b:art instruments

b:ond v2

Dual Digitally Controlled Oscillator

User Manual

Revision: 1.0 • March 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 provided 16-pin fine-pitch IDC cables.
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.

Controls

1. Octave Switch
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 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 switch, fine tune knob, CV or 1V/OCT inputs, and the FM input.

❶ 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.

❷ Fine Tune Knob

The fine tune knob offers precise control over the oscillator's 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 has a one-octave range. At fully counter-clockwise, the pitch corresponds to C note (261.6 Hz when the Octave Switch is at 12 o'clock position and DIP2 is OFF).

❸ V/OCT & ❹ 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 (1V/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 can be changed. Refer to the DIP switch configuration section on **page 14**.

⓮ 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 bipolar signals (-5V to +5V), allowing for full-range modulation. Details about through-zero capabilities can be found on **page 9**.

■ Pulse Width, Sync & VCO Link

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 in the harmonic content and timbre of the wave.

The PWM 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 PWM 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 slave oscillator's frequency is higher than the master oscillator's.

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

Both Soft and Hard Sync share one input and are selectable with the Soft/Hard 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 button links the right oscillator's OCTAVE and FINE TUNE controls to the left oscillator. This allows precise tuning of both oscillators at once, while maintaining the flexibility of their respective CV and other inputs.

Frequency / Phase Modulation

Both Frequency Modulation and Phase Modulation share one input (the MOD 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's 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.

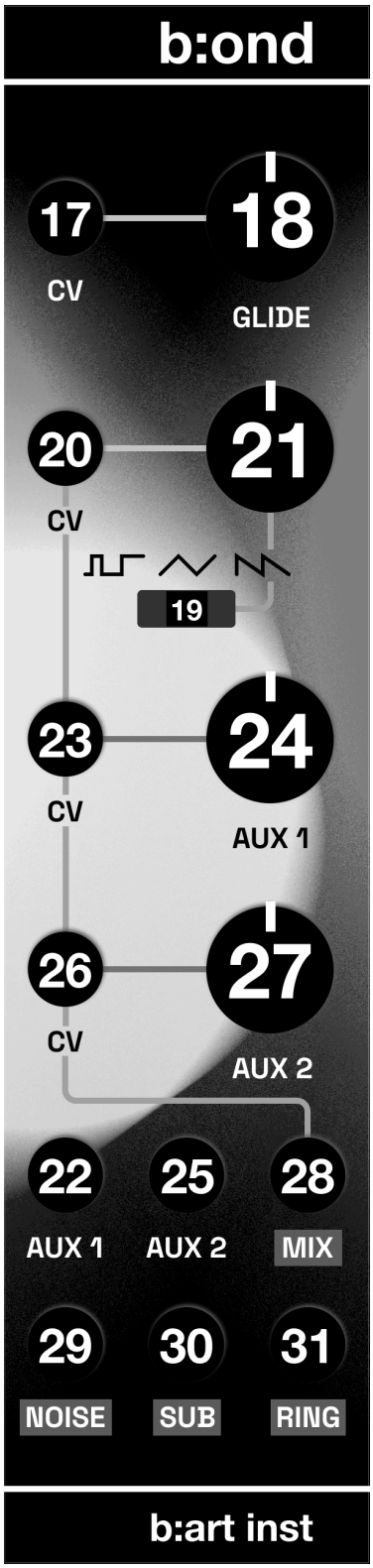
VCO Outputs

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 10Vp-p output, meaning it swings from –5V to 5V. The output impedances are 1000 ohm 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 Input 1

23 Aux Wave 1 Gain CV

24 Aux Wave 1 Gain Knob

25 Aux Wave Input 2

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

b:ond features two optional expanders that enable using even more features of the module. When installing, follow the markings near the serial number for the best precision. Refer to the Installation section on **page 4** for more information.

18 Glide Knob & 17 Glide CV

The module is equipped with a built-in portamento effect and Glide 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 Octave Selector or Fine Tune knob. Exponential smoothing is used, meaning that the speed of the glide is proportional to the difference between instant and target frequency.

When the Glide CV input is patched, the knob attenuates the modulation amount.

28 Mixer

The expanders feature a built-in three-input mixer with per-channel adjustable gain. The first input is internally patched to one of the oscillator waveform outputs. The 19 Wave Select switch can be used to choose between Pulse, Triangle and Saw. 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 amount of oscillator signal in the MIX output.

When the 20 Wave Gain CV is patched, the knob sets the amount of gain modulation.

24 27 AUX gain & 23 26 AUX CV

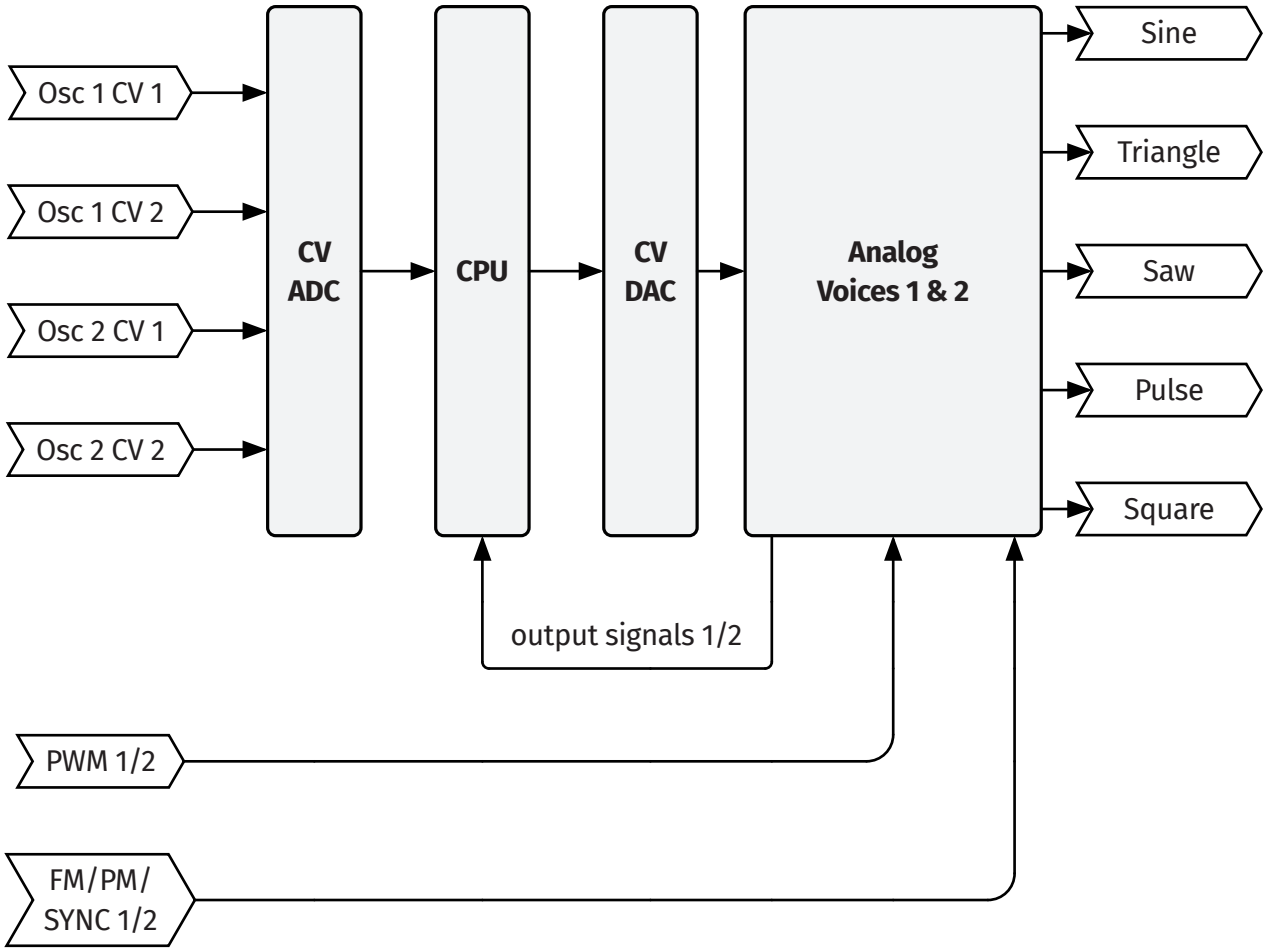
The AUX1 gain and AUX2 gain knobs control the volume of AUX1 and AUX2 signals on the MIX output respectively. When the CV inputs are patched, the knobs attenuate the amount of gain modulation.

31 Ring Mod Output

Each expander features an on-board ring modulator. The left expander outputs the product of Osc 1 sine wave multiplied by Osc 2 square wave. Conversely, the right expander outputs the product of Osc 1 square wave and Osc 2 sine wave.

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 oscillator. The overall architecture of the system is shown below:



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 processed directly by analog voices. Every module is also factory calibrated to neutralize effects of component tolerances and to deliver in-tune output as soon as the module is powered on.

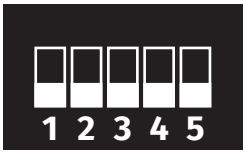
The module even learns from your playing. The algorithm continuously monitors frequency deviations and predicts the correction that should be applied whenever a CV voltage changes.

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 discrepancies between actual and expected oscillator frequencies. This only affects extreme modulation scenarios; normal operation remains stable. Make sure to let your b:ond v2 tune itself before using any of those features or turn ***Perform sweep after power on*** option on (DIP3). Refer to the section below.

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 below:

DIP1 – CV2 octave snapping

Default setting: OFF

When turned OFF, 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, 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 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 semi-tones). 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, each oscillator is independent. Octave selector, fine tune knob and CV inputs are separate and decoupled.

When turned ON, the second oscillator is relative to the first while the LINK function is on. Several controls of the second oscillator on the front panel change function. That includes:

- *Octave Selector* – controls the Osc 2 octave offset from Osc 1. At 12 o'clock position the second oscillator directly follows the octave of the first. Turning the selector counter-clockwise decreases the octave and turning it clockwise selects higher octaves.
- *Fine tune knob* and *V/Oct* – control the interval between Osc 1 and Osc 2. The two oscillators are detuned symmetrically. *Glide* controls 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 fine tune knob of the first oscillator controls the fine tune of the second oscillator, while the LINK function is on. The position of Osc 2 fine tune is ignored completely.

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

Noise and Sub outputs

The module expanders feature two independent supplementary digital outputs on each expander. Their output level is the standard –5V to +5V with 1000 ohm impedance.

- The **Noise** output produces white noise. The two channels are completely decorrelated, meaning their difference will be a different white noise.
- The **Sub** output produces a sine wave, two octaves (24 semitones) below the fundamental oscillator frequency.

Tip

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

Firmware update

The b:ond v2 features a USB-C port used for updating the device firmware and changing advanced module configuration. A web browser supporting WebUSB standard is used to perform this process. At the time of writing, a Chromium-based browser such as Microsoft Edge, Google Chrome, or Opera is required.

Firmware update functionality will be enabled in a future release. Detailed instructions will be published in April 2026.

Open-source licenses

The b:ond v2 firmware includes third-party software components under the following open-source licenses:

Components:

- FreeRTOS – Copyright (C) 2018 Amazon.com, Inc. or its affiliates. All Rights Reserved.
- tinyusb – Copyright (c) 2018, hathach (tinyusb.org)

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Components:

- stm32f4xx-hal-driver – Copyright 2017 STMicroelectronics. All rights reserved.

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Technical specifications

Operating voltages:	–12V / +12V
Power draw:	84mA –12V / 118mA +12V
Width:	12HP + 2 × 6HP (VCA expanders)
Depth:	17mm (22mm with power header)
Oscillator frequency tracking:	1V / oct
SYNC IN & MOD IN level:	10Vp-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:	10Vp-p (-5V/+5V)
V/OCT & CV 2 Input impedance:	1Mohm
Output impedance:	1000ohm (all outputs)
VCO Frequency Range:	20Hz – 20kHz
Glide Time Range	0 – 8s

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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