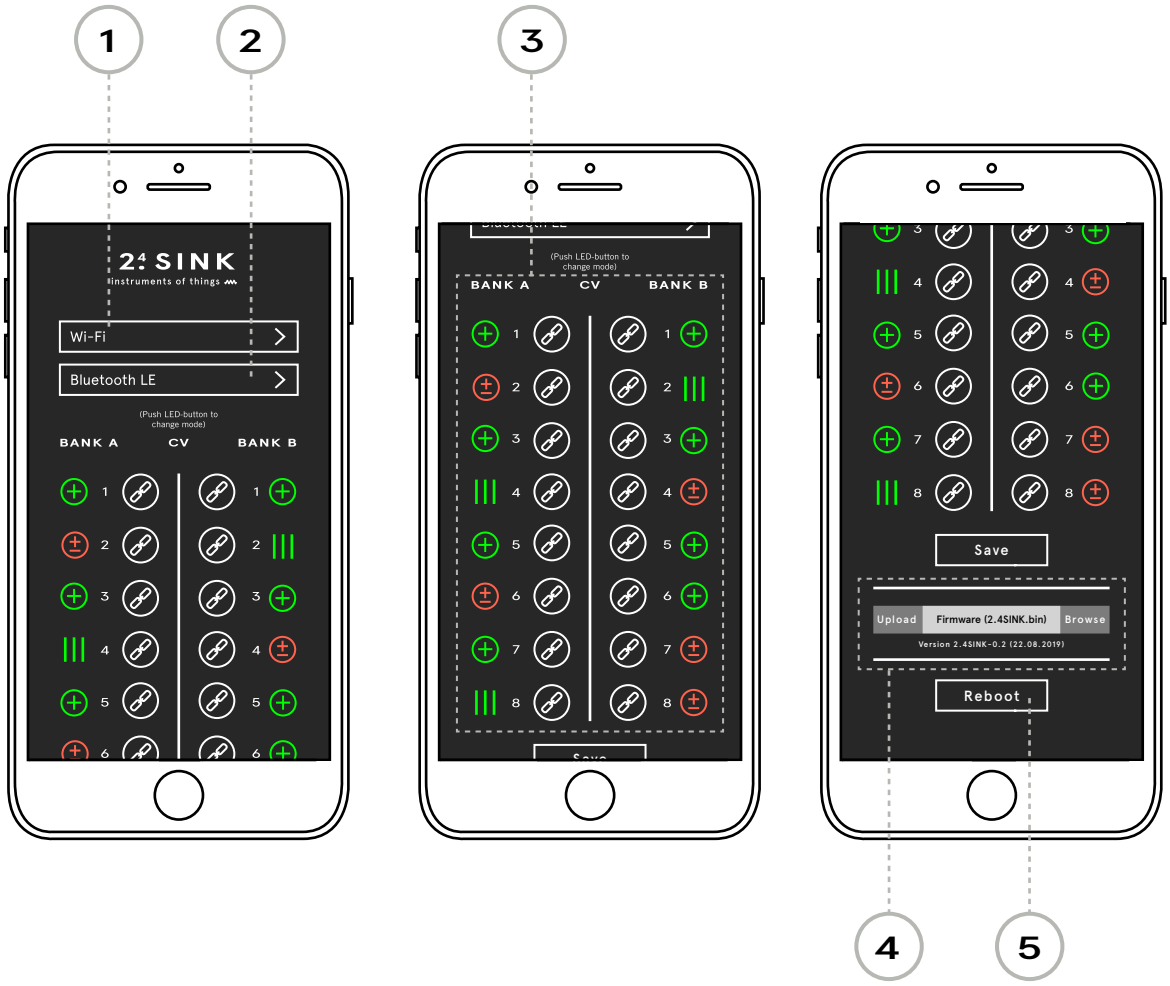
## Web App

2.4SINK offers a built-in, responsive web app for configuration purposes, which can be accessed from any web browser.

**Note: Before connecting to the webserver, make sure the mode switch is set to cfg (configuration mode).**

**Note: On some mobile phones the web app takes long time to load. This can be avoided by temporarily disable mobile data.**

The web app can be accessed via the URL http://2-4sink.local/ (assuming client device supports a zeroconf protocol such as Bonjour). By default, the ip address is 192.168.5.1 in access point mode, which can be used to access the web app, if no zero conf protocol is available on client device. In client mode, the IP is should be automatically obtained from a DHCP server (e.g. Router). At factory state, Wi-Fi is configured in access point mode with the SSID "2.4SINK". No password is required.



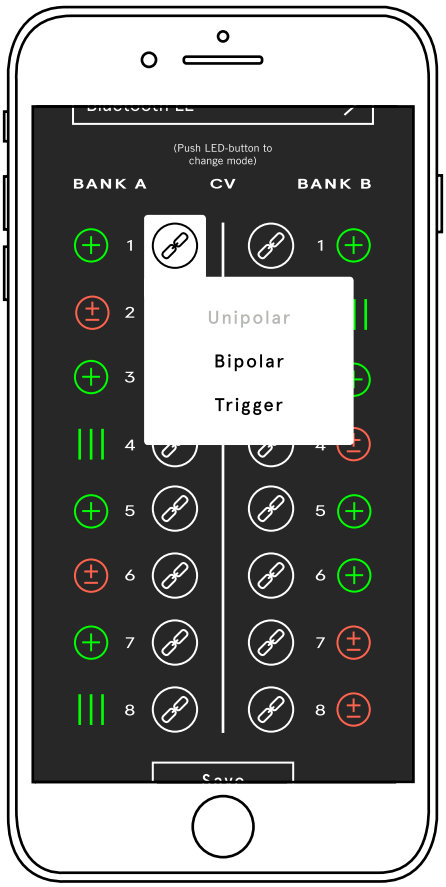
The web app is separated in the following sections:

1. Wi-Fi: Configure Wi-Fi Access point or Client mode settings
2. Bluetooth LE: Couple supported Bluetooth® LE devices
3. Outputs: Map and scale sensor values. Set output mode (unipolar, bipolar, gate)
4. Firmware Upgrade: Upload and apply new firmware upgrades
5. Reboot module

For detailed configuration settings see the according chapter in this manual.

## Multimode Outputs

2.4SINK offers 16 x 12 bit outputs where each output can be configured in a different mode (unipolar CV, bipolar CV, gate/trigger). This is useful to make use of a wide range of sensor data and cover several applications. For example, for motion controlled envelopes, unipolar mode is recommended. For LFO style signals, bipolar mode is recommended. For triggering external modules, gate/trigger mode is recommended.



After the desired output configuration is set, the settings can be persisted by clicking the Save button.

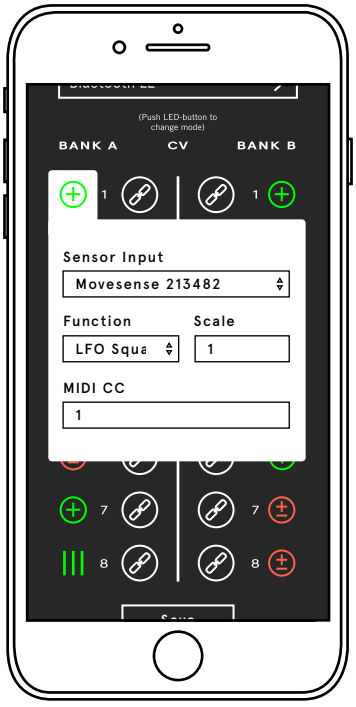
The output voltage range depends on the output mode and is described in table 2.

| Output Mode | Voltage Range |
|---|---|
| Unipolar Mode | 0V to +10V |
| Bipolar Mode | -5V to +5V |
| Gate/Trigger Mode | 0V (Low), +5V (High) |

**Table 2 – Output Voltage**

## Mapping Sensor Values

Mapping of sensor values is done in the web app by clicking on the tools button of the corresponding output, which shows are dropdown menu. Based on known BLE devices, the dropdown list shows all available sensor inputs via Bluetooth® LE.




By default, the output function is CV, which directly applies the incoming sensor value to the output. The sensor sensitivity can be changed by editing the scale factor. The MIDI CC mapping can be changed as well.

## Built-in LFOs

Additionally to pure CV, 2.4SINK offers built-in LFOs with the following waveforms:

- **Sine**
- **Saw**
- **Ramp**
- **Triangle**
- **Square**
- **Clock (unipolar only)**

Depending on the output mode, the LFOs are unipolar or bipolar expect the clock LFO which is always between 0V and +5V. If an output is used as a LFO, the incoming value corresponds to the frequency. By changing the scale factor, the maximum frequency can increased or decreased. The LFO settings can be changed by clicking on the tools button of the according output.

## Open Sound Control

2.4SINK is compatible to Open Sound Control (OSC) message protocol. If precise resolution of sensor data is needed, OSC is recommended as it supports floating point numbers. However, OSC can be used via Wi-Fi only. The address scheme of the OSC server is as follows:

**/<bank>/<output>/<mode> <value>**

**Note: The output mode is encoded in the OSC address and can be changed during runtime but is not persisted.**

The following table shows all supported OSC commands:

| Mode | Value Range | Description |
|---|---|---|
| cv | [0.0, 1.0] | Unipolar control voltage (0V to +10V) |
| cvbi | [-1.0, 1.0] | Bipolar control voltage (-5V to +5V) |
| trig | N.A. | Outputs a single trigger (0V to +5V) |

| Mode | Value Range | Description |
|---|---|---|
| gate | <=0.0, >0.0 | Sets gate to high (any value > 0.0) or low (any value <= 0.0) (0V to +5V) |
| lfosine | [0.0, 800.0] | Enables bipolar LFO (-5V to +5V) with sine waveform and frequency in value range |
| lfosaw | [0.0, 800.0] | Enables bipolar LFO (-5V to +5V) with saw waveform and frequency in value range |
| lforamp | [0.0, 800.0] | Enables bipolar LFO (-5V to +5V) with ramp waveform and frequency in value range |
| lfotri | [0.0, 800.0] | Enables bipolar LFO (-5V to +5V) with triangle waveform and frequency in value range |
| lfosquare | [0.0, 800.0] | Enables bipolar LFO (-5V to +5V) with square waveform and frequency in value range |
| lfosineuni | [0.0, 800.0] | Enables unipolar LFO (0V to +10V) with sine waveform and frequency in value range |
| lfosaw | [0.0, 800.0] | Enables bipolar LFO (-5V to +5V) with saw waveform and frequency in value range |
| lfosaw | [0.0, 800.0] | Enables bipolar LFO (-5V to +5V) with saw waveform and frequency in value range |
| lfosawuni | [0.0, 800.0] | Enables unipolar LFO (0V to +10V) with saw waveform and frequency in value range |
| lforampuni | [0.0, 800.0] | Enables unipolar LFO (0V to +10V) with ramp waveform and frequency in value range |
| lfotriuni | [0.0, 800.0] | Enables unipolar LFO (0V to +10V) with triangle waveform and frequency in value range |
| lfosquareuni | [0.0, 800.0] | Enables unipolar LFO (0V to +10V) with square waveform and frequency in value range |
| lfoclk | [0.0, 800.0] | Enables unipolar LFO (0V to +10V) with impulse waveform (i.e. trigger) and frequency in value range |

**Table 3 – OSC Commands**

Example: Set voltage of output A4 to maximum in unipolar mode (+10V)

**/A/4/cv 1.0**

Example: Set voltage of output B1 to minimum in unipolar mode (-5V)

**/B/1/cvbi -1.0**

Example: Activate bipolar (-5 to 5V) saw LFO with 5 Hz frequency on output B2

**/B/2/lfosaw 5.0**

Floating point messages are processed only. The OSC message value is normalized. Depending on the current mode, the value range is [0, 1] for unipolar mode and [-1, 1] for bipolar mode.

**TODO: Change range to be always [0, 1]**

If the OSC message value is outside the voltage range, the maximum or minimum voltage depending on the output configuration mode is applied. In trigger mode, any message regardless of the value causes a trigger signal on the output.

The OSC server port can be configured in the web app (Wi-Fi configuration section). Furthermore, the OSC server can be automatically discovered via a zeroconf protocol such as Bonjour.

## Bluetooth® LE MIDI

2.4SINK is compatible to Bluetooth® LE, specifically BLE MIDI. The module behaves as a device in central role (same as Android and iOS devices). For coupling Bluetooth® LE MIDI compatible devices, the web app can be used. Available and coupled devices are shown in the Bluetooth® LE section.

MIDI control change (CC) and Note On/Off messages are supported only. Control Change message index can be configured in the web app. Note On/Off messages have fixed mappings starting from output A1 (C note). When controlling several outputs at once, MIDI messages should be packed in a single BLE packet to increase the performance. See BLE MIDI specification for detailed information. The CC message value is scaled to the maximum and minimum voltage based on the output configuration mode. For example, if output mode is set to bipolar and CC message value is 127, the output voltage is set to 5V. In Gate/Trigger mode, any other value than zero causes a high on the output.

To change MIDI CC number of an output, click on the tools button of the corresponding output and enter the desired CC number between 1 and 128.

## Wi-Fi (802.11x)

The module is compatible to 802.11 b/g/n Wi-Fi standards and supports access point and client mode. In access point mode, the module creates a wifi network which is accessible for external devices.

**Note: At factory state, Wi-Fi network name (SSID) in access point mode is »2.4SINK«.**

Access point mode is especially useful for live performances to prevent latency problems with external networks. In client mode, the module connects to an external Wi-Fi network.

**Note: For best performance, access point mode is recommended.**

The configuration of Wi-Fi credentials and other settings can be done in the web app. In factory state Wi-Fi is configured in access point mode with the SSID "2.4SINK" and no password. If the connection to an external network (i.e. client mode) fails after five attempts, Wi-Fi falls back to access point mode.

## Firmware Upgrade

2.4SINK is continuously improved. To ease the update procedure, 2.4SINK firmware can be updated via over-the-air (OTA) updates. Latest firmware images can be downloaded from our website (http://instrumentsofthings.com/). To upload a new firmware image (.bin), open the web app, click on Upload firmware form and select the desired firmware file. The status LED will turn orange during upgrade procedure. After successfully update, 2.4SINK automatically reboots and the led animation should appear.

***Attention! All settings will be erased after firmware upgrade!***

## Troubleshooting

If for any reason a factory reset is required, 2.4SINK can be hard reset via USB connection.

Firmware images including readmes are available at our website:
http://instrumentsofthings.com/.

## About Us

Instruments of Things® is a music-tech StartUp based in the north of Germany, Kiel, founded in 2018. The three founders Henrik, David and Niko are connected by a strong passion for electronic music, especially made with modular synthesizers.

Henrik is the head of the team who discovered his passion for audio technologies in his early youth. Since then, he kept on working on free time projects and luckily found his mentor Robert Manzke during his studies, who is an absolute synth nerd himself. Together with Robert Manzke, he invented the CTAG multi-channel audio system, which is compatible with Bela. Henrik is active as an artist and is member of the Downtempo band Oberheimer and plays drums in a cross-over punk band as well.

David is the design guru who loves to create physical product designs as well as being deep dived into user experiences and interaction possibilities for electronic music instruments. He's also responsible for most of the creative representations of the projects e.g. on the website or social media channels.

Niko is the expert for the numbers and sales. After looking for a finance person, which suits our need for open minded thinking and celebrating electronic music culture, Niko luckily realized that selling music-tech products is much more fun than selling insurances.

2.4SINK is their first product which is furthermore representative for the specialization of Instruments of Things® – the development of novel interfaces for further thought-out possibilities of using electronic music instruments.

## Technical Specification

+12V: 250 mA
-12V: 30 mA
Width: 10 HP
CV output sampling depth: 12 bit
Unipolar voltage range: 0V to +10V
Bipolar voltage range: -5V to +5V
Gate/trigger voltage range: 0V to +5V

2.4SINK complies to the EU guidelines and is manufactured RoHS conforming.

## Kickstarter Supporters

Manfred Hill, Steven Boker, Christof Domrowe, Roy Gwinn, Luciano de Souza Zanatta, Beat Unternaehrer, keita hatakeyama, Lyle Mills, Edouard Janssens, Ed, Chris Purdon, Michael Jung, Gregor Beyerle, Ethan Bowers, Guido, davy, Yanick Herzog, Andrew McPherson, Guy Landver, NEVERSLEEP | Dirk Pogrzeba, Bertolt Meyer, Cornil, Björn Jauss, Robert Manzke, Patrick McMaster, Gast 1992748222, Andrew, Aard van Asseldonk, Aaron Levitz, Gabriel Smagorinsky, Christian Stauduhar, Heiko, Caro von Sobbe, Gunnar Eisenberg, Ann Chatarine Krippner, Rob Sørnsen, Sergej Eremin, Yella Dilara Hansen, Leon Klaussohn, Halkert Sach, Juan De Marcos González, Gast 1828694819, Vitali Wachramejew, Gast 1539353237, David Baader, Gast 1552518282, Crytical Mind, Fabian Knothe, Flo V. Tschammer, Florian Meindl, plusma, Daniel Mes, Finn Böttcher, Gabriela Papenburg, Jesse-Finn Langer, Lasse Papenburg, Gast 274954524, Moritz Topp, Marius Eschkötter, Torben Koch, Jan Henry Ling Ling, Lena Hagemeister, Kristoffer Laib, Joshua von Hofen, Andreas Scharfenstein, Say Clap, Nele, Speñcer Montgömérry, Sven Thiede, Fabian, Bartosz Wac, lena günther, Friederike Müller, Peter Nielson, The Creative Fund by BackerKit, Junona Dolleschal, analog monster, Gast 1966234204, Richard Brewster, Der Fabi, Gast 362709249, Sofie Dvorkina, Gast 1881273042, Gast 1208428945, h_hoelzl