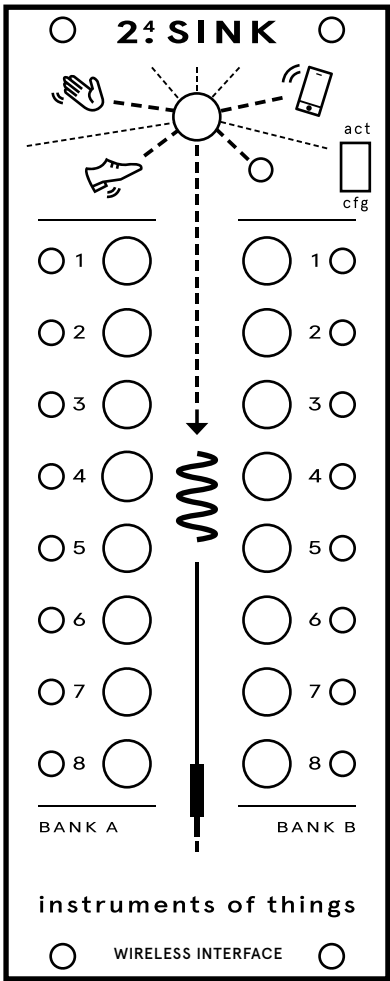


# 2.4SINK

Wireless Interface for Eurorack  
Modular Synthesizers



## User's Manual

Rev. B - February 2020 (Firmware version: 1.0.0)

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

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## 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.

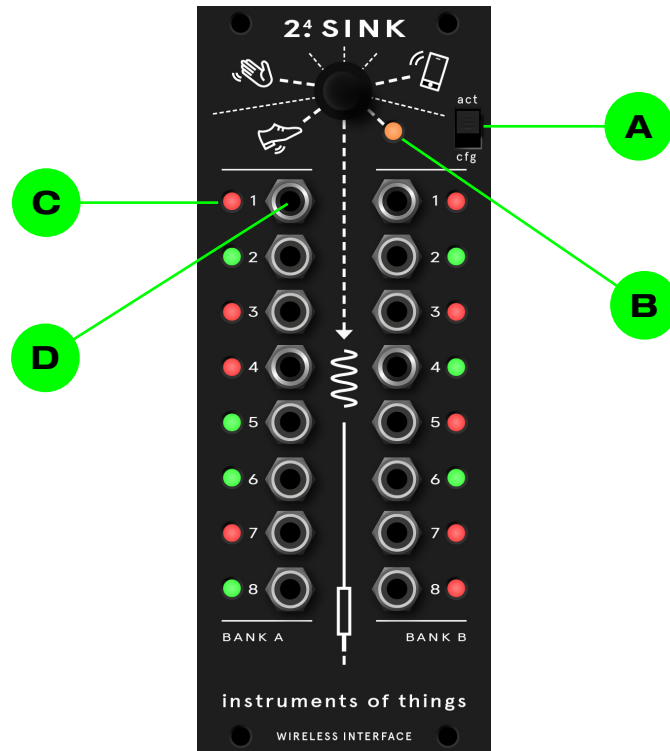
## What's in the Box

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 sensors 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 prevent 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. Everytime the toggle switch is toggled, 2.4SINK searches 1 minute for Bluetooth® LE devices.
- B Wireless LED** displays the current status of Wi-Fi and Bluetooth® LE.

|               | On   | Blinking                           |
|---------------|--|------------------------------------|
| <b>Yellow</b> | N.A.   | Firmware Upgrade is active         |
| <b>Green</b>  | Wifi Client Mode:<br>Connected<br><br>Wifi Access Point Mode:<br>At least one client is<br>connected | Module is in<br>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 control voltage. They are structured in two banks, A and B, with 8 outputs each.

## Getting Started (2.4SINK Starter Kit)

Connect your Eurorack power supply with included power cable (white bar on 2.4SINK PCB marks negative voltage).

**Note: Relax and just connect 2.4SINK to your Eurorack power supply. 2.4SINK is protected against false power supply polarization.**

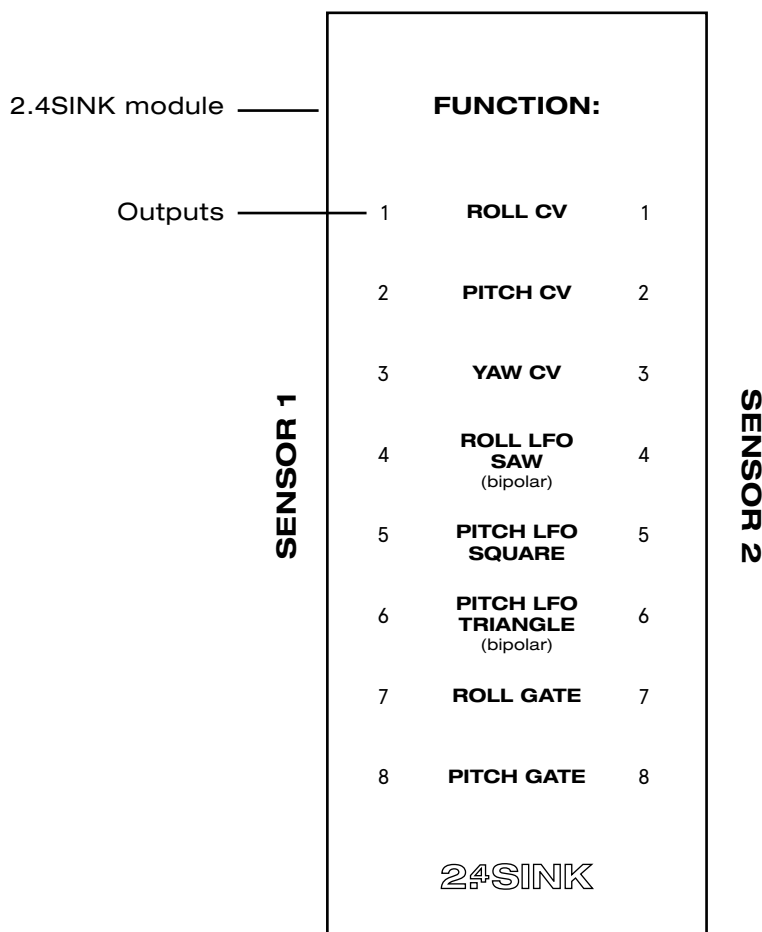
Mount 2.4SINK in Eurorack case with included screws.

Mount included antenna on SMA connector of front panel.

To wake up the sensors from battery saving sleep mode, short the two metal pins on the backside of sensor with a finger and lay down the sensor. The direction of the sensor, indicated by white bar printed on it, corresponds to the null position (i.e. 180 degree) of compass (yaw) axis.

**Note: Sensors are calibrated after each wake up. They have to stand still for 3 seconds from connection initialization (i.e. sensor LED starts blinking).**

Two sensors are connected by default. The mappings can be found in the following diagram:



## 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 Bluetooth® MIDI controllers
- Eurorack interface for mobile apps such as Lemur and Holon.ist
- Eurorack interface for various OSC compatible softwares such as Max for Live
- Combine everything. Use sensors, with a OSC application and Bluetooth® MIDI controllers simultaneously.

Typically, 2.4SINK is used in combination with our high precision motion sensors to offer high precision and low latency motion control for Eurorack systems and analog synthesizers.

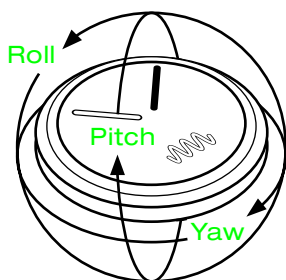
## Power Requirements

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.

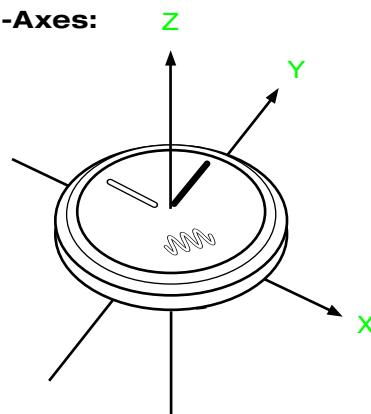
## Branded Movesense® Sensors

Our branded Movesense® sensors are powered with our customized firmware for musical applications. It includes state-of-the-art sensor fusion generating high precision roll, pitch and yaw axis from gyroscope, accelerometer and magnetometer. Additionally the sensors provide 3D acceleration axis resulting in a total of 6 values per sensor.

### 3 Tilt-Angle-Axes:



### 3 Acceleration-Axes:



**Note: Our branded Movesense® sensors work only with 2.4SINK Eurorack module!**

If no client (i.e. 2.4SINK) is connected, the firmware goes to sleep mode after 10 minutes to save battery power. Mapping of sensor values to outputs can be done in the web app CV configuration section.

**Note: If Wi-Fi is set to access point mode, up to 7 Movesense® sensors can be used simultaneously. If Wi-Fi is set to client mode, up to 6 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 15 hours.

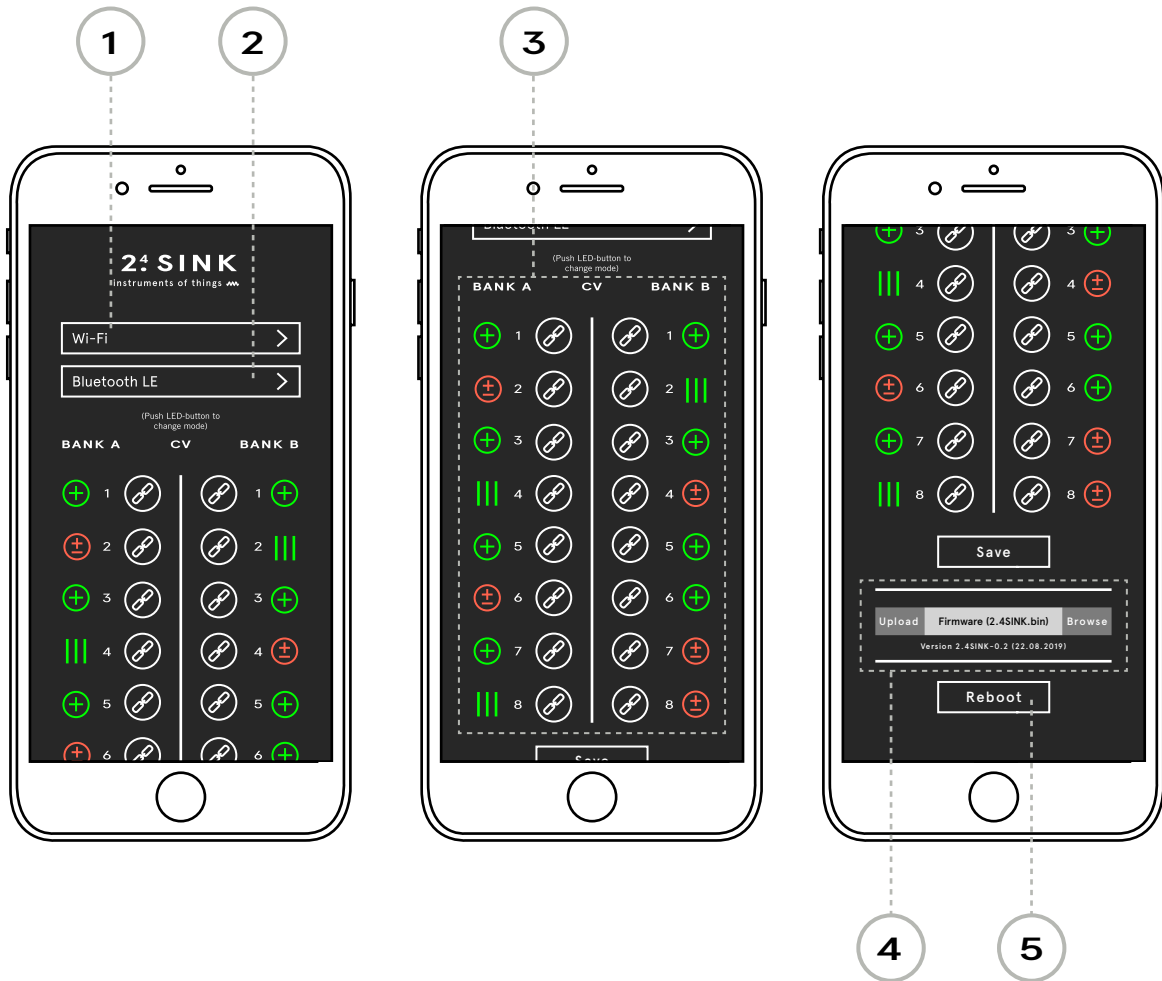
## Web App

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

**Note: For safety reasons, the web app is only accessible if the mode toggle switch is in configuration (CFG) 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 (e.g. <http://192.168.5.1/>), if no zeroconf protocol is available on client device. In client mode, the IP is automatically obtained from a DHCP server (e.g. Router). There are many tools available for free to find the IP address of 2.4SINK (e.g. [Angry IP Scanner](#)). At factory state, Wi-Fi is configured in access point mode with the SSID »2.4SINK« without a password.



The web app is separated in the following sections:

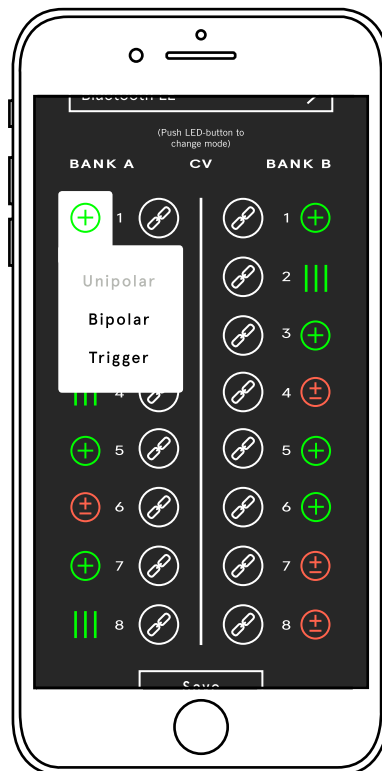
1. Wi-Fi: Configure Wi-Fi Access point or Client mode settings
2. Bluetooth LE: Couple supported Bluetooth® LE devices
3. Outputs: Map and scale sensor values. Set output mode (unipolar, bipolar, gate)
4. Firmware Upgrade: Upload and apply new firmware upgrades
5. Reboot module

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 cover all kinds of control voltages. For example, for motion controlled envelopes, unipolar mode is recommended. For LFO style signals, bipolar mode is recommended. To trigger external modules or envelope generators, gate/trigger mode is recommended.



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

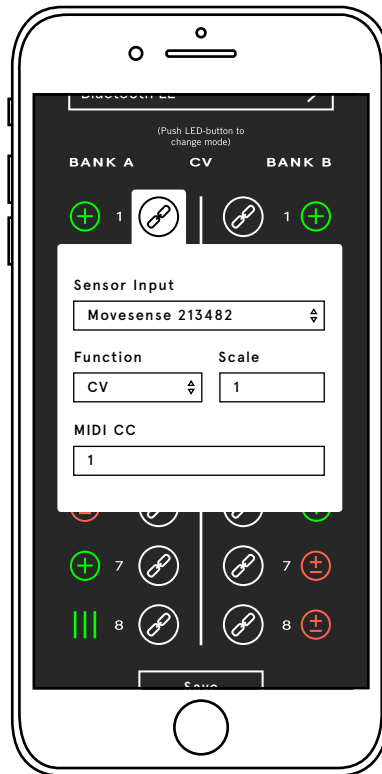
The output voltage range depends on the output mode and is described in table 2.

| Output Mode       | Voltage Range         |
|-------------------|-----------------------|
| Unipolar Mode     | 0V to +10V            |
| Bipolar Mode      | -5V to +5V            |
| Gate/Trigger Mode | 0V (Low), +10V (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 a dropdown menu. Based on known BLE devices, the dropdown list shows all available sensor inputs via Bluetooth® LE. The serial number shown in the web app matches the serial number printed on the backside of the sensor.



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 customized as well.

## Built-in LFOs

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

**Sine, Saw, Ramp, Triangle, Square, Stepped Noise, Clock (unipolar only).**

Depending on the output mode, the LFOs are unipolar or bipolar except the clock LFO which is always between 0V and +10V. If an output is used as a LFO, the incoming value corresponds to the frequency. By changing the scale factor, the maximum frequency can be increased or decreased (e.g. scale factor of 10 results in a maximum frequency of 10 Hz). The LFO settings can be changed by clicking on the tools button of the according output.

## Open Sound Control

2.4SINK is compatible with Open Sound Control (OSC) message protocol. If high resolution of input data is required, 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.**

2.4SINK supports OSC floating point messages only. The OSC message and bundles value must be normalized between [0, 1] for CV modes. For LFO modes, the floating point value corresponds to the frequency.

If a OSC message value is outside the voltage range in CV mode, the maximum or minimum voltage depending is applied.

If several (floating point) messages are sent in a OSC bundle, the output index is incremented starting from the output encoded in the OSC address.

Example OSC Bundle:

`/A/3/<mode> 0.1 0.2 0.3 0.4 0.5`

0.1 => Output A3

0.2 => Output A4

0.3 => Output A5

0.4 => Output A6

0.5 => Output A7

**Note: OSC bundles are processed with sample accuracy for each output and improve the performance. Whenever several parameters are changed at once, the values should be encoded in a single OSC bundle.**

SUPPORTED OSC COMMANDS

| Mode         | Value Range  | Description   |
|--------------|--------------|---|
| cv           | [0.0, 1.0]   | Unipolar control voltage (0V to +10V)   |
| cvbi         | [0.0, 1.0]   | Bipolar control voltage (-5V to +5V)  |
| trig         | N.A.         | Outputs a single trigger (+10V)   |
| gate         | <=0.0, >0.0  | Sets gate to high (any value > 0.0) or low (any value <= 0.0) (0V to +10V)                          |
| lfosine      | [0.0, 400.0] | Enables bipolar LFO (-5V to +5V) with sine waveform and frequency in value range                    |
| lfosaw       | [0.0, 400.0] | Enables bipolar LFO (-5V to +5V) with saw waveform and frequency in value range                     |
| lforamp      | [0.0, 400.0] | Enables bipolar LFO (-5V to +5V) with ramp waveform and frequency in value range                    |
| lfotri       | [0.0, 400.0] | Enables bipolar LFO (-5V to +5V) with triangle waveform and frequency in value range                |
| lfosquare    | [0.0, 400.0] | Enables bipolar LFO (-5V to +5V) with square waveform and frequency in value range                  |
| lfonoise     | [0.0, 400.0] | Enables bipolar LFO (-5V to +5V) with random voltage and frequency in value range                   |
| lfosineuni   | [0.0, 400.0] | Enables unipolar LFO (0V to +10V) with sine waveform and frequency in value range                   |
| lfosawuni    | [0.0, 400.0] | Enables unipolar LFO (0V to +10V) with saw waveform and frequency in value range                    |
| lforampuni   | [0.0, 400.0] | Enables unipolar LFO (0V to +10V) with ramp waveform and frequency in value range                   |
| lfotriuni    | [0.0, 400.0] | Enables unipolar LFO (0V to +10V) with triangle waveform and frequency in value range               |
| lfosquareuni | [0.0, 400.0] | Enables unipolar LFO (0V to +10V) with square waveform and frequency in value range                 |
| lfonoiseuni  | [0.0, 400.0] | Enables unipolar LFO (0V to +10V) with random voltage and frequency in value range                  |
| lfoclk       | [0.0, 400.0] | Enables unipolar LFO (0V to +10V) with impulse waveform (i.e. trigger) and frequency in value range |
| lforetrig    | [0.0, 400.0] | Resets LFO phase to zero (i.e. retrigger).  |

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 0.0**

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

**/B/2/lfosaw 5.0**

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 (name: 2-4sink-osc).

## **Bluetooth® LE MIDI**

2.4SINK is compatible with Bluetooth® LE, specifically Bluetooth® MIDI. The module behaves as a device in central role (same as Android and iOS devices). Bluetooth® devices can be discovered and coupled in the web app in the Bluetooth® configuration section.

2.4SINK supports the following MIDI messages:

- **Note On/Off (Gate, Pitch CV, Velocity CV)**
- **Pitchbend**
- **Aftertouch**
- **Control Change (CC)**

Note On/Off, Pitchbend and Aftertouch messages have fixed mappings on 2.4SINK. The MIDI channel corresponds to 2.4SINK's output bank (i.e. channel 1 corresponds to bank A, channel 2 to bank B).

The fixed mappings are as follows:

- **Out 1: Gate (for all notes)**
- **Out 2: Gate (for C# notes only. Suitable for drum pads)**
- **Out 3: Gate (for D notes only. Suitable for drum pads)**
- **Out 4: Gate (for D# notes only. Suitable for drum pads)**
- **Out 5: Pitch CV (1V/Oct)**
- **Out 6: Velocity**
- **Out 7: Aftertouch**
- **Out 8: Pitchbend**

The destination of MIDI control change (CC) messages can be customized by the user in the CV configuration section for each output regardless of the MIDI channel. In factory state, output A1 corresponds to CC1, A2 to CC2 and so forth.

MIDI Aftertouch, Pitchbend and CC messages are scaled to the minimum and maximum voltage based on the output configuration mode. For example, if output mode is set to bipolar and CC message value is 0, the output voltage is set to -5V. In Gate/Trigger mode, any value over zero causes a high on the corresponding output.

To change the MIDI CC destination 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 is configured in access point mode with network name (SSID) »2.4SINK« without password. For a performance scenarios, you should set a password for safety reasons.**

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.

***Attention: Recovering a password in access point can be only done via USB requiring additional device drivers – DON'T FORGET YOUR PASSWORD!***

In factory state Wi-Fi is configured in access point mode with the SSID »2.4SINK« and no password. If 2.4SINK fails to connect to an external network in client mode, after 5 attempts the module falls back to access point mode with the persisted credentials.

## Firmware Upgrade

2.4SINK will be continuously improved in the future, including bug fixes and new features. New firmware updates can be easily uploaded and applied in the built-in web app. Latest firmware images can be downloaded from our website (<https://instrumentsofthings.com/support/>). To upload a new firmware image, open the web app, click on the firmware upload button and select the desired firmware file (2.4SINK.bin). The status LED will turn orange during upgrade procedure. After successfully update, 2.4SINK automatically reboots and the led animation appears during boot.

***Attention: All settings (WiFi credentials, mappings, ...) will be erased after firmware upgrade!***

## Troubleshooting

***ATTENTION: DON'T FLASH ANY FIRMWARE IMAGES VIA USB! THIS RESULTS IN CORRUPTED FIRMWARE AND GUARANTEE LOSS!***

### Wi-Fi Password Loss

In case the Wi-Fi (Access Point) password was forgotten, there is the option to recover the password via USB connection to 2.4SINK.

**Note: USB connection to 2.4SINK requires additional device drivers!**

Before connecting 2.4SINK to a computer, some drivers have to be installed. The device drivers for different operating systems can be found here:

<https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers>

After installing device drivers, connect 2.4SINK (powered off) via USB to computer. When powering on 2.4SINK, a serial connection appears.

**Note: Set toggle switch of 2.4SINK to cfg (configuration mode). Only in configuration mode Wi-Fi credentials are printed via serial connection every few seconds.**

Depending on the operating system, the serial connection is exposed differently as shown below:

### **Windows:**

On Windows serial connections appear as COM ports. There several free available softwares for that. For Windows, we recommend PuTTY (<https://www.putty.org/>). To get the correct COM port, power on 2.4SINK and open device manager. Find the device "Silicon Labs CP210x USB to UART Bridge" to get the COM port number (e.g. COM6). Open PuTTY application, select serial and type in the COM port in "Serial line" field. Afterwards click on "Open" button.

### **Mac OS:**

On Mac os the serial connection is exposed in the filesystem under /dev (typically /dev/cu.SLAB\_USBtoUART). To open the serial connection, open a Terminal and type in "sudo cu -s 115200 -l /dev/cu.SLAB\_USBtoUART".

### **GNU/Linux:**

Under GNU/Linux, similar to Mac OS, serial connections are exposed in /dev file-system. However, serial connections have a different name (typically /dev/ttyUSB0). To open the serial connection, open a Terminal and type in "sudo cu -s 115200 -l /dev/ttyUSB0".

For detailed information, there are several sources available for free in web (e.g. <https://learn.sparkfun.com/tutorials/terminal-basics/command-line-windows-mac-linux>)



## 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 has always been passionate about music technology. After training as a systems engineer and studying information technology, he received a Google scholarship and completed an Erasmus internship at the Center for Digital Music at Queen Mary University of London. It was Henrik who did the technical development of the 2.4SINK interface for modular synthesizers.

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 is also responsible for all marketing activities.

Niko takes care of business plan and strategy, accounting and tax as an economist and businessman. He is a numbers person. At the same time, however, his heart, like Henriks and David's, beats for electronic music.

## 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 +10V

2.4SINK complies to the EU guidelines and is manufactured RoHS and WEEE 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 Montgómerry, 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