

Grainulator

Desktop Edition (macOS & Windows)

Contents

1. Grainulator	6
2. What is Grainulator?	7
2.1 Two layers, one engine	7
2.2 What you can make with it	7
2.3 Versions	7
2.4 Where to start	7
3. Quick Start	8
3.1 Next steps	8
4. Your First Patch — An Ambient Pad	9
4.1 Step 1 — Load a sample	9
4.2 Step 2 — Set the grain core	9
4.3 Step 3 — Pick a window shape	9
4.4 Step 4 — Add motion with modulation	10
4.5 Step 5 — Send it through reverb	10
4.6 Step 6 — Save it as a preset	10
4.7 What you just learned	10
4.8 Where to go next	10
5. What is granular synthesis?	12
5.1 Opening hook	12
5.2 The core idea	12
5.3 In Grainulator	13
5.4 Further reading	14
5.5 See also	14
6. Header Bar	15
6.1 Preset browser	15
6.2 Transport	15
6.3 Play mode	15
6.4 Layer selector	15
6.5 Tab navigation	15
6.6 See also	16
7. Waveform Display	17
7.1 What you see	17
7.2 Loading a sound	17
Clear Audio	17
7.3 Setting the position	17

7.4 See also	17
8. Layer System	18
8.1 What each layer owns	18
8.2 What is shared between layers	18
8.3 Buffer modes	18
8.4 Enabling and muting layers	19
8.5 Switching layers in compact mode	19
8.6 See also	19
9. GRAIN Tab	20
9.1 Per-layer panels	20
GRAIN sub-section	21
MORPH strip	21
FILTER sub-section	22
Layer header	22
9.2 MASTER panel	22
9.3 Dual waveform display	22
9.4 See also	22
10. TEXTURE Tab	23
10.1 Shape — Grain Window	24
Morph	24
10.2 Pitch Variation	24
10.3 Dynamics	25
10.4 Reverse	25
10.5 Scan	25
10.6 See also	25
11. SYNTH Tab	26
11.1 Spectral panel (Spectral Array Oscillator)	26
Top toggles	27
8-step pitch grid	27
Knobs (top row)	27
FMT toggle	27
Knobs (bottom row)	28
Capture / Clear	28
11.2 Voice Interaction panel	28
Direction	28
Knobs	29
Power toggle	29
Mod routing	29

Preset upgrade from v19 and earlier	29
11.3 Resonator	30
11.4 Sub Oscillator	30
11.5 VCA Envelope	31
11.6 Filter Envelope	31
11.7 MIDI Control	31
11.8 See also	32
12. FX Tab	33
12.1 Master Filter	33
12.2 Compressor	34
12.3 Delay	35
12.4 Reverb	35
Algorithm selector	36
Common controls	36
Notes on per-algorithm behavior	36
12.5 See also	36
13. MOD Tab	37
13.1 Overview	38
13.2 Sources	38
Per-lane LFO	38
Per-lane envelope	38
Rhythmic sources (added 2026-04-05)	39
13.3 Destinations	40
13.4 Layer targeting	40
13.5 See also	40
14. Parameter Reference	41
14.1 Quick lookup	41
14.2 Layer scope at a glance	42
14.3 See also	42
15. Install	43
15.1 Download	43
15.2 macOS install	43
15.3 Windows install	43
15.4 License activation	43
15.5 Verifying the install	44
15.6 Uninstalling	44
16. Audio setup	45
16.1 Audio interface selection (standalone only)	45

16.2	Sample rate and buffer size	45
16.3	DAW host compatibility	45
16.4	Instrument vs. effect	46
17.	Troubleshooting	47
18.	What's New	49
18.1	v2.1.0 — April 2026	49
	New features	49
	Fixes	49
	UI polish	49
	Preset compatibility	49
18.2	v2.0.0 — 2026	49
	New features	50
	Layout changes	50
	Renames and terminology	50
	Documentation	50
18.3	v1.4 and earlier	50
19.	Credits	51
19.1	Open-source components	51
19.2	Documentation	51
19.3	Thanks	51

1. Grainulator

A granular synthesis instrument and effect for macOS, Windows, and iPadOS.

Load any audio sample, slice it into thousands of tiny grains, and reshape those grains into pads, drones, textures, rhythms, and sound effects. Two independent layers, a polyphonic spectral synth per layer, multi-mode reverb, a resonant body model, and a flexible modulation matrix with 5 lanes and 45 destinations.

On first launch, Grainulator loads a factory preset called **First Patch** with a sample already attached — press Play and you're hearing granular synthesis on the second beat.

Quick start

Get sound out of Grainulator in about five minutes.

[Read the quick start →](#)

What is Grainulator?

The idea behind the instrument and what you can make with it.

[Read the intro →](#)

Parameter reference

Every control on every tab.

[Browse the reference →](#)

Troubleshooting

Common issues and how to fix them. See the **Troubleshooting** page in the Desktop or iPad section of the sidebar.

2. What is Grainulator?

Grainulator is a **granular synthesizer**. You give it an audio sample — a recording of anything, from a single piano note to a field recording of rain — and it slices that sample into hundreds or thousands of short fragments called **grains**. Each grain is between about 1 millisecond and half a second long. By spawning grains rapidly, varying their pitch, position, window shape, and amplitude, and layering the result through a modulation matrix, Grainulator turns any source sound into a new instrument.

2.1 Two layers, one engine

Grainulator has two independent **layers**, Layer 1 and Layer 2. Each layer has its own audio buffer, grain engine, window shape, pitch variation, filter, and envelopes. Use the two layers in parallel for thick layered sounds, in opposition for call-and-response patches, or mix a rhythmic layer against a pad for generative backgrounds.

A global synthesis block (resonator, sub oscillator, VCA/filter envelopes, glide) sits downstream of both layers, followed by the FX chain — master filter, compressor, tape delay, and multi-mode reverb. The [Layer System](#) reference explains exactly what is per-layer and what is global.

2.2 What you can make with it

- **Pads and drones** from a single held note or a vocal "ahh".
- **Rhythmic textures** by syncing grain density to your DAW's clock and routing a euclidean pattern to the grain trigger.
- **Frozen reverbs** by holding the grain position and sweeping density.
- **Pitched instruments** by mapping the grain source to MIDI notes with the root-note glide control.
- **Sound design** for film, games, and live performance.
- **Cinematic risers and impacts** by modulating scan rate and window shape over time.

2.3 Versions

Grainulator runs as:

- A **standalone desktop app** for macOS and Windows.
- A **plug-in** for any DAW that supports VST3, AudioUnit, or AAX.
- An **AUv3 plug-in** for iPadOS, runnable in any compatible host (AUM, Loopy Pro, Cubasis, GarageBand, Drambo) or as a standalone iPad app.

The interface and sound engine are identical across all versions. Only the installation path, audio routing, and a few input methods differ.

2.4 Where to start

If you want sound right now, read the [Quick Start](#). If you want to learn every control before you touch one, start with the [GRAIN tab reference](#). If you want to build something specific end-to-end, try [Your First Patch](#) — a ten-minute walkthrough that ends with a working ambient pad preset.

3. Quick Start

You'll have sound coming out of Grainulator in about five minutes. Pick your platform.

First-launch shortcut

The very first time you launch Grainulator, the app loads a factory preset called **First Patch** with a sample already attached. Press Play (standalone) or hold a MIDI note (plug-in, Instrument mode) and you'll have sound immediately — no setup required. The walk-throughs below assume a clean session with your own sample, but you can also just start tweaking First Patch.

Desktop (Mac / Windows) iPad

1. **Install Grainulator** by following the install guide (see **Desktop → Install** in the sidebar).
 2. **Launch the standalone app** (or open Grainulator as a plug-in in your DAW — load it on an instrument or audio track).
 3. **Drag any audio file** onto the waveform display at the top of the window. WAV, AIFF, FLAC, MP3, and Ogg are all supported, at any sample rate — Grainulator will resample to the host rate automatically.
 4. **Press Play** in the header (standalone), or play a MIDI note from your DAW (plug-in, Instrument play mode).
 5. **Turn the Density knob** on the GRAIN tab up to around 30. You should hear a stream of grains pulled from your sample.
 6. **Turn the Pitch knob** to ± 12 semitones. The grains shift up or down an octave while keeping the same grain size and density.
 7. **Open the FX tab** and raise the Reverb Mix knob. Welcome to ambient music.
1. **Install Grainulator** from the App Store (see **iPad → Install** in the sidebar).
 2. **Open Grainulator** as an AUV3 plug-in in any compatible host (AUM, Loopy Pro, Cubasis, GarageBand, Drambo) or launch the standalone app.
 3. **Tap the waveform display** at the top. The Files browser opens — pick any audio file from iCloud Drive, On My iPad, or your configured cloud storage.
 4. **Play a MIDI note** from your host's keyboard, an external MIDI controller, or the standalone app's on-screen keyboard.
 5. **Drag the Density knob** on the GRAIN tab upward to around 30.
 6. **Drag the Pitch knob** up or down. The grains shift in pitch.
 7. **Switch to the FX tab** and raise the Reverb Mix knob.

3.1 Next steps

- For a full guided walkthrough: [Your First Patch](#).
- To understand what you just heard conceptually: [What is Grainulator?](#).
- To learn every control on every panel: start with the [GRAIN tab reference](#) and work through the other tabs under **Reference → Tabs** in the sidebar.

4. Your First Patch — An Ambient Pad

This tutorial walks you through building a slowly-evolving ambient pad from a single audio sample. By the end you'll understand the core controls on the GRAIN, TEXTURE, MOD, and FX tabs, and you'll have a sound you can save as a user preset.

Time: about 10 minutes.

You'll need: any sustained sound recording — a held piano note, a vocal "ahh", a string drone, or a field recording with a pitched character all work well. A sharp drum hit is a poor choice for this particular recipe; short percussive samples produce rhythmic textures instead of pads.

4.1 Step 1 — Load a sample

Desktop iPad

Drag your audio file onto the waveform display at the top of the Grainulator window. The waveform appears and Grainulator automatically resamples the file to your current session sample rate on a background thread.

Tap the waveform display at the top of the plug-in. The Files browser opens. Navigate to your audio file (iCloud Drive, On My iPad, or any configured cloud provider) and tap it to load.

You should see a stereo waveform drawn across the top of the window and a vertical line marking the current grain spawn position.

4.2 Step 2 — Set the grain core

Open the **GRAIN** tab if it isn't already visible and dial in these starting values in the GRAIN column:

- **Size** — set to around **0.3 s** (300 ms). Large grains are the foundation of pad sounds: they play back enough of the source that each grain has a recognizable tone, but not so much that you just hear the original sample looping.
- **Density** — set to around **20**. Enough grains overlap to create a continuous texture without the CPU load of hundreds per second.
- **Pitch** — leave at **0** for now. We'll add variation with the MOD tab later.
- **Speed** — set to around **0.05**. This is the *playback* speed of the grain reader through the buffer — slow enough that successive grains come from nearly the same point in the sample, which is what makes a pad sound static.
- **Jitter** — set to about **0.15**. A small amount of random position offset prevents the machine-regularity that pure 20 Hz density would otherwise produce.

Press Play (standalone) or hold a MIDI note (plug-in, Instrument mode) and you should already hear a rough pad-like sound.

4.3 Step 3 — Pick a window shape

Switch to the **TEXTURE** tab. In the **Shape** column:

- Set **Window Shape** to **Hanning**.

The window is the amplitude envelope applied to every grain. Hanning (a raised-cosine curve) fades each grain in and out smoothly, which is exactly what you want for pad sounds — the fade-in and fade-out eliminate the clicks you would get from abrupt grain starts, and the soft envelope lets adjacent grains blend rather than compete. Try switching to **Triangle** or **Trapezoid** for comparison: they sound noticeably more percussive.

Leave Tilt, Curve, and Sides at their defaults for now.

4.4 Step 4 — Add motion with modulation

Pads get boring when nothing moves. Switch to the **MOD** tab and set up one of the five mod lanes:

- **Source** — **LFO**.
- **Dest** — **Position** (grain spawn position).
- **Amount** — about **0.15**. This is a bipolar depth, so the grain position will drift $\pm 15\%$ of the buffer around the currently-set point.
- **LFO Rate** — about **0.1 Hz** (one full cycle every 10 seconds).
- **LFO Shape** — **Sine**.

The position of the grains now slowly drifts through the sample over time. Because your sample is a sustained sound rather than a percussive one, the drift sweeps through slightly different timbres (different overtones, slightly different decay characteristics) and adds the organic evolution that a static pad lacks.

4.5 Step 5 — Send it through reverb

Switch to the **FX** tab. In the Reverb section:

- **Mode** — **Stormy**. Of the three reverb modes, Stormy has the longest tail and the most modulated character, which is the ambient-pad default.
- **Size** — **0.75**. A large virtual space.
- **Damping** — **0.4**. Some high-frequency absorption so the reverb tail doesn't get harsh.
- **Mix** — **0.45**. A generous wet amount — ambient pads live and die by their reverb.

If you want to push into washing-drone territory, raise Mix to 0.7 and enable **Freeze** on the reverb to hold the current tail indefinitely.

4.6 Step 6 — Save it as a preset

In the header bar, click the **Save** button (disk icon next to the preset name). Enter a name — "My First Pad" is traditional — and confirm. The preset file is written to your user presets directory and is now available from the preset browser on any future launch.

4.7 What you just learned

- The four most important grain parameters: **Size**, **Density**, **Speed**, and **Position**. Every pad recipe starts with these.
- How **window shape** changes the *character* of grains beyond their basic parameters — a Hanning window is smooth, a Trapezoid window is punchy, and the choice matters as much as any knob on GRAIN.
- How **modulation** adds movement to an otherwise static patch, and how even a very slow LFO on a single parameter can make a sound feel alive.
- How **reverb mode** is more than a tail length — it's a tonal choice, and the Stormy mode sounds different from Misty even at identical Size and Mix values.

4.8 Where to go next

- Read the full [GRAIN tab reference](#) to discover every control you didn't touch (including the MORPH column's assignable Macro knob, which is a tutorial of its own).

- Read the full [MOD tab reference](#) — the single lane you set up is one of five, and the rhythmic sources can drive entirely different types of patches.
- Try the same recipe with a **percussive** sample (a single drum hit, a snippet of speech, a guitar pluck). The same knob positions will produce a completely different sound, which is the whole point of granular synthesis.

5. What is granular synthesis?

5.1 Opening hook

Imagine you have a vinyl record playing a single piano note. The note holds steady for thirty seconds. Now imagine you pick up the needle, drop it back on the same groove, wait a few milliseconds, and repeat — ten times a second. You'll hear a rapid stutter. The original piano note is in there, but the sound itself is something new: a buzzing, textured drone stitched together from tiny snippets of the original.

That's granular synthesis. The technique takes any recorded sound, slices it into fragments shorter than a human ear can resolve individually, and resynthesizes a new sound out of the overlap.

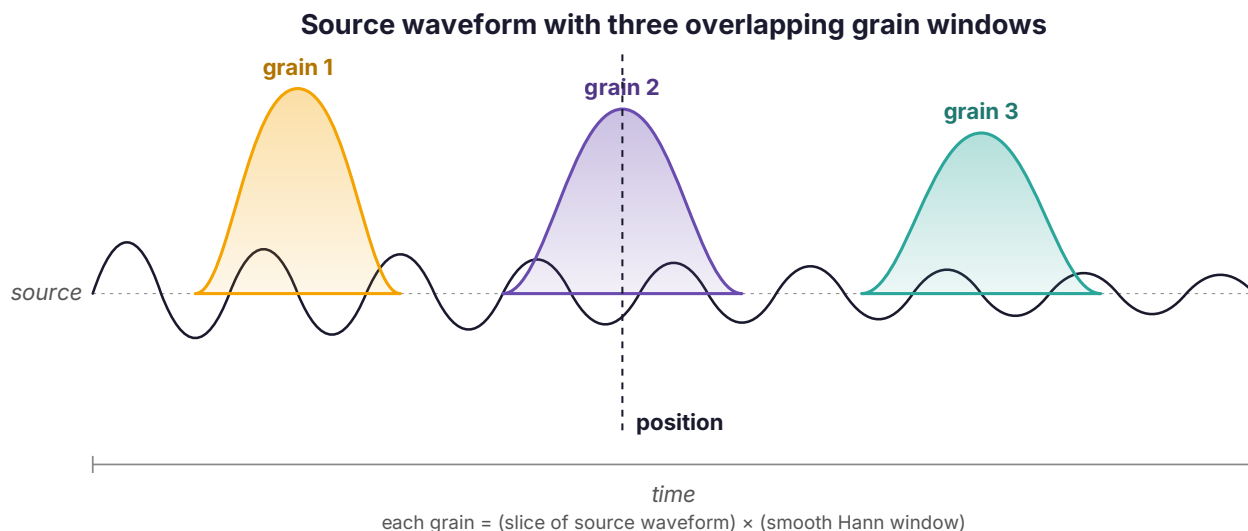
5.2 The core idea

A **grain** is a short audio fragment — typically between one millisecond and half a second long — taken from a source recording and shaped by a smooth amplitude envelope at both ends so it doesn't click when it starts or stops. By itself a single grain sounds like what it is: a tiny snippet of sound. The interesting part starts when you spawn many grains in rapid succession, each from a slightly different position in the source buffer, and let them overlap. Your ear can't resolve individual grains below about twenty per second, so above that rate the grains fuse into a continuous texture.

Four variables define how that texture sounds. **Grain size** — how long each grain is — controls whether you hear something pad-like (longer grains, more of the original sample audible in each) or percussive (shorter grains, each heard as a pointillistic click or pluck). **Density** — how many grains spawn per second — controls whether the result sounds sparse and rhythmic (low density, grains heard as discrete events) or smooth and continuous (high density, grains overlapping into a wash). **Position** — where in the source audio each grain is sliced from — lets you hold a single moment of the source or scan through it at any speed you like, including backwards. **Pitch** — the per-grain transposition — lets you shift the perceived pitch of the resynthesized sound without changing how fast the position scans, because each grain is short enough that the pitch-shift is effectively instantaneous.

Those four knobs are the heart of every granular patch ever made. Every other granular control — jitter, spread, window shape, trigger patterns, modulation — is a variation or a decoration on top of them.

The technique was first theorized by the physicist Dennis Gabor in 1947, in a paper called *Theory of Communication*. Gabor wasn't a composer; he was working on a mathematical decomposition of signals into elementary time-frequency atoms. Musically, the technique was first put into practice by Iannis Xenakis in the late 1950s — he assembled grain sequences by hand, cutting and splicing magnetic tape, because no computer of the era could do it in real time. Curtis Roads wrote the software implementations that made granular synthesis practical on computers in the 1970s and 1980s, and his book *Microsound* (2001) remains the canonical reference.



The diagram above shows a source waveform (the piano note) with three grain windows overlaid at different positions. Each grain takes a small slice of the source and multiplies it by a smooth envelope that fades in and out. The grains overlap each other, and the listener's ear blends them into a continuous texture.

5.3 In Grainulator

Everything above maps directly to controls on the [GRAIN tab](#):

- **Size** sets the grain length, from 1 ms (so short you hear each grain as a click or as its own pitch) to 500 ms (so long it sounds almost like the original sample playing). Most musical pad textures live in the 30–200 ms range.
- **Density** sets how many grains spawn per second. At low values (below about 10 Hz) you hear discrete grain events — useful for rhythmic, pointillistic patches. Above about 20 Hz the grains fuse into a continuous wash; above about 100 Hz the grain-spawn rate itself starts to be heard as pitch.
- **Pitch** transposes each grain up or down by a number of semitones at the moment it spawns. Because grains are short, you can pitch-shift them dramatically without the time-stretching artifacts you'd hear from pitch-shifting the entire sample in real time.
- The position cursor on the [waveform display](#) sets where in the source audio each grain is sliced from. Hold the cursor still and you get a "frozen" sound at one moment of the source. Sweep it with the **Speed** knob, or modulate it from the MOD tab, and you scan through the source in time.

The [TEXTURE tab](#) adds the window shape that each grain is multiplied by — Hanning for smooth pads, Trapezoid or Pluck for percussive attacks — plus pitch-variation and scan controls that modulate the core four parameters over time. The [MOD tab](#) lets you route any of those parameters to an LFO, envelope, or clock-synced rhythmic source to put the whole patch into motion.

The math, for the curious

A grain is a finite-length signal $\{g(n)\}$ formed by multiplying a source signal $\{s(n)\}$ by an envelope window $\{w(n)\}$:

$$g(n) = s(n_0 + n) \cdot w(n), \quad 0 \leq n < L$$

where L is the grain length in samples and n_0 is the read position in the source buffer. The window function $\{w(n)\}$ is typically a Hann or Tukey window — smooth at both ends so that the product of source-times-window fades in and out without an audible click. The output of the granular synthesizer is the sum of many overlapping grains, each spawned at its own start time t_i :

$$y(n) = \sum_i g_i(n - t_i)$$

Density is the rate λ at which spawn times t_i are scheduled — either uniformly (every $1/\lambda$ seconds) or stochastically (Poisson-distributed around a mean rate of λ). **Pitch shifting** is implemented by reading the source buffer at a different speed inside each grain: a per-grain resampling that doesn't affect the overall playback rate, because each grain is short enough that the resampling is inaudible as a time stretch.

Curtis Roads' *Microsound* (MIT Press, 2001) derives all of this formally, connects it to the Fourier-style time-frequency decomposition Gabor originally proposed, and is the canonical reference for anyone who wants to dig further.

5.4 Further reading

- **Microsound**, Curtis Roads (MIT Press, 2001) — the definitive book on granular synthesis theory and practice.
- **Theory of Communication**, Dennis Gabor (Journal of the Institution of Electrical Engineers, 1946) — the original mathematical paper that introduced the grain concept.
- **Formalized Music**, Iannis Xenakis (Indiana University Press, 1971) — the first composer to put the theory to musical use writes about it in his own words.

5.5 See also

- [GRAIN tab reference](#)
- [Your First Patch](#) — apply this theory in ten minutes.

6. Header Bar

The header bar runs across the top of the Grainulator window. It holds the preset browser, transport, host-sync toggle, and (in compact layouts) the layer selector and tab navigation.

6.1 Preset browser

At the center of the header bar is the **preset browser**:

- **← / →** — step to the previous or next preset.
- **Name** — click to open a searchable list of factory and user presets.
- **Save** — write the current patch as a user preset (`.gv2p` file).
- **Init** — load the default "init" preset.

User presets are stored in the application support directory and are shared between the standalone app and the plugin formats.

6.2 Transport

- **Play / Stop** — toggles global playback. Behavior depends on the play mode (see below).
- **SYNC** — a toggle that locks grain density, LFO rate, and delay time to the host's tempo. In the standalone app the toggle is disabled; in a DAW it follows the host transport.

6.3 Play mode

Grainulator has two play modes:

- **Free** — grains spawn continuously as long as a layer is enabled. The Play button drives playback.
- **Instrument** — grains spawn only while MIDI notes are held, and each note sets the root pitch for the layer.

The play-mode toggle is available from the header settings menu and from any MIDI-control panel on the SYNTH tab.

6.4 Layer selector

In compact layouts (AU plugin and iPhone), only one layer's controls are visible at a time. A **Layer 1 / Layer 2** segmented control in the header (or at the top of the GRAIN panel in the full layout) switches the visible layer. The selector is highlighted in the current layer's accent color.

Internally, Grainulator calls these "voices" (parameter names start with `v1` or `v2`), but the UI uses "Layer" everywhere a user sees them.

6.5 Tab navigation

The **GRAIN**, **TEXTURE**, **SYNTH**, **FX**, and **MOD** tab buttons sit beneath the header bar. Click a tab to switch the main panel view. The MOD tab is always visible, even in layouts that collapse other panels, so the modulation matrix is reachable from anywhere.

6.6 See also

- [Waveform Display](#)
- [Layer System](#)

7. Waveform Display

The waveform display sits beneath the header bar and shows the loaded audio sample together with the current grain activity. In the full (two-row) layout there are **two** waveform displays side by side — one for each layer. In compact layouts the selected layer's display is shown full width.

7.1 What you see

- **Stereo waveform** — the loaded sample drawn as a pair of channels.
- **Position cursor** — a vertical line marking the current grain spawn position in the buffer.
- **Active grain dots** — each currently sounding grain is drawn as a small dot over the waveform. The horizontal position encodes the grain's position in the buffer; the vertical position encodes pan; the brightness encodes amplitude.
- **Trim handles** — a pair of bars at the left and right edges of the audible region. Hover the waveform to reveal them; drag to set the loop in / out points. Double-click a handle to reset that side to the buffer edge. The handles auto-reset when you load a new sample or enter Live recording mode.
- **Freeze button** — captures the current buffer state so you can scroll the position freely without the playhead advancing (useful for holding a specific moment for manipulation).
- **Layer-link toggle** — on Layer 2's waveform display only, a chain icon toggles whether Layer 2 uses its own buffer (independent) or shares Layer 1's buffer.

7.2 Loading a sound

You can load an audio file three ways:

1. **Drag and drop** an audio file onto the waveform display.
2. **Click** anywhere on the waveform display to open a file browser.
3. **Use the Load menu** in the header (in full layout) or the layer's context menu (right-click / long-press).

Supported formats include WAV, AIFF, FLAC, MP3, and Ogg Vorbis. Files at any sample rate are automatically resampled to the current app or host sample rate on a background thread, so loading a 48 kHz file into a 44.1 kHz session plays back at the correct pitch.

Clear Audio

The per-layer context menu (right-click on a waveform display, or long-press on iPad) includes a **Clear Audio** item. Selecting it empties that layer's buffer and resets its trim handles. Useful when you want to disarm a layer without unloading the preset.

7.3 Setting the position

Click and drag on the waveform to scrub the grain spawn position manually. In Free play mode the position advances according to the Speed parameter; drag sets it explicitly. In Instrument play mode, the position advances only while notes are held.

7.4 See also

- [Header Bar](#)
- [Layer System](#)

8. Layer System

Grainulator has two independent **layers**, Layer 1 and Layer 2. Each layer has its own audio buffer, grain engine, window shape, pitch variation, filter, resonator, sub oscillator, and envelopes. The two layers share the global effects chain (delay, reverb, compressor, master filter) and the modulation matrix.

Internally the code calls these "voices" and parameter names begin with `v1 / v2`, but the UI and this manual use "Layer 1" / "Layer 2" throughout.

8.1 What each layer owns

Truly per-layer controls — independent between Layer 1 and Layer 2 — live on the GRAIN and TEXTURE tabs:

- Grain core (size, density, pitch, speed, jitter, spread, pan, level)
- Window shape, window morph, decay
- Pitch variation (probability, mode, direction, range)
- Dynamics randomisation
- Reverse probability
- Scan rate / depth
- Loop points, freeze state
- The per-layer filter (model, cutoff, resonance, drive, env depth)

On the SYNTH tab, only **Root 1** and **Root 2** are truly independent. The Resonator, Sub Oscillator, VCA envelope, Filter envelope, and Glide are all **global**: they are mounted in the UI via Layer 1's parameters, and any change applies to both layers. This is a v2-era simplification — the per-layer parameter slots still exist in the preset format for backward compatibility, but the audio engine runs a single shared instance.

See the SYNTH tab page for details.

8.2 What is shared between layers

The following are global and affect both layers together:

- SYNTH panel: resonator, sub oscillator, VCA / filter envelopes, glide
- FX chain: master filter, compressor, delay, reverb
- Master gain, dry/wet
- Modulation matrix (each lane can be targeted at a specific layer)
- Macro knob (the hero Morph control on the GRAIN tab)

8.3 Buffer modes

A **Link** toggle on Layer 2's waveform display controls whether the two layers share one audio buffer or use independent ones:

- **Independent** (unlinked) — each layer loads its own sample. Dropping a file onto Layer 1's waveform fills Layer 1; dropping onto Layer 2's waveform fills Layer 2.
- **Linked** (shared) — Layer 2 reads from Layer 1's buffer. Loading a new sample into Layer 1 updates both layers. Useful for building dense textures from a single source.

In linked mode, Layer 2 still has its own grain parameters — it's only the underlying audio that is shared.

8.4 Enabling and muting layers

Each layer has a power toggle that disables it entirely (no grains spawn, no CPU spent). Mute and solo buttons provide quick in-session silencing without resetting the layer.

8.5 Switching layers in compact mode

In the full two-row standalone layout, both layers' controls are visible side by side. In the compact AU or iPhone layout, only one layer's controls are visible at a time and the **Layer 1 / Layer 2** segmented control in the header bar switches the view. Changing layers never stops playback — both layers keep running, you are only changing what is visible for editing.

8.6 See also

- [Header Bar](#)
- [Waveform Display](#)

9. GRAIN Tab



The GRAIN tab is Grainulator's default view and the heart of the granular engine. The desktop layout shows **both layers side by side, all the time** — there is no layer-focus toggle. From left to right the tab is:

- **LAYER 1** panel — Layer 1's grain core, per-layer Morph, and per-layer filter, stacked top-to-bottom.
- **LAYER 2** panel — the same controls for Layer 2, independently set.
- **MASTER** panel — pans, faders, the global VU meter, and the Dry/Wet blend.

A pair of waveform displays sits above the panel row, one per layer. See [Waveform Display](#) for everything they do.

9.1 Per-layer panels

Layers 1 and 2 carry the same controls; setting them independently is how you build dual-source patches, call-and-response textures, and layered pads. Each panel has three sub-sections — **GRAIN**, **MORPH**, and **FILTER** — stacked from top to bottom.

GRAIN sub-section

Eight knobs in two rows of four drive the granular engine.

Control	Range	Description
Size	0.001-1.5 s	Duration of each grain. Short sizes give choppy, rhythmic textures; longer sizes produce smooth, pad-like tones. Latched at grain spawn.
Density	1-512 Hz	Grain spawn rate. Higher values create denser, overlapping clouds; lower values leave sparse, audible gaps.
Pitch	-24 to +24 st	Transposes each grain in semitones. Applied at spawn time, so moving it re-pitches only new grains.
Speed	-3 to +3 (displayed as %)	Internal playback speed multiplier. Negative values play in reverse; values outside ± 1 combine with Pitch for extreme time-stretch effects. Displayed as a percentage (100 % = 1.0). Latched at grain spawn.
Jitter	0-0.5 s	Random offset added to each grain's start position. Small amounts humanize the stream; larger amounts scatter grains across the buffer.
Spread	0-1	Stereo spread of grain pan. 0 is mono, 1 is full L/R separation.
Level	-70 to +12 dB	Per-layer grain level. Mirrors the layer fader in the MASTER panel — moving one moves the other.
Morph	0-1	Per-layer macro that simultaneously moves every assigned morph target. 0 leaves parameters at their base values; 1 drives them to their configured target values. Targets and depths are configured from the gear button in the MORPH strip.

Size and **Density** interact: their product is roughly the overlap. At 100 Hz with 50 ms grains you have ~5 grains at once — a continuous drone. Drop density to 5 Hz and you hear each grain individually. **Jitter** then breaks up machine-gun periodicity.

MORPH strip

Below the eight grain knobs sits the per-layer **Morph LFO** strip — an LFO that automates the **Morph** knob above. The two together are how a single layer evolves over time without any MOD lane assignment.

Control	Range	Description
ON	toggle	Enables the Morph LFO for this layer. Off = the Morph knob is static.
Wave	Sine / Triangle / Saw / Square / S&H	LFO shape, picked from the inline wave-selector buttons.
SYNC	toggle	When on, the rate snaps to the host tempo at the configured division. When off, Rate is in Hz.
Rate	0-20 Hz (free) / 1/32 - 1/1 (synced)	LFO speed. Very slow rates (below 0.1 Hz) work well for long evolving pads.

A horizontal bar beneath the controls visualises the live LFO output across each assigned target.

The gear button at the top right of the MORPH strip opens the morph settings popup, where you assign which parameters the **Morph** knob drives and at what depth.

FILTER sub-section

The FILTER row is the **per-layer** filter, upstream of the global master filter on the [FX tab](#). Only the tone-shaping controls live here; the filter envelope (ADSR and Env Depth) is on the [SYNTH tab](#).

Control	Range	Description
Filter Model	10 models	Dropdown selector: Stilson, Microtracker, Krajeski, MusicDSP, Oberheim, Improved, RKSimulation, Hyperion, DaisyLadder, CytomicSVF. Each model has a distinct saturation and resonance character. Defaults to CytomicSVF.
Cutoff	20 Hz - 20 kHz	Filter cutoff frequency.
Reso	0-1	Resonance amount at the cutoff. High settings self-oscillate on some models.
Drive	0-1	Input drive into the filter stage. Adds saturation and harmonic content, especially at higher resonance.

Layer header

Each layer panel's header shows **LAYER 1 GRAIN / LAYER 2 GRAIN** and a small activity indicator. The indicator lights when any grain is sounding on that layer — a quick way to verify a layer is producing audio without watching the meters.

9.2 MASTER panel

The Master panel sits to the right of the two layer panels. It moved here from the FX tab in the 2026-04-07 layout revision so layer balance and wet/dry are always visible on the default view.

Control	Range	Description
Layer 1 Pan	-1 to +1	Stereo pan for Layer 1.
Layer 2 Pan	-1 to +1	Stereo pan for Layer 2.
Layer 1 Level	-70 to +12 dB	Layer 1 vertical fader. Mirrors the Level knob in Layer 1's GRAIN row.
Layer 2 Level	-70 to +12 dB	Layer 2 vertical fader. Mirrors the Level knob in Layer 2's GRAIN row.
Master VU meter	—	Stereo meter on the master output (post layers, post wet/dry).
Wet/Dry	0-1	Global wet/dry balance between the granular output and the dry input.

The faders carry small tick marks at common reference levels ($-\infty$, -12, -6, 0, +6) so you can balance two layers by feel.

9.3 Dual waveform display

Above the panel row, the GRAIN tab draws **two waveform displays side by side**, one per layer, each with its own position cursor, active-grain dots, freeze button, and trim handles. Layer 2's display also carries the layer-link toggle for switching between shared and independent buffers. See [Waveform Display](#) for the full treatment.

9.4 See also

- [Waveform Display](#)
- [Layer System](#)
- [TEXTURE Tab](#)
- [SYNTH Tab](#) — Spectral, Voice Interaction, resonator, sub, envelopes
- [FX Tab](#)

10. TEXTURE Tab



The TEXTURE tab shapes the *character* of each grain once the GRAIN tab has decided how big, how dense, and from where in the buffer it reads. Everything here is per-layer — Layer 1 and Layer 2 each have their own independent TEXTURE settings. The tab is organised into five columns: **Shape**, **Pitch**, **Dynamics**, **Reverse**, and **Scan**.

10.1 Shape — Grain Window

Every grain has an amplitude envelope ("window") applied on playback. The window determines whether grains sound smooth and pad-like, punchy and percussive, or plucked and decaying. A live preview above the knobs shows the current shape; tweaking Tilt, Curve, or Sides updates it in real time.

Control	Range	Description
Window Shape	Hanning / Gaussian / Trapezoid / Triangle / Tukey / Pluck / PluckSoft / ExpDecay	Base envelope shape applied to every grain.
Tilt	0 - 1	Shifts the envelope peak earlier or later within the grain. 0.5 is symmetric.
Curve	0 - 1	Bends the attack and release slopes between linear and exponential.
Sides	0 - 1	Softens or sharpens the edges of the window (trapezoid / Tukey plateau width).
Decay	1 - 10	Exponent for the Pluck / PluckSoft / ExpDecay shapes. Higher = faster fall-off.

Hanning and Gaussian give the smoothest, most classical granular sound. Trapezoid and Triangle produce punchier, more rhythmic grains. Pluck, PluckSoft, and ExpDecay give each grain a struck-string envelope that is great for pitched percussion and pointillist textures.

Morph

A **MORPH** toggle lets the window crossfade between two shapes over time. When enabled, a second dropdown (Window B) and two extra knobs appear.

Control	Range	Description
Window B	same 8 shapes as Window Shape	Target window for the morph.
Morph	0 - 1	Static crossfade position between Window A and Window B.
Rate	0 - 20 Hz	Automatic morph LFO speed. 0 = static (use the Morph knob manually), higher values cycle between A and B.

10.2 Pitch Variation

Pitch Variation re-tunes individual grains at spawn time to add harmonic richness, arpeggios, or scale-snapped generative melodies. It stacks on top of the base Pitch knob on the GRAIN tab. Only grains that "win" the Probability dice roll are re-pitched.

Control	Range	Description
Prob	0 - 100 %	Chance that a new grain is re-pitched. 0 % = always use base pitch, 100 % = every grain.
Mode	Octaves / Oct+5ths / Scale	Octaves picks random octave transpositions; Oct+5ths adds perfect fifths; Scale snaps grains to a musical scale.
Direction	Both / Up / Down	Constrains variation to move only upward, only downward, or in either direction from the base pitch.
Range	1 Oct / 2 Oct / 3 Oct	Maximum transposition distance.

In Scale mode an additional scale preset (0-11) selects the quantisation scale used to snap re-pitched grains. The preset is set in the pitch-variation engine rather than from a top-level knob.

Note: **Glide** (pitch smoothing between notes) was previously shown here but is now on the SYNTH tab's MIDI panel.

10.3 Dynamics

Dynamics randomises each grain's amplitude at spawn, adding natural breathiness or aggressive volume jitter depending on the Range setting. The base grain level itself lives on the GRAIN tab (**Level**); this section only adds variation on top of it.

Control	Range	Description
Probability	0 - 100 %	Chance that a grain's amplitude is randomised.
Range	0 - 1	Maximum amplitude deviation. 0 = no change, 1 = grains can be fully attenuated.

10.4 Reverse

Control	Range	Description
Probability	0 - 100 %	Chance that a grain plays backward. 50 % gives an even mix of forward and reversed grains; 100 % reverses every grain.

Because only the *grain's* playback direction flips — not the source buffer — Reverse works with any position, speed, or loop setting and can be modulated for rhythmic forward/backward effects.

10.5 Scan

Scan applies a slow position LFO to the grain spawn point, sweeping through the buffer over time. Combine with a static Position knob on the GRAIN tab to drift around a focal point, or with Speed 0 to replace static freezing with gentle motion.

Control	Range	Description
Rate	0 - 5 Hz	Speed of the scan LFO. 0 disables scanning.
Depth	0 - 0.5	Amount of buffer traversed by the LFO, as a fraction of the whole file. 0.5 covers half the buffer peak-to-peak.

10.6 See also

- [GRAIN Tab](#)
- [SYNTH Tab](#)
- [Layer System](#)

11. SYNTH Tab



The SYNTH tab gathers the traditional-synthesis elements that sit on top of the granular core: the two **Spectral Array Oscillator (SAO)** columns — per-layer phase-vocoder synths — a **Voice Interaction** panel between them for cross-layer routing, a **Sub Oscillator**, and the **VCA and Filter envelopes** that shape each played note. The **Resonator** lives on the SYNTH tab in compact layouts and elsewhere in the desktop layout; see the section below.

Unlike the GRAIN tab — where every knob edits one layer at a time — most of the SYNTH panels drive a single shared engine. The Sub Oscillator, VCA envelope, Filter envelope, and Glide are **global**: they are mounted in the UI via Layer 1's parameters and any change applies to both layers. The two **Spectral** columns are genuinely per-layer — Layer 1 and Layer 2 each have an independent Spectral Array Oscillator. Only **Root 1** and **Root 2** under MIDI are genuinely independent per layer.

11.1 Spectral panel (Spectral Array Oscillator)

Each layer has its own **Spectral Array Oscillator (SAO)** column that sits at the head of the SYNTH tab — Layer 1's panel on the left, Layer 2's on the right, with the Voice Interaction panel between them. The SAO is a phase-vocoder-based synth that captures or generates a spectral frame and then re-tunes, re-shapes, and re-pitches it. It is **MIDI-responsive and polyphonic** — held notes drive multiple voices through a single SAO instance.

Top toggles

A row of three toggles runs along the panel header:

Toggle	Behaviour
ENABLE	Master power for the Spectral panel. Off bypasses the SAO entirely and consumes no CPU.
SAO	Switches between Spectral Array Oscillator mode (synth-style polyphonic re-pitch driven by MIDI) and the simpler frame-pass mode. SAO mode is the default for melodic playing.
FREEZE	Captures the current spectral frame and holds it. Useful for sustaining a moment of the source under polyphonic re-pitch.

8-step pitch grid

Beneath the toggles, an **8-step pad row** displays the SAO's pitch sequence — each cell shows where in the spectral frame the next voice will read. The grid scrolls under polyphonic activity; the active cell is highlighted in the layer's accent color (orange for Layer 1, green for Layer 2). The current center pitch (e.g. **A2**, **G#4**) and its frequency are displayed alongside the grid.

Knobs (top row)

Three knobs above the FMT toggle shape the spectral frame's pitch and balance:

Control	Range	Description
Focus	-1 to +1	Sharpens or softens which partials are emphasised in the spectral frame. Negative values broaden the spectrum; positive values concentrate energy on the strongest partials.
Transpose	-24 to +24 st	Pitch offset applied to the entire spectral frame in semitones. Independent of MIDI note tracking.
Tilt	-1 to +1	Tilts the spectrum: negative darkens (rolls off highs), positive brightens (rolls off lows).

FMT toggle

A **FMT – PITCH BOTH** segmented toggle sits between the two knob rows. It controls how MIDI notes interact with the spectral frame:

State	Behaviour
FMT	Formant-only — incoming notes shift formants without changing fundamental pitch.
PITCH	Pitch-only — notes re-pitch the frame without preserving formants.
BOTH	Both formant and pitch track the played note. The default — the most "synth-like" behaviour.

Knobs (bottom row)

Control	Range	Description
Clarity	0-1	Removes noise and softens artifacts in the spectral frame. Higher values produce a cleaner, more pitched tone at the cost of texture.
Partials	0-1	Number of harmonic partials retained, as a fraction of the available bins. Lower values produce thinner, more focused tones; higher values include more harmonic detail.
Scan	0-1	Position scan through the spectral frame buffer. At 0 the SAO reads the captured frame; turning Scan up sweeps through earlier frames in the buffer for textural movement.

Capture / Clear

Two buttons at the bottom of the panel control the spectral frame:

- **Capture** — grabs a snapshot of the live grain output as the new spectral frame. Press while audio is playing through the layer to load fresh material into the SAO.
- **Clear** — wipes the captured frame and returns to silence until the next capture.

The captured frame is per-layer and is saved with the preset.

11.2 Voice Interaction panel

Sits between the two Spectral columns. Replaces the former **MASTER · XMOD** panel in v20+. Three knobs drive categorically different cross-voice effects — **Follow** (time-domain source coupling), **Vocode** (spectral envelope transfer), and **Duck** (amplitude sidechain) — governed by a shared direction switch and a power toggle that bypasses the whole section.

An animated bus indicator above the direction switch visualises current effect amount (line thickness) and routing (flow direction of the travelling dots). In **Both** mode the dots follow whichever layer is louder at the moment.

Direction

One 3-state segmented control governs all three knobs:

State	Behaviour
V1 → V2	Layer 1 is driver; Layer 2 is follower. All three knobs affect Layer 2 only.
V1 ↔ V2 (Both)	Mutual / symmetric. Each layer acts on the other with the same knob amounts.
V2 → V1	Layer 2 is driver; Layer 1 is follower.

Knobs

Control	Range	Description
Follow	0-1	The follower layer's granular engine reads the driver's live post-grain audio instead of its own loaded buffer. At 1 the follower is fully tracking the driver's output; at 0 it plays its own buffer (default). The follower's Position knob is reinterpreted as ring-buffer age — 0 = newest, 1 = oldest (~2 s back). Grain size, pitch, and speed still work inside the live source. In Both mode, a one-block latency prevents feedback.
Vocode	0-1	True spectral vocoding. The driver's mean-normalised spectral envelope multiplies the follower's bin magnitudes. At 1 the follower adopts the driver's timbral/formant contour while keeping its own harmonic content. Loudness-preserving — the mean normalisation stops the follower from getting quiet when the driver is sparse. This replaces the old X-Mod enhancer, which was a subtle per-bin boost; Vocode is categorically different.
Duck	-1 to +1	The driver's amplitude envelope modulates the follower's output gain. Negative = classic sidechain duck (follower dips when driver is loud). Positive = "swell" / shadow (follower amplifies with the driver). 0 is bypass. Attack ≈ 3 ms, release ≈ 150 ms, hard-coded in v20. Read from pre-duck envelopes so mutual ducking in Both mode is feedback-safe.

Power toggle

The power icon in the panel title stripe hard-bypasses the entire section. Use it to A/B the contribution of Voice Interaction without resetting all three knobs.

Mod routing

All three knobs are available as mod destinations under a new **Voice FX** category on the [MOD tab](#). The direction switch and power toggle are not modulatable (they're discrete state), but their param values round-trip cleanly through preset save/load and DAW automation.

Preset upgrade from v19 and earlier

Presets saved in v19 with a non-zero X-Mod value are automatically upgraded on load: **Vocode** is seeded to $\max(V1 \text{ X-Mod}, V2 \text{ X-Mod})$, direction is set to **Both**, and the section is enabled. The legacy per-layer X-Mod params are retained in the enum as no-ops so old mod-lane routings do not produce errors — their destination menu entry now reads **(Legacy)**.

11.3 Resonator

A global resonant body based on the Mutable Instruments *Rings* DSP. When **Enable** is off the resonator is bypassed and consumes no CPU. A small live preview next to the panel visualises the current harmonic structure.

Control	Range	Description
Enable	on / off	Bypass the resonator entirely. Default off.
Polyphony	1 / 2 / 3 / 4	Number of simultaneous resonator voices. Higher values give richer chords at higher CPU cost.
Chord	0-1	Harmonic structure. Sweeps through chord qualities and inharmonicities (internal name: <i>Structure</i>).
Bright	0-1	Brightness — the balance of upper partials. Higher values add treble and shimmer.
Damp	0-1	Damping / decay time of the resonance. Low = short ping, high = long ring.
Scatter	0-1	Modal position / excitation point. Shifts the harmonic balance (internal name: <i>Position</i>).
Note	0-127 (MIDI)	Center pitch of the resonator. Displayed as a note name.
Mix	0-1	Dry/wet blend between the pre-resonator signal and the resonator output.
Distort	0-1	Drive / saturation inside the resonator feedback path.
Polarity	Saw / Square	Feedback polarity of the resonator. Saw is positive feedback (softer, vowel-like); Square is negative feedback (hollow, square-wave character).

The Resonator runs post-grain, so its pitch follows the grain material by default. Lower **Mix** values keep the grains in front; crank it toward 1 to turn the plugin into a pure physical-modelled voice.

11.4 Sub Oscillator

A global monophonic sub that tracks the played note and thickens the low end. Set **Level** to 0 to disable.

Control	Range	Description
Level	0-1	Output level of the sub. 0 silences it.
Note	0-127 (MIDI)	Base pitch of the sub when no MIDI note is playing (Free mode), or the reference pitch in Instrument mode. Displayed as a note name.
Wave	Sine / Tri / Saw / Sqr	Oscillator waveform. Sine is pure, Triangle is soft, Saw and Square (both band-limited) add harmonics.
Octave	-2 / -1 / 0	Octave offset relative to the played note.

11.5 VCA Envelope

A global ADSR that shapes the amplitude of every played note. In **Instrument** play mode the envelope retriggers on each note-on; in **Free** mode it effectively holds at sustain while the global transport is running.

Control	Range	Default	Description
A (Attack)	0.001–3 s	1 ms	Time from note-on to peak level.
D (Decay)	0.001–5 s	1 ms	Time from peak down to the sustain level.
S (Sustain)	0–1	1.0	Level held while the note is active.
R (Release)	0.001–5 s	300 ms	Time to fade to silence after note-off.

11.6 Filter Envelope

A second ADSR that modulates the per-layer filter cutoff. The filter itself — model, cutoff, resonance, drive — lives on the **GRAIN** tab FILTER column, along with the bipolar **Depth** knob that scales how much of this envelope reaches the cutoff.

Control	Range	Default	Description
A (Attack)	0.001–3 s	10 ms	Time from note-on to peak envelope level.
D (Decay)	0.001–5 s	100 ms	Time from peak to sustain.
S (Sustain)	0–1	1.0	Level held while the note is active.
R (Release)	0.001–5 s	100 ms	Time to fade after note-off.

With **Depth** at 0 the envelope has no effect. Push it positive to open the filter on note-on and let it close back toward the static cutoff; push it negative to invert the shape.

11.7 MIDI Control

Grainulator has two play modes, selected in the header settings popup:

- **Free** — the global transport runs grains continuously; MIDI notes are ignored for pitch.
- **Instrument** — note-on / note-off gate the VCA and filter envelopes, and incoming notes transpose the grain pitch relative to the layer's root note.

The MIDI panel in the SYNTH tab exposes three knobs:

Control	Range	Default	Description
Root 1	0–127 (MIDI)	60 (C3)	Root note for Layer 1 . When you play this MIDI note in Instrument mode, Layer 1 plays its source at unshifted pitch.
Root 2	0–127 (MIDI)	60 (C3)	Root note for Layer 2 , independently settable.
Glide	0–2 s	0 s	Portamento time between consecutive MIDI notes. Applied to both layers.

Both root-note knobs render their value as a note name (**C3**, **F#4**, ...) rather than a raw number, matching the **Note** knobs on the Resonator and Sub panels.

On every MIDI note-on in Instrument mode the engine calculates `note - root` for each layer and applies that offset on top of the **Pitch** knob from the GRAIN tab — so Layer 1 and Layer 2 can transpose against the same incoming note by setting different root values. The Resonator tracks the note offset from Layer 1's root as a single global reference.

Glide smooths pitch transitions between notes at the per-layer level; 0 disables portamento, 2 s gives a long, slow slide. It applies equally to both layers.

11.8 See also

- [GRAIN Tab](#) — the per-layer filter (model, cutoff, resonance, drive, envelope depth) lives there
- [MOD Tab](#) — route LFOs, envelopes, and step sequencers to resonator, sub, and envelope parameters
- [Layer System](#)

12. FX Tab



The FX tab holds Grainulator's post-mix effects chain. Everything on this tab is **global** — both layers are already summed by the time the signal arrives, so there is no per-layer FX. Signal flows strictly left to right: **Master Filter** → **Compressor** → **Delay** → **Reverb**.

The master mixing controls — Layer 1 / Layer 2 faders, pans, and Wet/Dry — used to live on FX but were relocated to the [GRAIN](#) tab MASTER column in the 2026-04-07 layout update.

12.1 Master Filter

A single post-mix filter stage applied before the compressor. The filter bypasses itself automatically when **Cutoff** is wide open (20 kHz) and **Drive** is 0, so a fully-open setting costs nothing.

Control	Range	Description
Model	10 models	Filter topology: Stilson, Microtracker, Krajeski, MusicDSP, Oberheim, Improved, RKSimulation, Hyperion, DaisyLadder, CytomicSVF. Defaults to CytomicSVF. Same bank as the per-layer filter on the GRAIN tab.
Cutoff	20 Hz - 20 kHz	Global filter frequency (log-scaled).
Reso	0-1	Resonance at cutoff. High values add a singing, whistling character to the full mix.
Drive	0-1	Saturation applied alongside the filter. Adds warmth and gentle compression even with cutoff wide open.

12.2 Compressor

A feed-forward log-domain compressor (Giannoulis / Massberg / Reiss 2012) with stereo-linked peak detection, a fixed 6 dB soft knee, and an optional soft-knee limiter. The character is clean and transparent — this is a glue/bus compressor, not a coloration effect. A live gain reduction meter next to the knob grid shows how hard the detector is working. All six continuous knobs read 0-1 on the UI; the ranges in the table are the mapped musical values.

Control	Range	Description
ON	on/off	Master bypass for the compressor stage. Click-free. Default on .
Thresh	-60 to 0 dB	Level above which gain reduction starts. Default ≈ -3 dB (very light touch).
Ratio	1:1 to 20:1	Amount of reduction above the threshold. Default $\approx 4:1$.
Atk	0.1 - 100 ms (log)	How quickly the envelope follower reacts to peaks. Short attacks catch transients; long attacks let them through for punch.
ReL	10 - 1000 ms (log)	How quickly gain recovers after a peak.
Makeup	0 - +40 dB	Output gain added after compression to compensate for reduction.
Mix	0-1 (dry→wet)	Parallel-compression blend. At 1.0 the signal is fully compressed; lower values blend in the uncompressed signal for NY-style parallel compression. Default 1.0 (fully wet).
LIM	on/off	Post-compressor soft-knee limiter. Transparent below ± 0.9 (linear passthrough), then a smooth \tanh -shaped rolloff asymptotic at ± 1.0 (0 dBFS). No hard clipping, no square-wave fold, no aliased harmonic breakup when the pre-limiter signal is well above 0 dBFS. Default on as a safety net.

The compressor only sees the wet signal; the dry path on the GRAIN tab's Dry/Wet mix skips it, so the unprocessed input is never compressed.

12.3 Delay

A stereo tape-style delay with independent L/R times, four routing modes, and two time-change behaviors. Feedback can be pushed above unity for self-oscillating runaways, and the infinite-loop toggle turns the delay into a captured loop.

Control	Range	Description
TimeL / TimeR	5 - 2730 ms	Delay time per channel (log-scaled).
Link	on/off	When on, TimeR follows TimeL. Turn off to set stereo offsets manually. Default on .
Feedback	0 - 1.25	Amount fed back into the delay line. Values above 1.0 are self-oscillating — use with care.
Mod Mode	Tape, Fade	How the delay reacts when its time parameter is changed. Tape re-pitches the tail as the read head moves (classic tape warp). Fade crossfades between old and new positions without pitch shift.
Mode	Dual, PingPong, Single, Cascade	Routing of the two internal delay lines. Dual : independent L/R. PingPong : L→R→L bouncing. Single : mono delay duplicated to both channels. Cascade : the two lines are chained in series for longer or more rhythmic echoes.
Tone	-1 to +1	Bipolar tone control on the delayed signal. Negative darkens (low-pass), positive brightens (high-pass).
Sat	0-1	Saturation drive inside the feedback loop. Adds warmth and iterative grit as feedback regenerates.
Sync	on/off	When on, delay times snap to host tempo. Uses Clock Div and Sync Offset .
Clock Div	1/4 - 4/1	Tempo division when Sync is on. Available values: 1/4, 1/3, 1/2, 2/3, 3/4, 1/1, 3/2, 2/1, 3/1, 4/1. Default 1/1 .
Sync Offset	-5 to +5	Integer offset from the selected clock division (steps in the divisor table) for swing and pushed/pulled feel.
Loop	on/off	Infinite-loop mode — the current delay buffer is captured and plays back indefinitely regardless of feedback.
Mix	0-1	Delay wet/dry blend for the delay stage itself (independent of the global Dry/Wet on GRAIN).

The two mode parameters are not duplicates. **Mode** is the **routing** between the two internal delay lines (Dual / PingPong / Single / Cascade). **Mod Mode** is the **time-change behavior**: Tape pitches the tail when you turn the time knob, Fade crossfades without pitch shift.

12.4 Reverb

The reverb panel has an **algorithm selector** that switches between three distinct reverb engines. The surrounding knobs (**Size**, **Damp**, **Width**, **Shimmer**, **Tone**, **Mix**, **Freeze**) are shared across all three algorithms — the UI layout never changes — but the underlying interpretation depends on which engine is active.

Algorithm selector

The three engines are named for their character, not their internal algorithm. Default is **Stormy**.

Algorithm	Engine	Character	Best for
Misty	Signalsmith Basics	Clean, modern, diffuse. No shimmer, no freeze behavior.	Transparent ambience, pads, realistic-sounding spaces where the reverb should get out of the way.
Cloudy	Mutable Rings (Griesinger)	Smooth, classic plate/hall tone with gentle modulation. No shimmer, no freeze behavior.	Warm vintage-style reverb on grain clouds and sustained textures.
Stormy	Oliverb (extended Griesinger/Dattorro)	Rich, heavily-modulated, with pitch-shift shimmer in the feedback loop and infinite freeze.	Shimmer pads, ambient tails, evolving textures, long drones. This is the default and the most Grainulator-like.

Common controls

Control	Range	Description
Size	0-1	Room size / decay length. All three engines scale decay time from this.
Damp	0-1	High-frequency damping in the feedback loop. Higher values make tails darker over time.
Width	0-1	Stereo width / diffusion. Maps to diffuser AP coefficients inside each engine.
Shimmer	0-1	Pitch-shift amount in the reverb feedback loop. Only audible on Stormy — mapped to approximately ± 12 semitones around a center-off point. Ignored by Misty and Cloudy.
Tone	-100 to +100	Bipolar post-reverb tone shelf. Negative darkens, positive brightens. Common to all engines.
Mix	0-1	Reverb wet/dry blend for the reverb stage. Default 0 — reverb is off until you turn it up.
Freeze	on/off	Captures the current reverb state and sustains it indefinitely. Only has effect on Stormy : input gain, damping, and high-pass are disabled so the tail holds forever. Misty and Cloudy ignore this toggle.

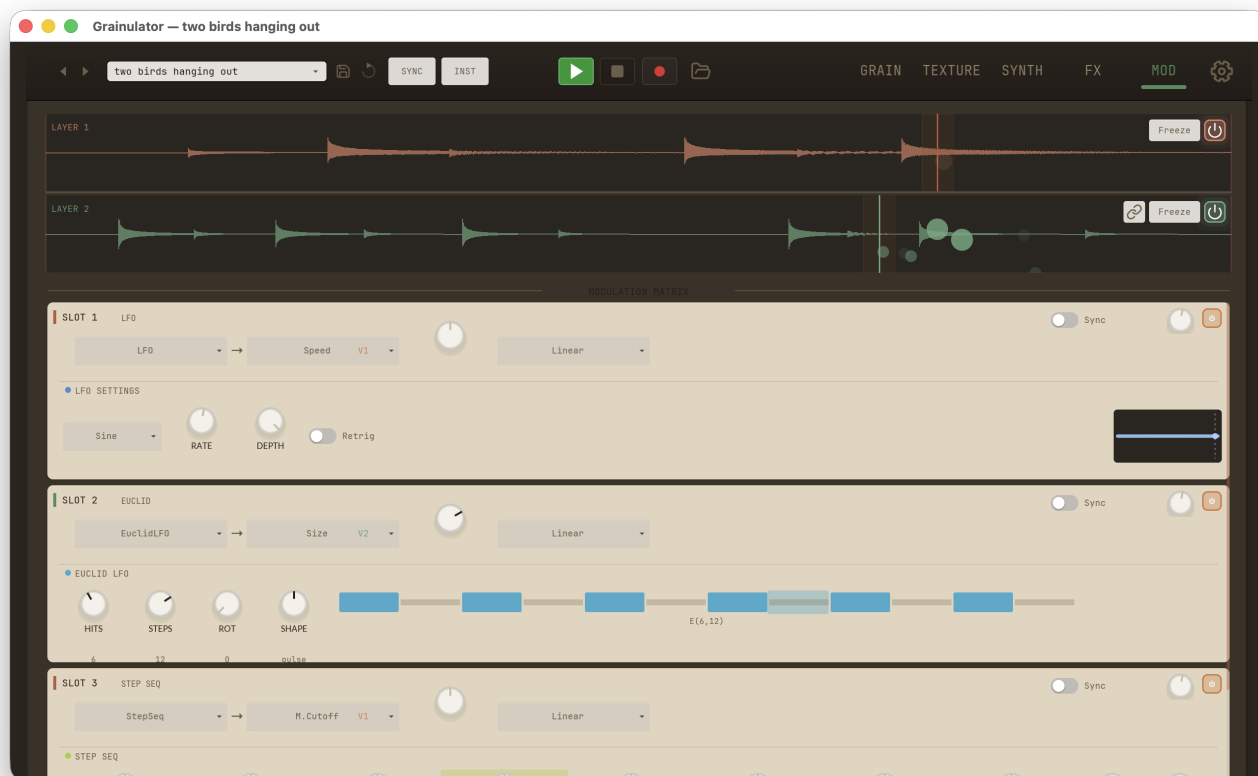
Notes on per-algorithm behavior

- **Stormy** is where the personality lives: nine random modulation LFOs scattered through the topology, a dual-tap pitch shifter per feedback branch, a HP filter to keep long tails clean, and an infinite freeze. Modulation rate and depth scale automatically with **Size**.
- **Cloudy** is the previous default — the Mutable Rings Griesinger reverb. Smooth and musical, without shimmer or freeze.
- **Misty** is the cleanest of the three; best when you want the reverb to feel like a natural space rather than an effect.
- Switching algorithms briefly clears the newly-selected engine's buffers, so you will hear the tail cut on switch.
- **Shimmer** and **Freeze** remain visible in all modes on purpose — they simply do nothing in Misty and Cloudy.

12.5 See also

- **GRAIN Tab** — master mixing (layer faders, pans, Wet/Dry) and the per-layer filter
- **TEXTURE Tab** — resonator and sub stages upstream of the FX chain

13. MOD Tab



The MOD tab is Grainulator's modulation matrix — five independent **lanes** that each pick a **source**, a **destination**, and a set of per-lane shaping controls. Because the MOD tab is always visible (including in the compact AU layout, where SYNTH / FX / MOD live in a tab strip at the top), every modulation assignment is reachable from any other view without losing your place on the GRAIN, TEXTURE, or FX tabs.

The UI labels each lane **SLOT 1**, **SLOT 2** ... through **SLOT 5**; this manual uses "lane" interchangeably with "slot" — they are the same thing.

Each lane carries its own LFO, ADSR envelope, Euclidean generator and 8-step sequencer, so you don't have to reserve a global resource to get movement on a single parameter. Sources cover LFOs, envelopes and two rhythmic generators added on 2026-04-05 — a clock-divided **Euclidean LFO** and a tempo-synced **step sequencer**. Destinations reach **45 active targets** covering the grain core, window, filter, resonator, spectral block, master filter, global effects, cross-voice interaction, and the compressor (plus one (**legacy**) slot retained for v19 preset compatibility — see [Destinations](#) below).

Mod lanes always respect the layer model. Each lane has a **Target** that picks which layer(s) it applies to, and the UI uses the **Layer 1 / Layer 2** naming throughout even though the underlying parameters are stored as `Voice 1 / Voice 2`.

13.1 Overview

Every lane exposes the same set of core controls:

Control	Description
Source	What drives the modulation. Per-lane LFO, envelope, Euclidean LFO, or step sequencer.
Dest	Which parameter is modulated. One of 45 targets grouped by category.
Amount	Bipolar scale from -1 to $+1$. Negative values invert the source.
Curve	Response shaping applied to the source before it hits the destination.
Target	Which layer(s) the modulation applies to: both, Layer 1 only, or Layer 2 only.
Enable	Lane on/off without having to reset Source or Dest .

The **Curve** menu offers nine shapes — **Linear**, **Exponential**, **Logarithmic**, **S-Curve**, **Stepped**, **RandomSmooth**, **Threshold**, **Inverted** and **Bipolar**. **Threshold** is particularly handy with the **Spectral Freeze** destination: it converts any bipolar source into a clean gate (1 above zero, 0 below).

13.2 Sources

The **Source** dropdown on each lane lists every available modulation source. The previous Macro / Velocity / Pressure entries are retained in the underlying parameter enum for preset compatibility but are hidden from the UI and produce zero output at runtime — the four live sources are described below.

Per-lane LFO

Classic free-running or tempo-synced LFO. Each lane has its own, so you never run out.

Control	Range	Description
LFO Shape	enum	Sine , Triangle , Saw , Square , Random , S&H .
LFO Rate	0.01-50 Hz	Free-running rate when the lane's Sync toggle is off.
LFO Depth	0-1	Output scale applied before Amount .
LFO Retrig	toggle	When on, the LFO resets to phase 0 on every MIDI note-on (Instrument mode). When off, the LFO runs free.

When the lane's shared **Sync** toggle is on the LFO is driven by the rhythmic clock described below and **LFO Rate** is ignored.

Per-lane envelope

A full ADSR envelope, one per lane. In Instrument mode it is triggered by MIDI note-on and released on note-off; in Free mode it triggers alongside the global play transport.

Control	Range	Description
Env A	0.001-10 s	Attack time from 0 to peak.
Env D	0.001-10 s	Decay time from peak to sustain.
Env S	0-1	Sustain level held while the note is active.
Env R	0.001-10 s	Release time after note-off.

Rhythmic sources (added 2026-04-05)

Two phase-driven generators share a single clock with the LFO. The clock can free-run at a Hz rate, or lock to host tempo at a musical division (1/32 through 1/1, straight / dotted / triplet), so all three time-based source types line up with the rest of your project.

Euclidean LFO distributes **Euc Hits** evenly across **Euc Steps** using Bjorklund's algorithm, rotates the pattern by **Euc Rot**, and renders each hit according to **Euc Shape**: at 0 each hit is a gate (square pulse), at 1 it's a ramp that decays linearly to zero over the step, and 0.5 sits between the two.

Step Sequencer plays back an 8-step pattern of bipolar slider values at the lane's clock rate. **Seq Len** truncates the sequence to anywhere from 1 to 8 active steps, and **Glide** slews between adjacent steps over a fraction of the step duration (0 = instant, 1 = full step slew). When the lane's **Dest** is **Pitch** the sliders snap to integer semitones and the hybrid pitch path emits a full ± 12 semitone range, bypassing the usual **Curve** and **Amount**.

Every rhythmic source shares the same 18 per-lane parameters:

Control	Range	Description
Sync	toggle	Lock this lane's clock to host tempo. Off = use Free Rate .
SyncDiv	0-15	Division index (1/32 → 1/1, including dotted and triplet variants). Used when Sync is on.
Free Rate	0.01-50 Hz	Free-running clock rate. Used when Sync is off.
Euc Hits	0-16	Number of active hits in the Euclidean pattern.
Euc Steps	1-16	Pattern length for the Euclidean LFO.
Euc Rot	0-15	Pattern rotation. Shifts which step the pattern starts on.
Euc Shape	0-1	Hit rendering: 0 = gate, 0.5 = pulse, 1 = ramp.
Step 0 ... Step 7	-1...+1	Eight bipolar step values for the sequencer. On pitch destinations they snap to integer semitones.
Seq Len	1-8	Active step count. Steps beyond the length are skipped and dimmed in the UI.
Glide	0-1	Fraction of step duration spent slewing between step values.
Reserved	—	Reserved for future use; has no effect.

One clock "cycle" is one full pass through the source's period — the Euclidean pattern's step count, or the step sequencer's length. A lane synced to 1/4 at 120 BPM therefore produces one full pass every two beats.

13.3 Destinations

Each lane's **Dest** dropdown lists 45 active modulation targets grouped by category, plus one **(Legacy)** slot retained for v19 preset compatibility. Per-layer destinations are routed through **Target**; global destinations (master filter, effects, Voice FX, compressor) ignore **Target**.

Group	Destinations
Grain	Position , Speed , Pitch , Size , Density
Window	Tilt , Curve , Morph Amt , Morph Rate
Filter	Cutoff , Resonance
Resonator	Chord , Brightness , Damping , Scatter , Mix , Note
Amplitude	Level , Pan , Spread
Master	M.Cutoff , M.Reso
Effects	Delay Mix , Reverb Mix , Reverb Size , Rev Freeze
Spectral	Transpose , Tilt , Frz Blend , Clarity , Focus , Freeze , Formant Mix , Partials , Peak Lock , (Legacy) , Scan
Voice FX	Follow , Vocode , Duck
Compressor	Comp Thresh , Comp Ratio , Comp Attack , Comp Release , Comp Makeup , Comp Mix

The **Voice FX** destinations drive the new [Voice Interaction panel](#) on the SYNTH tab — see that section for what each target does. The **(legacy)** slot under Spectral is the former x-Mod destination, retained so mod-lane routings in pre-v20 presets round-trip; it has no DSP effect in v20+.

13.4 Layer targeting

Each lane's **Target** picks which layer(s) the lane applies to:

Value	Behaviour
Both	Apply to both layers.
Voice 1	Apply only to Layer 1.
Voice 2	Apply only to Layer 2.

The underlying enum labels still read `voice 1` / `voice 2`, but the layer they address is Layer 1 / Layer 2 as named everywhere else in the UI. Global destinations (master filter, delay, reverb, compressor) ignore this setting.

13.5 See also

- [Layer System](#)
- [GRAIN Tab](#)
- [TEXTURE Tab](#)

14. Parameter Reference

Grainulator's parameters are documented on the per-tab pages under **Reference** → **Tabs**. This page is a quick lookup for "which tab is parameter X on?". For ranges, defaults, and descriptive prose, follow the link to the tab page.

14.1 Quick lookup

Area	Parameters	Tab
Grain core	Position, Speed, Pitch, Size, Density, Jitter, Spread, Pan	GRAIN
Per-layer filter	Model, Cutoff, Resonance, Drive, Env Depth	GRAIN
Master mixer	Layer 1/2 Level, Layer 1/2 Pan, Wet/Dry	GRAIN
Global Morph (hero knob)	Macro, Morph LFO Rate, assignable targets	GRAIN
Grain window	Window Shape, Tilt, Curve, Sides, Decay, Window B, Morph, Rate	TEXTURE
Pitch variation	Prob, Mode, Direction, Range	TEXTURE
Dynamics	Prob, Range	TEXTURE
Reverse	Reverse probability	TEXTURE
Scan	Rate, Depth	TEXTURE
Spectral Array Oscillator (per-layer)	Enable, SAO, Freeze, Focus, Transpose, Tilt, FMT mode, Clarity, Partial, Scan, Capture, Clear	SYNTH
Voice Interaction	Enable, Direction, Follow, Vocode, Duck	SYNTH
Resonator	Enable, Polyphony, Chord, Bright, Damp, Scatter, Note, Mix, Distort, Polarity	SYNTH
Sub oscillator	Level, Waveform, Octave, Note	SYNTH
VCA envelope	Attack, Decay, Sustain, Release	SYNTH
Filter envelope	Attack, Decay, Sustain, Release	SYNTH
MIDI	Root 1, Root 2, Glide	SYNTH
Master filter	Model, Cutoff, Resonance, Drive	FX
Compressor	Enable, Threshold, Ratio, Attack, Release, Makeup, Mix, Limiter	FX
Delay	Time L/R, Link, Feedback, Mode, ModMode, Tone, Sat Drive, Sync, Clock Div, Sync Offset, Infinite, Mix	FX
Reverb	Mode (Misty/Cloudy/Stormy), Size, Damping, Width, Modulation, Tone, Mix, Freeze	FX
Mod matrix — per lane	Source, Dest, Amount, Curve, Target, Enable	MOD
Mod matrix — per lane LFO	Rate, Shape, Depth, Retrigger	MOD
Mod matrix — per lane envelope	A, D, S, R	MOD
Rhythmic sources	Sync, Div, Free Rate, Euclid Hits/Steps/Rotation/Shape, 8 Step values, Step Length, Step Glide	MOD

14.2 Layer scope at a glance

Most parameters exist per layer (Layer 1 and Layer 2 can hold different values). The exceptions — parameters that are global regardless of the layer you are editing — are:

- All FX chain parameters (master filter, compressor, delay, reverb)
- The global Morph (Macro knob) and its LFO rate
- Master mix (Layer 1/2 level and pan, Wet/Dry)
- The modulation matrix (though each lane can be targeted at a specific layer via its Target setting)
- **SYNTH tab:** Resonator, Sub Oscillator, VCA envelope, Filter envelope, and Glide are all global even though the UI mounts them under Layer 1. Only Root Note is truly per-layer. The Spectral Array Oscillator controls are genuinely per-layer. The Voice Interaction controls are global (they describe the routing *between* layers, not per-layer state). See [Layer System](#) for the full story.

14.3 See also

- [Interface — Header Bar](#)
- [Interface — Waveform Display](#)
- [Layer System](#)

 **Note**

The authoritative ranges, defaults, and units for every parameter live on the per-tab pages linked above. A consolidated auto-generated parameter table is on the post-launch roadmap.

15. Install

Grainulator ships as a standalone app plus VST3 and AudioUnit plugins for macOS, and a standalone app plus VST3 plugin for Windows. The macOS build is a universal binary (Apple Silicon and Intel) and the Windows build is 64-bit.

15.1 Download

Grab the latest Grainulator installer from the [Plastic Factory downloads page](#).

15.2 macOS install

Open the downloaded `.dmg` and double-click the `Grainulator.pkg` inside. The installer drops each component in the right place:

- **Standalone app:** `/Applications/Grainulator.app`
- **AudioUnit:** `/Library/Audio/Plug-Ins/Components/Grainulator.component`
- **VST3:** `/Library/Audio/Plug-Ins/VST3/Grainulator.vst3`
- **AAX:** `/Library/Application Support/Avid/Audio/Plug-Ins/Grainulator.aaxplugin`

You can deselect any component you don't need in the installer's customize screen.

First-launch Gatekeeper prompt

Grainulator is signed and notarized by Plastic Factory, so Gatekeeper should let it run without fuss. If macOS still blocks the app on first launch, right-click `Grainulator.app` in Finder and choose **Open**, then confirm the dialog. You only need to do this once.

The build is a universal binary, so there's no separate download for Apple Silicon and Intel Macs.

15.3 Windows install

Run the downloaded `Grainulator-Setup.exe` and follow the prompts. The default install locations are:

- **Standalone app:** `C:\Program Files\Plastic Factory\Grainulator\Grainulator.exe`
- **VST3:** `C:\Program Files\Common Files\VST3\Grainulator.vst3`

SmartScreen on first run

Because Grainulator is a new installer, Microsoft SmartScreen may show a blue warning the first time you run it. Click **More info**, then **Run anyway** to continue. Subsequent launches are silent.

AAX and AudioUnit are not available on Windows.

15.4 License activation

The first time you launch Grainulator after install, a **license screen** appears. Enter the license key from your purchase email and click **Activate**. The activation runs against Plastic Factory's licensing service (Keyzy) and only needs to be done once per machine — subsequent launches go straight to the main UI.

If activation fails:

- Confirm the machine is online — activation requires a one-time internet round-trip.
- Re-check the license key for typos. Keys are case-sensitive.
- If you've already activated on the maximum number of machines, free a seat at plasticfactory.com/account before trying again.

The license is bound to your account and works across both the standalone app and the plug-in formats — there's no separate plug-in activation.

15.5 Verifying the install

Launch the standalone app. The current version is shown in the header next to the Plastic Factory logo; if it matches the version you downloaded, you're set. In a DAW, open the plugin manager, rescan, and load Grainulator on a track.



If you see both **Grainulator** and **Grainulator FX** in your DAW's plugin list, that's expected. The main build is a MIDI-controlled instrument; the FX build is a plain insert effect for audio tracks. Install whichever fits your workflow — or both.

15.6 Uninstalling

macOS. Drag `Grainulator.app` from `/Applications` to the Trash, then remove the plugin bundles:

```
bash
rm -rf /Library/Audio/Plug-Ins/Components/Grainulator.component
rm -rf /Library/Audio/Plug-Ins/VST3/Grainulator.vst3
```

Removing the AAX bundle (if installed) requires deleting `/Library/Application Support/Avid/Audio/Plug-Ins/Grainulator.aaxplugin`.

Windows. Open **Settings** → **Apps** → **Installed apps**, find Grainulator, and click **Uninstall**. If the entry is missing, delete `c:\Program Files\Plastic Factory\Grainulator\` and `C:\Program Files\Common Files\VST3\Grainulator.vst3` by hand.

16. Audio setup

Grainulator runs either as a standalone app with its own audio engine, or as a plugin inside your DAW. This page covers both paths and the host-compatibility matrix.

16.1 Audio interface selection (standalone only)

Open the standalone app and choose **Settings** → **Audio I/O**. The dialog lets you pick:

- **Driver** — Core Audio on macOS, ASIO or Windows Audio on Windows. ASIO is strongly recommended on Windows for usable latency.
- **Input device** — used by the Live Input mode on each layer. Leave it on your interface's stereo input, or set it to "None" if you don't need live input.
- **Output device** — where the grains play back. Select your audio interface here, not the built-in speakers, if you want low latency.
- **Channel count** — Grainulator is stereo in and stereo out. Pick the two channels on your interface you want to use.

16.2 Sample rate and buffer size

The standalone app defaults to **44.1 kHz**. You can change the sample rate from the same **Settings** → **Audio I/O** dialog. As a plugin, Grainulator always follows the host sample rate, so there's nothing to configure.

Buffer size trades latency for CPU headroom:

- **128 or 256 samples** — good for live playing and MIDI performance.
- **512 samples or higher** — good for mixing, bouncing, and dense patches with heavy grain density.

If you hear crackles or dropouts, raise the buffer size first. If latency feels sluggish, lower it.

Sample-rate auto-resampling

When you load an audio file, Grainulator resamples it to the current session sample rate on a background thread. A 48 kHz file dropped into a 44.1 kHz session plays back at the correct pitch — no manual conversion required. The resample happens once at load time, so there's no ongoing CPU cost.

16.3 DAW host compatibility

Grainulator is tested against these hosts:

- **Logic Pro** — AudioUnit. Insert on an instrument or audio track via the channel-strip plugin slot.
- **Ableton Live** — VST3 or AudioUnit. Drag from the Plug-ins browser onto a track.
- **Reaper** — VST3 or AudioUnit. Use the FX button on any track.
- **Studio One** — VST3 or AudioUnit. Drag from the Instruments or Effects browser.
- **FL Studio** — VST3. Add from the Channel Rack or the Mixer's plugin slots.
- **Bitwig Studio** — VST3. Drag from the browser onto a track.
- **Cubase / Nuendo** — VST3. Add from the Instruments or Inserts rack.
- **Pro Tools** — AAX. Insert on an audio or instrument track from the AAX plug-in menu.

If your host doesn't see Grainulator after install, force a plugin rescan — most DAWs only look for new plugins at startup or when you press a **Rescan** button. See the [troubleshooting](#) page if the plugin still doesn't show up.

16.4 Instrument vs. effect

The default Grainulator build is a MIDI-controlled instrument: load it on an instrument track and send MIDI notes to trigger pitched playback. The separate **Grainulator FX** build is a plain insert effect that processes whatever audio is on the track, with no MIDI required. Both builds share the same granular engine and UI.

17. Troubleshooting

Common problems and their fixes. If none of these solve your issue, email support@plasticfactory.com with your OS version, DAW, and a short description of what you're seeing.

I get no sound

Run through this checklist in order:

1. **Play is enabled.** Each layer has its own Play toggle in the header. Make sure Play is lit on Layer 1 (and Layer 2 if you're using it).
2. **The output device is correct.** In the standalone app, open **Settings → Audio I/O** and confirm you're routed to your audio interface, not a disconnected output.
3. **Density and wet/dry are non-zero.** If **Density** is all the way down, no grains spawn. If **Dry/Wet** is fully dry, you only hear the input (or silence, if there's no input). Start both knobs around the 12 o'clock position.
4. **MIDI is arriving (Instrument mode only).** The default Grainulator build is a MIDI-controlled instrument. Without incoming notes it stays silent. Arm the track, play a note, and watch the keyboard indicator. If you want audio without MIDI, use the **Grainulator FX** build instead.

The app crashes on launch

The most common cause on macOS is a stale quarantine flag on the bundle. Clear it from Terminal:

```
bash
xattr -dr com.apple.quarantine /Applications/Grainulator.app
```

If that doesn't help, check that your macOS version is supported. Grainulator requires macOS 11 Big Sur or later. On Windows, Grainulator needs the Visual C++ 2022 runtime; the installer bundles it, but a failed install can leave it out. Re-running the installer usually fixes it.

If the crash is reproducible, grab the crash log (macOS: **Console.app → Crash Reports**; Windows: **Event Viewer → Windows Logs → Application**) and send it to support.

My audio file won't load

Grainulator accepts **WAV, AIFF, FLAC, MP3, and Ogg Vorbis** files. Anything else — including M4A/AAC, WMA, and protected iTunes files — has to be converted first.

Sample rate is handled automatically: files are resampled to the current session rate on a background thread, so a 96 kHz WAV in a 44.1 kHz session still plays at the right pitch. That conversion happens once at load time.

Very long files (over about five minutes) take a moment to decode and resample. The waveform display stays blank while the load is in flight, then pops in when it's ready. If a file never finishes loading, it's probably corrupt — try opening it in another audio app to confirm.

CPU usage is too high

Granular synthesis is expensive by nature, and dense patches on both layers can push a laptop hard. Try these in order:

1. **Drop grain density.** Density is the biggest CPU lever. Halving density roughly halves the grain count and therefore the CPU cost.
2. **Bypass unused FX.** The compressor, reverb, and especially reverb freeze each add overhead. If a slot isn't doing anything musical, disable it.
3. **Turn off the resonator** if it's enabled but not audibly contributing.
4. **Disable the second layer.** If you're only using Layer 1, switch Layer 2's Play toggle off so it stops spawning grains.
5. **Raise the buffer size** in your host or the standalone Audio I/O settings. Larger buffers give the engine more headroom per block.

The plug-in is missing or times out in my DAW

First, force a rescan. Logic Pro caches AU validation results aggressively — delete `~/Library/Caches/AudioUnitCache/` and relaunch Logic to force a clean revalidation. In Ableton Live, go to **Options → Preferences → Plug-ins** and click **Rescan**. Most other hosts have a Rescan button in their plugin manager.

On macOS, check that Gatekeeper hasn't quarantined the bundle itself. The same `xattr` command from above also works on plugin bundles:

```
bash
xattr -dr com.apple.quarantine /Library/Audio/Plug-Ins/Components/Grainulator.component
xattr -dr com.apple.quarantine /Library/Audio/Plug-Ins/VST3/Grainulator.vst3
```

If a DAW reports the plugin "timed out during validation", it usually means the host killed the scan before Grainulator finished initializing its sample cache. Rescan once more — the second attempt almost always succeeds because the cache is already warm.

18. What's New

A summary of user-visible changes per Grainulator release. For commit-level history, see the [GitHub commit log](#).

18.1 v2.1.0 — April 2026

Cross-voice interaction gets a proper panel, compressor clipping gets fixed, and the MOD + TEXTURE tabs get label polish.

New features

- **Voice Interaction panel** (SYNTH tab) — replaces the previous MASTER · XMOD slot between the two Spectral columns. Three categorically different cross-layer effects — **Follow** (the follower's grain engine reads the driver's live audio), **Vocode** (spectral envelope transfer), and **Duck** (amplitude sidechain, bipolar) — driven by a shared 3-state direction switch ($v1-v2$ / $v2-v1$) and a power toggle that hard-bypasses the whole section. Presets saved with a non-zero X-Mod value are auto-upgraded on load: **Vocode** is seeded from the previous X-Mod amount and direction defaults to **Both**. See [SYNTH tab → Voice Interaction panel](#).
- **Voice FX mod destinations** — **Follow**, **Vocode**, and **Duck** are each routable from any MOD lane under a new **Voice FX** category.

Fixes

- **Compressor limiter no longer distorts when overdriven.** The "brickwall limiter" option used to be a literal hard clip at ± 1.0 , which folded the waveform into a near-square and produced harsh aliased harmonics when the pre-limiter signal was well above 0 dBFS. It is now a soft-knee limiter — transparent below ± 0.9 , with a smooth \tanh -shaped rolloff asymptotic at ± 1.0 . No breakup on heavily compressed or overdriven material.

UI polish

- **TEXTURE tab** — the **DYN** / **REV** group labels are spelled out in full as **DYNAMICS** and **REVERSE**. The knob labels in each of those groups now read **Probability** (previously **Prob** and **Reverse**) to match the value they actually control.
- **GRAIN tab — Morph strip** — the Morph LFO rate slider sits directly beneath the shape-wave controls (sin / tri / saw / sqr / s&h) and the visualisation bars moved below. Easier to see cause and effect at a glance.
- **MOD tab — Spectral destination labels** now match the on-screen Spectral panel knob text: **Transpose**, **Clarity**, **Frz Blend**, **Formant Mix**, **Peak Lock**. The former per-voice X-Mod destination is renamed (**legacy**) and has no DSP effect in v20+; old mod-lane routings pointing at it still load cleanly.

Preset compatibility

- **Format version bumped to v20.** v19 presets load cleanly — the legacy per-voice X-Mod parameters are retained in the param enum as no-ops, and a one-time migration maps their value onto the new **Vocode** knob so cross-voice coupling you had saved still sounds roughly equivalent on first load.

18.2 v2.0.0 — 2026

A major layout and effects update plus the first public release of the new documentation system.

New features

- **Compressor on the FX tab** — a feed-forward compressor with parallel mix and limiter, sitting between the master filter and the delay in the post-mix chain.
- **Multi-mode reverb** — the reverb now has three selectable algorithms (Misty, Cloudy, Stormy) sharing one unified control surface. Pick the mode that fits the material; common controls behave as expected.
- **Rhythmic mod sources** — clock-divided modulation patterns, including a Euclidean LFO generator and an 8-step bipolar sequencer, each optionally synced to host tempo.
- **Dual waveform display** on the GRAIN tab — see both layers' audio at a glance in the full layout.
- **MIDI root-note glide** — independent root notes for Layer 1 and Layer 2 with a shared glide knob for smooth voice tracking.
- **Layer Link** — Layer 2 can share Layer 1's audio buffer, making it easier to build dense textures from a single source sample.

Layout changes

- **Master panel moved** — the master faders (Layer 1/2 level, pan, wet/dry) relocated from the FX tab to the GRAIN tab's new MASTER column. The FX tab is now dedicated to the post-mix effects chain.
- **Window shape visualization** — a live preview above the TEXTURE tab's shape controls updates as you change tilt, curve, and sides.

Renames and terminology

- **Grainulator** — the project formerly known as *GrainulatorV2* is now shipped simply as Grainulator. Internal parameter IDs still begin with `v1/v2` and some code comments reference the old name, but all user-facing copy has been updated.
- **Layer 1 / Layer 2** — what used to be called "Voice 1" and "Voice 2" in the UI is now "Layer 1" and "Layer 2". The terminology change clarifies that a layer is a granular engine instance, not a polyphonic voice in the classical sense.

Documentation

- **First release of the new docs site** — a single source of prose produces the website you are reading, plus two edition PDFs (Desktop and iPad). The old `docs/manual/mac.html` and `docs/manual/ipad.html` files are deprecated; anything they said and the current code disagreed on has been reconciled in favor of the code.

18.3 v1.4 and earlier

Earlier releases are summarised in the project's [GitHub Releases](#) page.

19. Credits

Grainulator is made by **Andy Smith** under the **Plastic Factory** label.

19.1 Open-source components

Grainulator stands on the shoulders of several open-source projects:

- **iPlug2** — the cross-format plug-in framework. VST3, AudioUnit, AAX, AUv3, and standalone targets all share a single C++ codebase through iPlug2.
- **Visage** — the GPU-backed graphics and UI library used for every control, panel, and visualization in the editor.
- **CloudSeed** — a classic algorithmic reverb by Valdemar Erlingsson, adapted as one of Grainulator's reverb modes.
- **Mutable Instruments Rings** — the physical-modelling resonator at the heart of the SYNTH tab's Resonator section is a port of the Rings Eurorack module's DSP by Émilie Gillet.
- **SignalSmith Audio** — basics and reverb building blocks used in one of the multi-mode reverb algorithms.

19.2 Documentation

This documentation is built with:

- **MkDocs Material** — the site generator, theme, and search.
- **mkdocs-with-pdf** and **WeasyPrint** — the PDF renderer that produces the Desktop Edition and iPad Edition PDFs.
- **Vercel** — the hosting platform serving `docs.plasticfactory.com`.
- **GitHub Actions** — the continuous-integration pipeline that builds and deploys the site on every push to `main`.

19.3 Thanks

To the beta testers who caught real bugs and to everyone who asked for features that turned out to be better than the ones on the original roadmap. The rhythmic mod sources, the compressor's parallel mix, and the multi-mode reverb all came out of user requests.

If you find a bug, have a feature idea, or want to contribute, file an issue at github.com/azsmith/grainulator-v2.