b:art instruments

b:ond v2

Dual Digitally Controlled Oscillator

User Manual

Revision: 1.2 • July 2026

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Foreword

The v2 of the b:ond started out as a simple idea: automate the calibration process so our users won't need to go through it every now and then – ideally, at all. To do that, we needed a simple microcontroller that monitors both VCOs and automatically applies correction current – simple enough.

Turns out that by adding a digital brain, we could achieve much more than that. We rebuilt the control architecture from the ground up. We have made the b:ond do real-time phase and frequency corrections between its two VCO cores. We eliminated oscillator drift and temperature-related inaccuracies.

On top of that, the expanders have been completely rethought: ring mod, suboscillators, noise, and per-VCO glide are now built in. And a configuration app lets you reshape how the module behaves – custom scales, detune algorithms, remappable outputs – without a single menu on the front panel.

You can ignore all of that and just start patching. Or you can go as deep as you want and customize the b:ond to fit your needs exactly.

Either way, it stays in tune.
We hope it becomes the most reliable module in your rack.

– *b:art instruments team*

Installation

1. Ensure that your Eurorack system is powered off.
2. Connect the 10-pin IDC connector to the back of the module.
3. Connect the 16-pin IDC connector to the power supply board inside your Eurorack case.
4. Optionally connect one or both expanders to the main module. Use only the supplied 16-pin fine-pitch IDC cables. Plug each cable into the nearest connector on the main module so that the cables run straight between the boards. The cables **should not cross**.
5. Mount the module and optional expander(s) to the case using M3 screws.
6. Power on your Eurorack system.

Information

The module is factory calibrated to compensate for potentiometer imperfections. The expanders are thus not interchangeable. The left and right ones are marked with an “L” and “R” at the back accordingly. Follow the markings for the highest potentiometer precision.

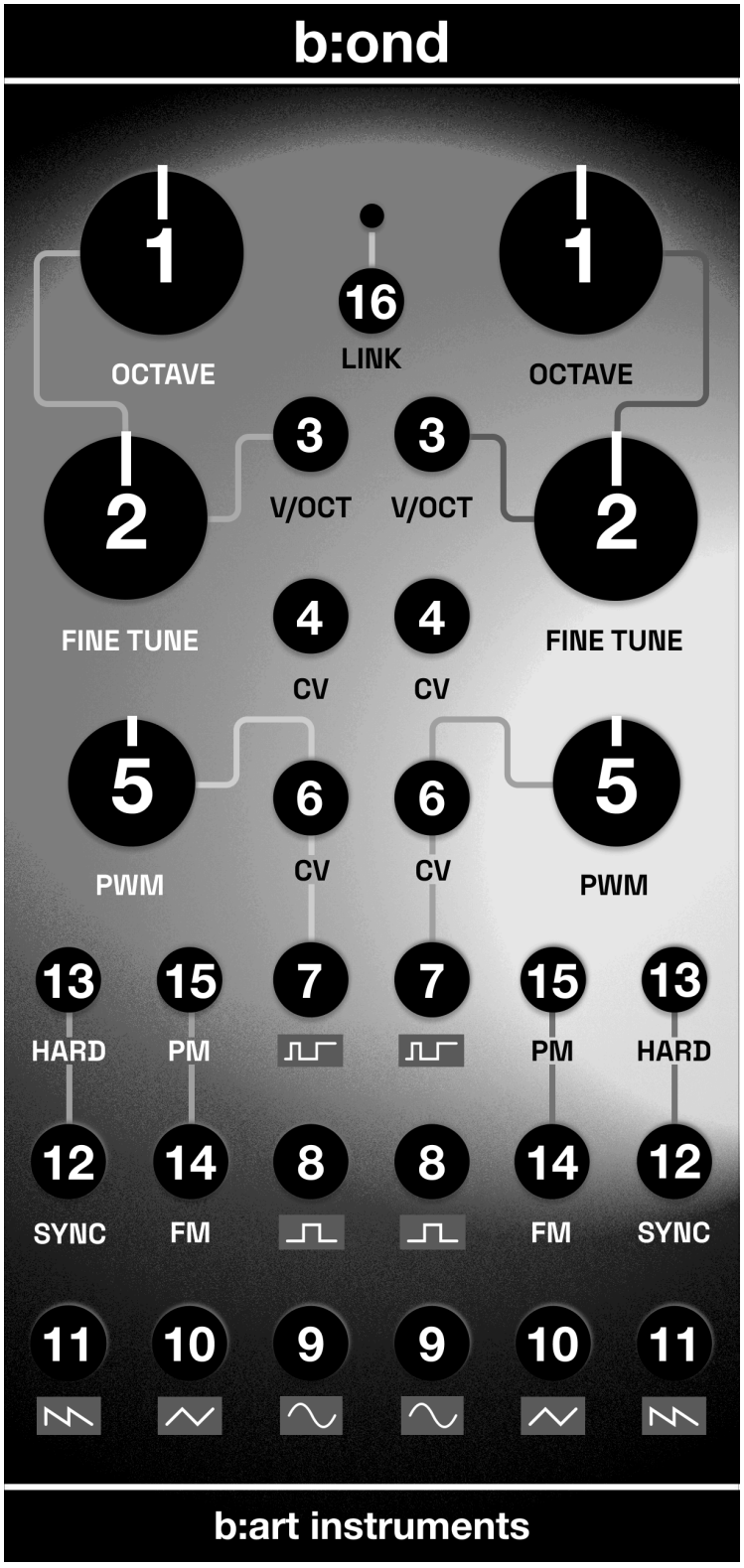
Safety information

- Do not expose the module to moisture or extreme temperatures.
- Do not operate the module in environments with excessive amounts of dust in the air.
- The module’s inputs are protected against electrostatic discharge, but be careful when handling the module itself.

Changelog

Revision	Description
1.0	Initial release.
1.1	Small wording changes, move licenses to the website, clarify Installation, Expanders and VCO Linking sections, add Phase Lock section.
1.2	Add firmware update procedure, add quantizer description, add Configuration options section, add patch ideas

Controls



1. Octave Selector
2. Fine Tune knob
3. V/OCT inputs (CV1)
4. Assignable CV inputs (CV2)
5. Pulse Width knob
6. Pulse Width CV input
7. Pulse Wave output
8. Square Wave output
9. Sine Wave output
10. Triangle Wave output
11. Saw Wave output
12. Sync input
13. Soft/Hard Sync switch
14. Modulation input
15. Frequency/Phase Modulation switch
16. VCO Link switch

Tuning

b:ond v2 offers precise control over its oscillators pitch through several methods. This section details the four primary ways to affect the tuning of the VCOs: the Octave Selector, Fine Tune knob, CV or 1 V/Oct inputs, and the FM input.

1 Octave Selector

Each oscillator is equipped with an octave switch that allows for quick and easy transposition of the oscillator frequency across different octaves.

This 8-position switch provides discrete steps for changing the base frequency from –3 to +4 octaves.

2 Fine Tune knob

The Fine Tune knob offers precise control over the oscillator pitch within a single octave range. This allows subtle frequency adjustments, especially useful when matching pitch with other oscillators or instruments.

The Fine Tune knob by default has a one-octave range. At fully counter-clockwise, the pitch corresponds to the note C (261.63 Hz when the Octave Selector is at the 12 o'clock position and DIP2 is OFF).

3 V/OCT & 4 CV inputs

The module features two CV inputs for each oscillator, allowing external control voltages (CV) to modulate the pitch. Their sensitivity matches the 1-Volt-per-Octave (1 V/Oct) standard. The inputs are bi-polar, meaning that you can use negative voltages to lower the pitch of the oscillators.

The function of the Assignable CV Inputs (CV2) can be changed. Refer to the *DIP switches* section on **page 16**.

14 FM input

Frequency Modulation (FM) allows for complex and dynamic sound shaping by modulating the oscillator frequency with an external signal in a linear fashion.

The through-zero FM input accepts bi-polar signals (-5V to +5V), allowing for full-range modulation. Details about through-zero capabilities can be found on **page 10**.

Pulse Width, Sync & VCO Link

Pulse Width, Sync and VCO Link enable advanced control over oscillator voices.

❺ Pulse Width knob & ❻ PWM CV input

Pulse Width Modulation (PWM) alters the duty cycle of the pulse wave, changing the width of the pulse without affecting its frequency. This results in a change of the harmonic content and timbre of the wave.

The Pulse Width knob manually adjusts the pulse width of the pulse wave from 90% to 10% duty cycle. Setting the duty cycle to 50% results in a square wave.

When the Pulse Width CV input is patched in, the knob acts as an attenuator for the incoming signal. This input accepts CV in the 0–5V range.

⓬ Sync input & ⓭ Soft / Hard Sync switch

Synchronization (Sync) forces the oscillator (slave) to reset its cycle based on the frequency of another oscillator (master) patched into the Sync input. This creates harmonically related waveforms and can produce complex sounds, especially when the frequency of the slave oscillator is higher than the frequency of the master oscillator.

The Sync input accepts standard Eurorack 10 Vp-p levels (-5V to +5V).

Both Soft and Hard Sync share one input and are selectable with the Soft/Hard Sync switch.

Soft sync gently nudges the slave oscillator to match the phase of the master oscillator without completely resetting its cycle. This results in more subtle and complex interactions between the two oscillators.

Hard sync, on the other hand, forces the slave oscillator to reset its cycle abruptly whenever the master oscillator completes a cycle. This creates a more pronounced and aggressive synchronization effect.

⓰ VCO Linking

The Link switch links the right oscillator's Octave control – and optionally the Fine Tune control – to the left oscillator. This allows precise tuning of both oscillators at once while preserving independent control through their CV and other inputs.

Exact behavior of the Link function can be configured by the user. Refer to the *DIP switches* configuration section on **page 17**.

Frequency / Phase Modulation

Both Frequency Modulation and Phase Modulation share one input (the Modulation input) and are selectable with the Modulation switch.

⓮ Frequency Modulation

Through-zero FM (TZFM) is an advanced form of frequency modulation where the modulating signal can drive the carrier oscillator frequency both above and below zero, effectively reversing its phase when the frequency crosses zero. This allows for a wider range of modulation and richer harmonic content compared to traditional FM.

Any external modulation source, such as an LFO, Envelope, or Audio can be patched into the TZFM input. The accepted voltage range is −5V to 5V.

TZFM is particularly useful for creating metallic, bell-like tones, evolving textures, and complex harmonic structures. Experiment with different modulation sources and rates to explore the full potential of through-zero FM.

⓯ Phase Modulation

Phase Modulation involves modulating the phase of the oscillator rather than its frequency. Through-zero PM (TZPM) allows the phase to shift through zero, creating unique and complex waveforms that differ from standard PM.

As with TZFM, any external modulation source is accepted in the −5V to 5V range.

TZPM can be used to generate rich and dynamic textures, adding complexity to the sound. It's particularly effective for creating evolving pads, complex leads, and experimental sounds.

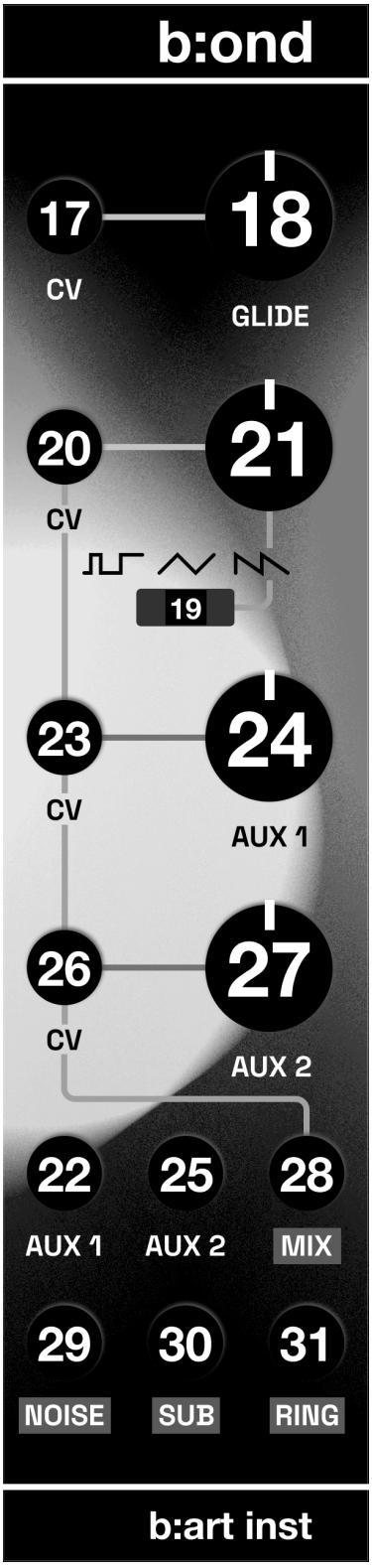
VCO Outputs

Each VCO on the main module features five simultaneous outputs:

- ❼ Pulse Wave (adjustable duty cycle)
- ❽ Square Wave (always 50% duty cycle)
- ❾ Sine Wave
- ❿ Triangle Wave
- ⓫ Saw Wave

Each output is an AC coupled 10 Vp-p output, meaning it swings from −5V to 5V. The output impedances are 1000 Ω for each output.

Expander controls



17 Glide CV input
18 Glide knob
19 Internal Wave Select switch
20 Internal Wave Gain CV
21 Internal Wave Gain knob
22 AUX Wave 1 input
23 AUX Wave 1 Gain CV
24 AUX Wave 1 Gain knob
25 AUX Wave 2 input
26 AUX Wave 2 Gain CV
27 AUX Wave 2 Gain knob
28 AUX + Internal Wave Mix output
29 Noise output
30 Suboscillator output
31 Ring Mod output

Expanders

The b:ond v2 features two optional expanders that unlock additional functionality of the module. When installing them, follow the markings near the serial number for optimal precision. Refer to the *Installation* section on **page 5** for more information.

Each of the expanders is assigned to one oscillator voice: the left expander connects to Oscillator 1, and the right expander to Oscillator 2.

18 Glide knob & 17 Glide CV

The module is equipped with a built-in portamento effect. The Glide knob controls the rate of oscillator frequency change due to CV1/CV2 voltage changes. A custom-designed curve is used to maximize usability of this function. Turning the knob counter-clockwise results in gentle portamento; turning it fully clockwise pushes the effect to the extreme (with transition times reaching several seconds). To disable glide completely, turn the knob fully counter-clockwise.

No portamento is applied when changing pitch with the Octave Selector or the Fine Tune knob. Exponential smoothing is used by default, meaning that the speed of the glide is proportional to the difference between current and target frequency.

With a cable inserted into the Glide CV input, the knob attenuates the amount of modulation. This input accepts signals in 0–5V range.

Glide behavior can be customized with the ***GLIDE_CURVE*** option. Refer to the **Configuration options** section.

28 Mixer

The expanders feature a built-in three-input mixer with per-channel adjustable gain, providing a way to conveniently combine oscillator and external signals. The first input is internally connected to one of the oscillator's waveform outputs. The 19 Wave Select switch can be used to choose between Pulse, Triangle and Saw waveforms. The remaining channels are available to patch on the front panel, as 22 AUX1 and 25 AUX2 inputs, taking any −5V to +5V audio signal.

The 21 Wave Gain knob controls the volume of the oscillator signal in the Mix output.

When the 20 Wave Gain CV is patched, the knob sets the amount of gain modulation. The CV input accepts 0–5V signals.

24 27 AUX Gain knobs & 23 26 AUX CV

The AUX1 Gain and AUX2 Gain knobs control the volume of AUX1 and AUX2 signals in the Mix output. When the CV inputs are patched, the knobs attenuate the amount of gain modulation. The CV range is 0–5V.

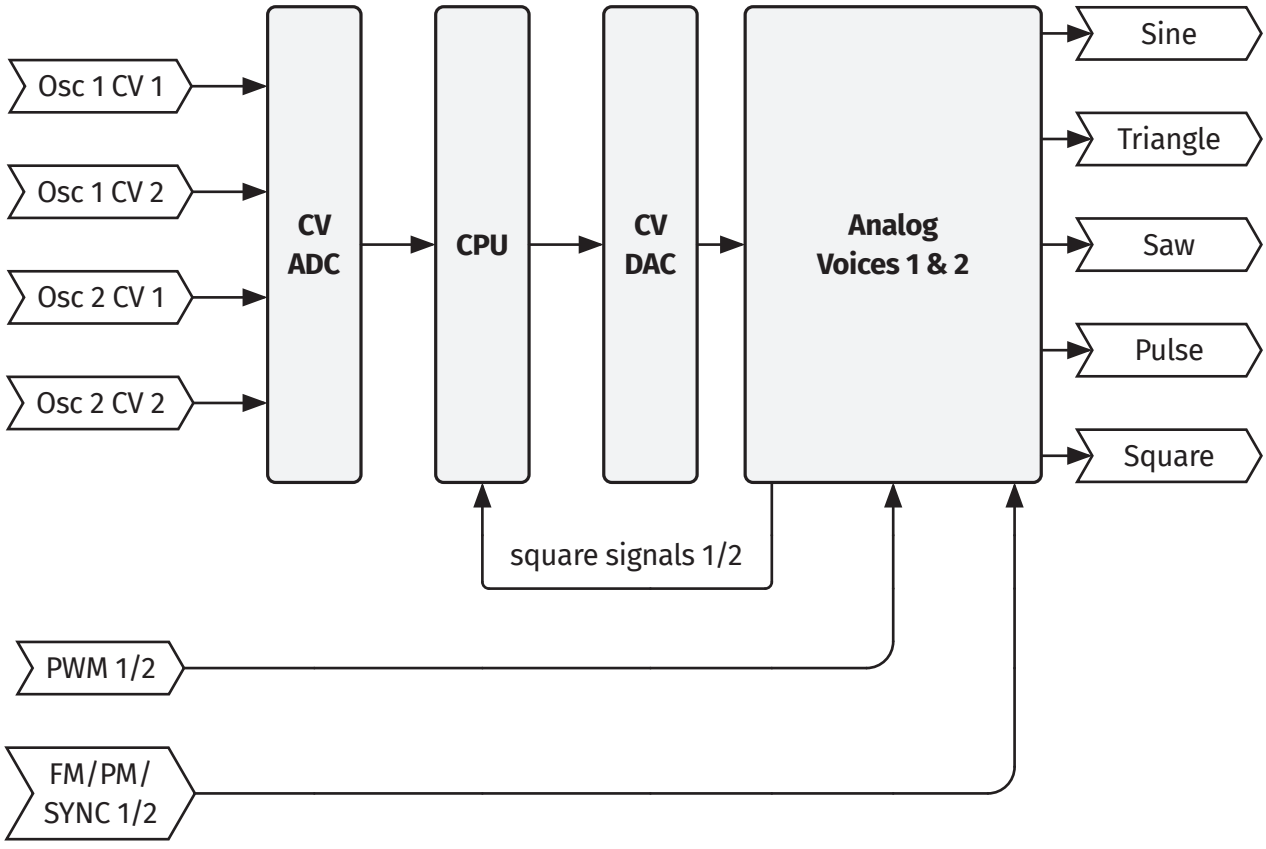
31 Ring Mod output

Each expander features an onboard ring modulator. The left expander outputs the product of the Oscillator 1 Sine Wave and the Oscillator 2 Square Wave. Conversely, the right expander outputs the product of the Oscillator 1 Square Wave and the Oscillator 2 Sine Wave.

The *Phase Lock* feature of the digital core ensures that the ring modulator timbre is stable over time, as long as both oscillators are tuned to the same frequency.

Digital core

The most distinctive feature of b:ond v2 is an integrated digital core that provides real-time supervision over analog voices. It consists of a processor and supporting peripherals that continuously monitor the oscillator output frequencies and compensate for any detected drift. The measurements are extremely accurate as the CPU is driven by a precise reference quartz resonator.



All four CV inputs are connected to the CPU, as it allows for much more precise control over analog voice frequency. PWM, FM/PM and Sync signals are routed directly to analog voices. Every module is also factory calibrated to compensate for component tolerances and to deliver in-tune output as soon as the module is powered on.

The module even learns from your playing. The algorithm continuously monitors frequency deviations and predicts the correction that should be applied whenever a CV voltage changes.

Information

As FM, PM and Sync are still implemented using analog circuits to preserve their warm character, they bypass the control circuitry of the digital core. Therefore, it can't actively compensate for discrepancies between actual and expected oscillator frequencies. The VCO cores will remain stable but will not be perfectly in tune when using these features.

For best results, allow the module to stabilize by playing notes across a wide frequency range before using these features. Alternatively, enable ***Perform sweep after power on*** option (DIP3). Refer to the *DIP switches* section below.

Phase Lock

The digital core actively compensates for phase deviations between the two analog voices. When both oscillators are tuned to the same frequency (regardless of the Link switch position), the core ensures they remain exactly in phase by applying small pitch corrections to the second oscillator. This feature is automatically disabled when the frequency difference between oscillators exceeds 0.1 Hz.

This feature can be disabled using the ***PHASE_LOCK*** configuration option. Refer to the **Configuration options** section.

Quantizer

The digital core contains a built-in quantizer that snaps CV1 and CV2 voltages to a user-selected musical scale. The Fine Tune knob position is not taken into account, i.e. the fine tune is applied after the quantizer, as well as portamento. If the oscillator is not perfectly tuned to a note that belongs to the selected scale, a nearest note is played instead.

This feature is disabled by default. To enable it, simply toggle the ***QUANTIZE*** configuration option on. Refer to the **Configuration options** section.

To prevent voltage measurement noise from causing rapid note changes, a small amount of hysteresis is applied. Hysteresis gives the quantizer a short memory of its current note, making it less sensitive to tiny fluctuations in the input voltage. As a result, when the control voltage is close to the boundary between two notes, the quantizer remains stable instead of rapidly switching back and forth. This helps maintain smooth and predictable pitch tracking. You can control this feature by toggling the ***QUANTIZE_HYSTERESIS*** configuration option on or off. Refer to the **Configuration options** section.

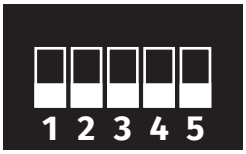
Scales

The quantizer provides several scale types to choose from.

Name	Notes (Root C)
Chromatic	C - C# - D - D# - E - F - F# - G - G# - A - A# - B
Major	C - D - E - F - G - A - B
Minor	C - D - D# - F - G - G# - A#
Pentatonic Major	C - D - E - G - A
Pentatonic Minor	C - D# - F - G - A#
Harmonic Major	C - D - E - F - G - G# - B
Harmonic Minor	C - D - D# - F - G - G# - B
Melodic Minor	C - D - D# - F - G - A - B
Blues	C - D# - F - F# - G - A#
Gypsy (Hungarian Minor)	C - D - D# - F# - G - G# - B
Jewish (Ahava Rabbah)	C - C# - E - F - G - G# - A#
Byzantine	C - C# - E - F - G - G# - B
Root & Fifth	C - G

DIP switches

Several features of the digital core can be turned on and off using DIP switches, as shown on the right. They are located on the back of the module, at the top of the main board. To access them, you'll need to remove the module from your rack.



Warning!

Make sure to turn your rack power supply off before trying to change DIP switch configuration. Do not use sharp or pointed tools, as they may damage the module.

Each switch is labeled accordingly on the module board. A brief description of each DIP switch function is provided:

DIP1 – CV2 octave snapping

Default setting: OFF

When turned OFF, the CV2 input of each oscillator voice works exactly the same as CV1 (V/Oct). A direct sum of two inputs controls the oscillator pitch.

When turned ON, the CV2 input of each oscillator voice is snapped to the closest octave. Control voltage is effectively rounded to the nearest integer and added to CV1. The resulting sum controls the oscillator pitch.

DIP2 – Transpose two octaves down

Default setting: OFF

When turned OFF, there is no transposition at all. The base oscillator note is C4 (261.63 Hz) for the Octave Selector at the 12 o'clock position, the Fine Tune knob turned fully counter-clockwise and no CV voltage applied.

When turned ON, the pitch of both oscillators is transposed two octaves down (24 semitones). The base oscillator note is C2 (65.41 Hz) for the octave selector at 12 o'clock position, the fine tune knob turned fully counter-clockwise and no CV voltage applied.

DIP3 – Perform sweep after power on

Default setting: OFF

When turned OFF, the module is ready to play as soon as possible. As no measurements are done, the oscillator initially solely relies on factory calibration. Training of the internal error prediction model happens as different output frequencies are being requested. Tones generated immediately after power-up may be slightly out of tune.

When turned ON, each time the module is powered on, it performs a short sweep to measure the initial oscillator characteristics. The process lasts approximately 1–2 seconds and updates the internal error prediction model.

DIP4 – Detune mode

Default setting: OFF

When turned OFF, the two oscillators operate independently. Octave Selector, Fine Tune knob and CV inputs control each oscillator separately.

When turned ON and the Link function is enabled, Oscillator 2 becomes relative to Oscillator 1. The Octave Selector, Fine Tune knob and CV inputs of Oscillator 1 affect both oscillators. Several front panel controls of Oscillator 2 change their function:

- *Octave Selector* — controls the octave offset of Oscillator 2 relative to Oscillator 1. At 12 the o'clock position, Oscillator 2 directly follows the octave of Oscillator 1. Turning the selector counter-clockwise selects lower octaves, while turning it clockwise selects higher octaves.
- *Fine Tune knob* and *V/Oct* — control the interval between Oscillator 1 and Oscillator 2. The oscillators are detuned symmetrically. The Glide knob controls the slew rate of the spread.

The ***Fine Tune link*** option (DIP5) is incompatible with Detune mode.

DIP5 – Fine Tune link

Default setting: OFF

When turned OFF, both oscillators have independent fine tune controls.

When turned ON, the Tine Tune knob of the first oscillator controls the fine tune of the second oscillator while the Link function is enabled. The position of Oscillator 2 fine tune is ignored completely.

This option is incompatible with ***Detune mode*** enabled (DIP4) and in that case will be ignored.

29 Noise & 30 Sub outputs

The b:ond v2 features two independent supplementary digital outputs per expander. Their output swing is the standard −5V to +5V with 1000 Ω impedance.

- The Noise output produces white noise by default. The two channels are completely uncorrelated, meaning their difference will be a different noise. The noise color can be configured with the ***NOISE_TYPE_x*** option. Refer to the section below.
- The Sub output produces a sine wave, two octaves (24 semitones) below the oscillator fundamental frequency by default. The waveform and offset can be configured with ***OSCx_SUB_WAVEFORM*** and ***OSCx_SUB_TRANSPOSE*** options. Refer to the section below.

Tip

You can patch Noise and Sub outputs directly to AUX1 and AUX2 inputs to mix them with analog oscillator outputs.

Configuration options

Several advanced module options can be customized using the web application available at **https://flash.bartinstruments.com**. Follow the connection procedure described in the **Firmware update** section. The options can be of the following types:

- **toggle** – simple switch to enable or disable an option
- **choice** – select one option from the dropdown list
- **number** – a real number (decimals allowed, e.g. −1.25)
- **number range** – a range between two real numbers
- **integer** – a whole number (no decimals, can be negative)

- **integer range** – a range between whole numbers
- **text** – an editable text

The ***x*** in the option name denotes the oscillator/expander number when individual oscillators/expanders can be configured separately. At the time of writing, the following options are available for the user to configure:

MASTER_TUNE number *Default: 440 Hz*

Sets the global tuning reference (pitch of A4) in Hz. The standard concert tuning of Western music is 440 Hz.

MASTER_TRANSPOSE integer *Default: 0*

Sets the overall pitch offset in semitones. Both oscillators and suboscillators are affected. A value of zero keeps middle C at 261.6 Hz in the default tuning.

NOISE_TYPE_x choice *Default: WHITE*

Available options:
WHITE, PINK, BROWN

Sets the noise color for the left and right expander Noise outputs.

OSCx_SUB_WAVEFORM choice *Default: SINE*

Available options:
SINE, TRIANGLE, SAW, SQUARE

Sets the wave type for the left and right expander Sub outputs.

OSCx_SUB_TRANSPOSE integer *Default: -24*

Sets the offset of suboscillator pitch relative to the fundamental pitch in semitones of the left and right expander Sub outputs. The default value is -24 semitones (-2 octaves).

FINE_TUNE_RANGE integer *Default: 12*

Sets the Fine Tune knob range for both oscillators, in semitones. The default value is 12 semitones (1 octave).

GLIDE_CURVE choice *Default: EXPONENTIAL*

Available options:
EXPONENTIAL, LINEAR

Sets the glide curve for both oscillators. If the exponential curve is selected, the rate of pitch change is proportional to the difference between current and target value. If the linear curve is selected, the rate of pitch change is constant.

PHASE_LOCK toggle *Default: Enabled*

Sets whether the *Phase Lock* feature is enabled. Go to **page 14** for more information.

QUANTIZE toggle *Default: Disabled*

Sets whether the *Quantizer* feature is enabled. Go to **page 14** for more information.

QUANTIZE_ROOT choice *Default: C*

Available options:
C, C_SHARP, D, D_SHARP, E, F, F_SHARP, G, G_SHARP, A, A_SHARP, B

Sets the root note of the selected quantize scale. Needs ***QUANTIZE*** to be enabled to take effect.

QUANTIZE_SCALE choice *Default: CHROMATIC*

Available options:
CHROMATIC, MAJOR, MINOR, PENTATONIC_MAJOR, PENTATONIC_MINOR, HARMONIC_MAJOR, HARMONIC_MINOR, MELODIC_MINOR, BLUES, GYPSY, JEWISH, BYZANTINE, ROOT_AND_FIFTH

Sets the scale of the quantizer. Needs ***QUANTIZE*** to be enabled to take effect. Go to **page 15** for the list of notes in these scales.

QUANTIZE_HYSTERESIS toggle *Default: Enabled*

Sets whether the quantizer hysteresis is enabled to cancel voltage measurement noise. You probably won't ever need to disable it. Needs ***QUANTIZE*** to be enabled to take effect. Go to **page 14** for more information.

More options will be made available with future firmware updates.

Firmware update

The b:ond v2 features a USB-C port used for firmware updates and advanced module configuration. These operations are performed through a web browser that supports the WebUSB standard. At the time of writing, a Chromium-based browser is required. You can even use an Android phone to update your module.

The Flash web app is used to execute the upgrade process. To update the module firmware, perform the following steps:

1. Start a Chromium-based browser, such as Microsoft Edge, Google Chrome, or Opera.
2. Plug one end of a USB cable to the Eurorack module and the second end to your computer. The module **should not** be powered by your rack power supply.
3. If this is the first time you have connected the device to this computer, the required drivers may need to be installed. The installation process will start automatically. Simply wait for it to finish.
4. A popup titled **“b:art instruments bootloader detected”** should appear. Click on it to open the Flash web app. If you can’t see the popup, simply open **https://flash.bartinstruments.com**.
5. Click on the **“Connect to device”** button. A popup with a list of devices will appear. Select **“b:art instruments bootloader”** and click **“Connect”**.
6. If the device does not appear, check your connection. Try another USB cable if the module still cannot be detected (some USB-C cables are for charging only and do not support data transfer).
7. Go to the **“Update firmware”** tab. Click on the **“Install”** button in the **“Latest firmware”** box.
8. A **“Firmware updater”** modal will show up. Wait for the firmware to be downloaded, then click **“Install”**. The installation process will begin. Do not disconnect your module from the computer while the update is in progress!
9. If the update was successful, click on the **“Reconnect”** button. You should now be able to use the newest features of your b:ond module!

Information

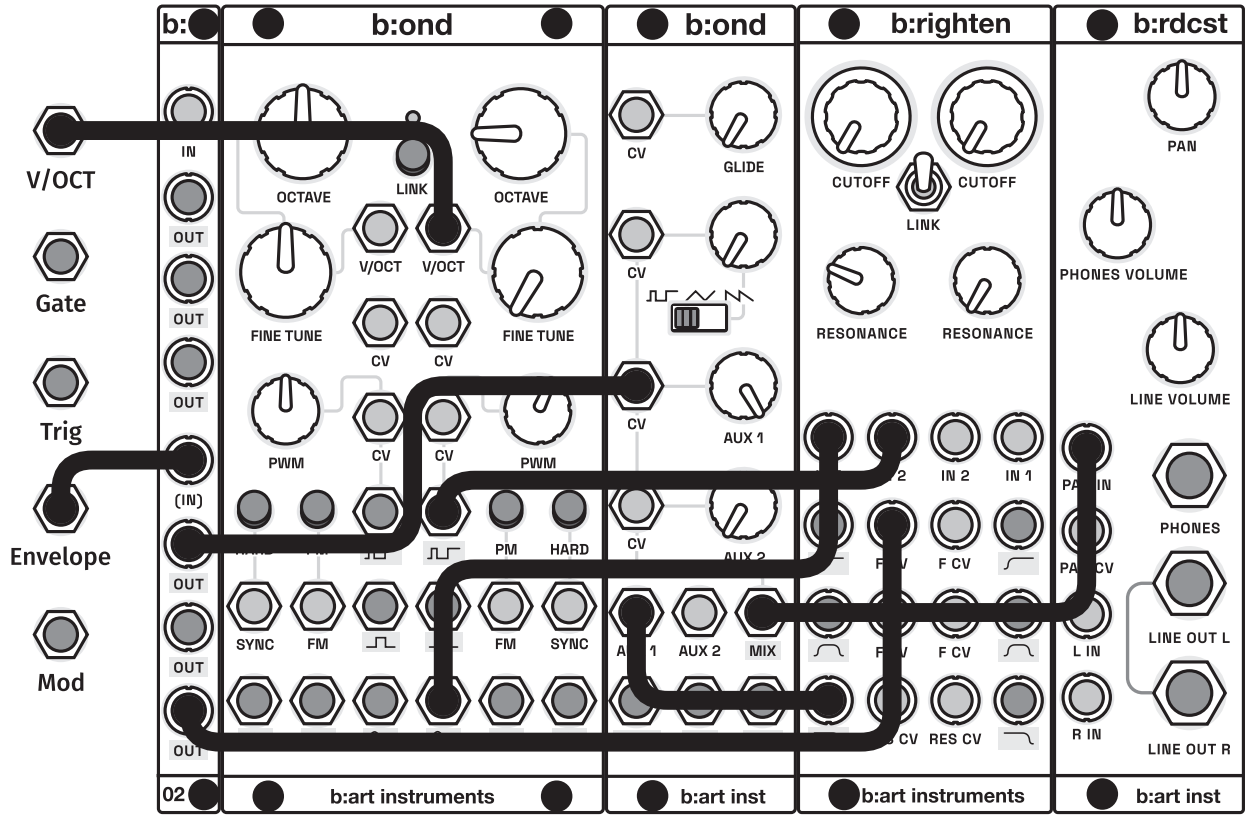
If you are performing the update on Linux, you might need to add a `udev` rule to grant access to the module before starting the process.

The module Vendor ID is `0x16D0` and the Product ID is `0x14D5`.

Patch examples

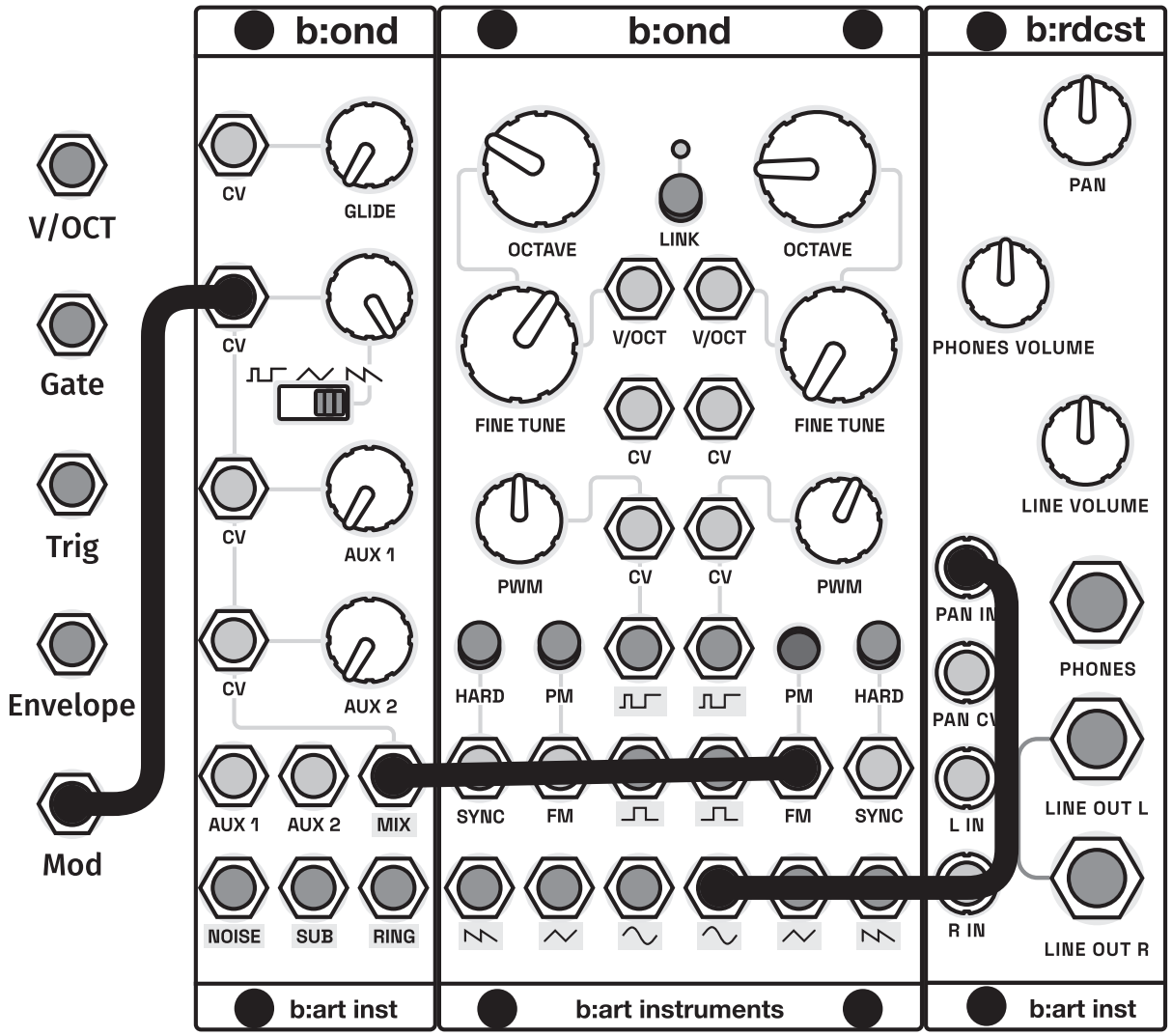
The b:ond v2 offers endless patching possibilities. Here are some ideas to get you started:

East Coast Synth



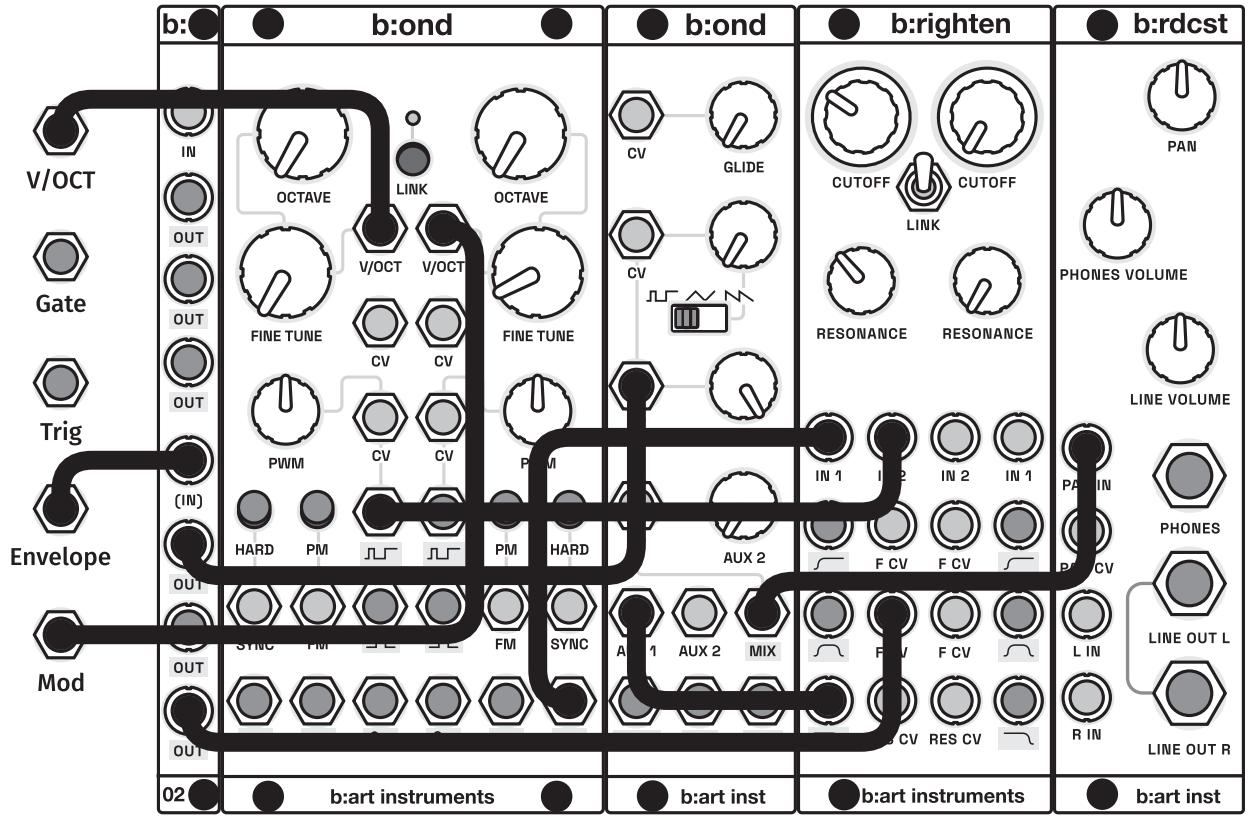
This patch follows the classic subtractive synthesis signal flow. A V/OCT signal from a keyboard or sequencer controls pitch, while an external envelope modulates both the filter cutoff and VCA gain simultaneously. Two b:ond wave outputs feed into one of b:righten's filters. One of b:ond's expanders acts as an independent post-filter VCA before the final signal reaches the output (b:rdcst).

Cross-Phase Modulation



This common yet powerful modulation technique uses one of b:ond's expanders as an attenuator for the left VCO's sawtooth wave before feeding into the right VCO's Phase Modulation input. Adjusting the attenuation amount yields a wide range of interesting timbres, from very subtle to harmonically-rich and complex.

Dual Detuned Voice



Based on the East Coast synth voice patch, this configuration adds a second VCO for increased harmonic complexity. The two oscillators work best in detune mode, producing harmonically rich tones when mixed together. A keyboard or sequencer patched into the left V/OCT input controls the base pitch, while a Mod CV patched into the right V/OCT input sets the detune amount.

Open-source licenses

The b:ond v2 firmware includes third-party software components under open-source licenses. The full license texts are available at:

https://bartinstruments.com/pages/licenses

Technical specifications

Operating voltages:	–12V / +12V
Power draw:	84 mA –12V / 118 mA +12V
Width:	12 HP + 2 × 6 HP (expanders)
Depth:	17 mm (22 mm with power header)
Oscillator frequency tracking:	1 V/oct
SYNC IN & MOD IN level:	10 Vp-p (-5V/+5V)
PWM CV input level:	0–5V
Expander CV inputs level:	0–5V
V/OCT CV input level:	–4V–8V
Audio outputs level:	10 Vp-p (-5V/+5V)
V/OCT & CV 2 Input impedance:	1 MΩ
Output impedance:	1000 Ω (all outputs)
VCO frequency range:	20 Hz–20 kHz
Glide time range:	0–8 s

CE

This product was tested and found compliant with the following standards:
EN 55032:2015/A11:2020, EN 55035:2017, EN IEC 63000:2018.
For details, please visit:
https://www.bartinstruments.com/pages/conformity

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