ZORBA

SYNTHESIZER

User Guide

Version 1.0

Pulsar Modular

PULSAR™ MODULAR

Preface

Zorba started from a simple question: What would a synthesizer sound like if it carried the warmth and soul of classic analog machines but wasn't boxed in by their original architecture?

The instruments that shaped electronic music — the Junos, Jupiters, Prophets, and Moogs — each made brilliant compromises in oscillator count, modulation paths, and envelope destinations. Those constraints became their character, and that character became the sound of decades of records.

Today's soft synths can offer hundreds of parameters and unlimited routings. Zorba doesn't try to win that race. It tries to win on sound, and on the kind of focused depth that only emerges when an instrument has a clear voice and asks you to listen to it. The limitations are deliberate. They're what made the classics inexhaustible, and they're what we wanted Zorba to inherit.

The result is an instrument that can be a Juno on your first patch, a Jupiter on your second, and something neither could dream of on your third. All of it built on a signal path that honors the Pulsar Modular P900 analog heritage.

Welcome to Zorba. The Sound Is Unbelievable.

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1. Introduction

1.1 What Zorba Is

Zorba is a polyphonic synthesizer plugin designed to feel like a classic analog instrument while offering modern flexibility under the hood. It has three oscillators, two multimode filters, three envelopes, two LFOs, an arpeggiator with a five-step accent system, and a modulation matrix that connects almost anything to almost anything else.

The goal of Zorba is to be immediate. The first patch you load should already feel playable. The controls are laid out to match how you think about sound: oscillators for tone, filter for brightness, envelope for shape, LFO for movement, effect for space. You don't need to set up routing to get a usable sound. Everything important is already connected.

At the same time, Zorba is deep. When you want to reach further — make the mod wheel open the filter, have velocity change the FM amount, let the arpeggiator's accent punch the cutoff every third step — the modulation matrix is waiting. Start simple. Go as far as you like.

1.2 How to Read This Guide

Each chapter follows the same pattern:

- **First**, a plain-language description of the musical thing being controlled: how a note starts and ends, how filters change tone, what LFOs do.
- **Then**, the specific knobs and switches on Zorba that handle it, in the order they appear on the panel.
- **Finally**, a Going Deeper callout box with details that reward exploration: stored values, calibration points, and tricks worth knowing.

If you skip the Going Deeper boxes entirely, you still get a complete, working understanding of the instrument. They're there if you want them.

1.3 The Signal Flow

A sound in Zorba starts at the oscillators and travels through the filters to the output. There are three parallel paths that meet at the VCA (the voice amplifier):

- **Path 1:** Oscillators → Filter 1 (with its own pan) → VCA
- **Path 2:** Oscillators → Filter 2 (with its own pan) → VCA
- **Path 3:** Noise generator (with its own filtering and pan) → VCA (bypasses both filters)

VCO1, VCO2, and VCO3 each decide for themselves which filter they go to — one, the other, both, or neither (in which case the oscillator drops out of the audio path entirely). The noise generator is entirely separate: it has its own high-pass filter, low-pass filter, and pan control, and it never passes through VCF1 or VCF2.

After the filter and noise paths recombine, the signal passes through the reverb module, then the VCA Out stage sets the final voice level before the master output.

Going Deeper — Architecture at a glance

Zorba's signal path is modeled after the Pulsar P900 analog heritage. The two filters are both based on the 904-F State Variable Filter design. Having the noise generator run on its own path means the noise character is independent of filter cutoff, which is critical for breath transients, BBD-style chorus haze, and organ key click that need to sit on top of the main tone without being shaped by it. The mod matrix provides 174 routes across 10 sources (LFO1, LFO2, EG1, EG2, EG3, Velocity, Mod Wheel, Aftertouch, Arp Accent, Keyboard Tracking) and 38 unique targets. All routes are available simultaneously with no slot limits.

2. Oscillators: Where the Sound Begins

2.1 What an Oscillator Does

An oscillator generates the raw tone, the vibration that becomes your note. Different waveforms have different characters: a saw wave is bright and buzzy, like a full orchestra section holding one note; a pulse wave is hollow and nasal, like a clarinet; a triangle is soft and round, like a whistle; a sine is pure and simple, like a tuning fork.

Most classic synths gave you one or two of these shapes, selected by a switch. Zorba lets you slide between all four, continuously, on VCO1 and VCO2. Somewhere between saw and pulse there's a tone that's neither, and it belongs to Zorba.

2.2 The Three Oscillators

Zorba has three oscillators. Each one has its own role:

- **VCO1** and **VCO2** are the primary voices. They share a continuously morphable waveform, independent tuning, routing to either or both filters, and can FM each other. These are the workhorses for almost every patch.
- **VCO3** is the sub oscillator. It reaches an octave lower than VCO1 or VCO2 can go and has its own independent tune knob (±12 semitones) and its own VCF1/VCF2 routing. Built for low-end reinforcement, organ-style stacking, and any time you need a third independent voice. Four fixed waveforms.

2.3 The Waveform Morph

VCO1 and VCO2 both have a single Waveform Morph knob that slides between four shapes:

Morph position	Waveform	Character
0.0	Saw	Full harmonic series. Bright and buzzy. The sound of strings, brass, leads.
0.33	Square	Odd harmonics only. Hollow, nasal, reedy. Pulse width controlled separately by the PW knob. Clarinets, vintage square leads.
0.66	Triangle	Soft odd harmonics. Warm and mellow. Soft pads, flutes.
1.0	Sine	Almost pure tone, no edge. Sub bass, bells, FM carriers.

The knob doesn't just switch between these four. It blends continuously. The zone between 0.50 and 0.60 (sometimes called the Hybrid zone) has its own character: bright, odd-harmonic content that's not quite square and not quite triangle. Positions like 0.15 or 0.80 give you tones you won't find on a vintage fixed-waveform synth.

Tip: *The morph position is itself a modulation target. Route EG3 to VCO Wave with a negative amount and you get a note that starts close to pure sine and opens up into richer harmonics as the envelope decays: a reverse-brightness effect that no filter can produce, because it changes the source rather than what comes after it. As of the current build, LFO1 and LFO2 can also reach VCO Wave for continuous cyclical morphing — set LFO2 to POLY for per-voice morph scatter in pads.*

2.4 The Pulse Width Control

In the Pulse region of the morph (around 0.25 to 0.45), a second knob becomes meaningful: Pulse Width. At 50%, the pulse is a perfect square (equal on and off time). Narrower values (say, 20%) produce thinner, more nasal tones; wider values (say, 80%) produce hollow tones with the same character as narrow settings, mirrored. Animating this width with an LFO is what gives string sections and pads that breathing, alive quality.

2.5 VCO1 Controls

- **Range:** Octave footage, from 32′ through 16′, 8′, 4′, and 2′. Lower numbers mean higher pitch (thinking in organ pipe lengths).
- **Tune:** Fine pitch adjustment, ±12 semitones. Use small amounts (±0.004 to ±0.01) for chorus detune against VCO2; use semitone amounts for intervals.
- **Waveform Morph:** The continuous shape blend described above.
- **Pulse Width:** Width of the pulse in the square region.
- **Gain:** Output level in dB. At −40 dB, the oscillator is silent.
- **To VCF1 / To VCF2:** Independent routing switches. Both can be on at once.
- **FM Amount:** How much VCO2 frequency-modulates VCO1. Zero for standard patches; small amounts (2–6 on the GUI) for bells, electric pianos, metallic tones.
- **FM Mode:** Linear (clean, stable, harmonic) or X-MOD (aggressive, beating, inharmonic).

Going Deeper — VCO1 / VCO2 range enum

Range is stored as an integer. Verified enum values:

GUI Label	Stored Value
32′	0
16′	1
8′	2
4′	3
2′	4

2.6 VCO2 Controls

VCO2 has the same core controls as VCO1 (Range, Tune, Morph, Pulse Width, Gain, Routing) and adds a few things that make it especially useful for thicker tones and FM:

- **Phase Trigger (TRIG):** Resets the oscillator's phase on every note-on, so the attack is consistent from note to note. Useful for punchy basses and plucks.
- **Key-Off:** VCO2 ignores which note you're playing and holds a fixed frequency. Essential for FM bell patches, where the modulator stays fixed while the carrier changes, so the ratio between them changes across the keyboard and the timbre shifts musically as you play up and down.
- **Hard Sync (H-Sync):** Forces VCO2 to restart its waveform in sync with VCO1. This is the classic hard-sync lead sound: aggressive, cutting, with a distinct formant character that depends on how far VCO2's pitch is offset from VCO1's.

2.7 VCO3: The Sub Oscillator

VCO3 is called the sub oscillator because its primary job is to reinforce the low end. Its lowest range setting (64′) reaches an octave below what VCO1 or VCO2 can produce, a true sub-bass register only VCO3 can hit.

VCO3 has its own Tune knob (±12 semitones), its own Gain control, its own VCF1/VCF2 routing switches, and its own Trigger button. It is fully independent from VCO1 and VCO2. You can use it as a unison-locked sub (Tune at 0), as a fifth above the root (Tune at +7), or as a high stable layer above the chorused VCO1+VCO2 pair when working organ-style registrations. The Range dial spans 64′, 32′, 16′, 8′, and 4′ — five positions, and unlike VCO1 and VCO2 it has no OFF position. To remove VCO3 from the audio path, either turn off both VCF1 and VCF2 routing switches, or set the Gain knob to −40 dB. The Trigger button controls VCO3's phase behavior on note-on: when OFF (default), VCO3 runs continuously with phase carrying across notes for a smoother, classic-analog feel; when ON, VCO3 resets its phase at the start of each note, giving tighter and more defined attack transients for plucks, drums, and percussive patches.

At 8′ and 4′, VCO3 sits in the same register as the main oscillators. This is for organ-style registration, stacking partials the way a Hammond does with its drawbars. Because VCO3 has its own Tune knob, you can build a rich detuned VCO1+VCO2 foundation and then add VCO3 either perfectly in tune (for a stable upper register) or slightly detuned (for a thicker chorus across all three oscillators). The choice is yours per preset.

VCO3 offers four fixed waveforms:

Position	Waveform
0	Saw
1	Square
2	Triangle
3	Sine

Going Deeper — VCO3 range enum

VCO3 uniquely reaches 64′ — one octave below the VCO1 / VCO2 minimum. Stored enum values:

GUI Label	Stored Value
64′	0
32′	1
16′	2
8′	3
4′	4

Tip: *For sub-bass, try VCO3 Sine or Triangle at 32′ starting around −18 dB gain. For organ registration, use Sine at 8′ or 4′ to add upper partials without using up a main oscillator.*

2.8 The Noise Generator

Noise is Zorba's fourth sound source. It doesn't have a pitch; it produces a continuous hiss or texture instead of a musical tone. That makes it useful for breath in wind instruments, the click at the start of an organ note, air and haze in pads, percussive hits, and BBD chorus simulation.

Four noise types are available, selected by the TYPE rotary in the center of the noise panel. The currently selected type is always shown in the small display at the top of the panel, rendered in its own color: WHT in white, PINK in pink, ETHER in green, and FRAY in red — a quick visual confirmation of which noise character is loaded.

Type	Character
WHT	Flat broadband spectrum, equal energy at every frequency. Bright, hissy, full of high-frequency content. Foundational for hi-hats, snares, claps, and cymbal crashes.
PINK	Warmer and bassier than WHT, less harsh in the highs. Useful for breath, soft pad beds, and any noise layer that needs to sit underneath without dominating the top end.
ETHER	A smooth, airy character less hissy than WHT or PINK — closer to the sound of analog haze or BBD chorus clock noise. Ideal for ensemble haze, organ key click, and chorus beds.
FRAY	Complex, fibrous, evolving texture with motion and detail that flat-spectrum noise doesn't have. Useful for organic textures, wind, motion beds, and anywhere you want noise that moves rather than just sits.

Noise has its own Level control, its own HPF and LPF for shaping the frequency range, and its own Pan. It bypasses both main filters entirely. The only way to color noise is through its dedicated HPF and LPF.

2.9 FM (Frequency Modulation)

Frequency Modulation is what happens when VCO2 vibrates fast enough, at audio rates, to shift VCO1's pitch hundreds or thousands of times per second. Instead of hearing two oscillators, you hear a single tone with new harmonics that neither oscillator produced on its own. This is how Zorba makes bell tones, electric piano shimmer, brass edge, and metallic textures without samples or wavetables.

Two FM modes are available:

- **Linear FM:** Produces clean, predictable harmonic sidebands. Stable and musical, ideal for bells, electric pianos, and brass that needs edge without chaos. Usable range depends on the carrier-to-modulator ratio: at 1:1 (both VCOs at 8') Linear FM stays stable up to GUI 60; at 4:1 (VCO1 at 2', VCO2 at 8' — the bell architecture) it stays stable up to GUI 50. Above those thresholds the FM enters overmodulation and pitch becomes unstable.
- **X-MOD (Cross-Modulation):** Exponential FM. Produces inharmonic, beating, aggressive sidebands, the sound of the Roland Jupiter-8 Cross Mod. Best used at a fixed sweet spot for your chosen oscillator ratio rather than swept through a range.

FM Amount is a modulation target in the mod matrix. EG3 can open FM gradually during the note. Mod Wheel can push it up on demand. Aftertouch can add it when you lean into a note. Arp Accent can pulse FM on accented steps for rhythmic metallic bursts.

Two things worth knowing about FM on Zorba:

- **VCO2's gain doesn't affect FM depth.** Only the FM Amount knob controls modulation intensity. VCO2's gain setting only determines how loud VCO2 is as a tone in the mix, not how much it's modulating VCO1.
- **VCO2 can be a pure modulator.** Turn both of VCO2's routing switches off and VCO2 disappears from the mix, but it's still modulating VCO1 at full strength. This gives you clean bell tones where only the FM-modulated VCO1 is audible.

Going Deeper — FM at 96 kHz

FM produces harmonics well above the normal oscillator range. At a sample rate of 44.1 kHz, those harmonics can alias above roughly C5, producing audible high-frequency artifacts. Running your DAW session at 96 kHz keeps FM patches clean through the full keyboard range. Your final export can still go to 44.1 kHz; the aliasing happens at the source, not the output.

2.10 Oscillator Routing

VCO1 and VCO2 each have two independent routing switches: To VCF1 and To VCF2. This opens up several practical configurations:

Configuration	VCO1	VCO2	What it's good for
Split	VCF1 only	VCF2 only	Genuine stereo width, dual-timbre patches
Parallel	Both filters	Both filters	Juno-style blended character
Single filter	VCF1 only	VCF1 only	Mono leads, basses, solo tones
Cross-routed	VCF2 only	VCF1 only	Creative dual-timbre mixing

VCO3 has its own VCF1 / VCF2 routing switches, just like VCO1 and VCO2 — it can be sent to either filter, both, or neither.

Tip: *Split routing (VCO1 → VCF1, VCO2 → VCF2) with each filter panned apart gives you about five times more stereo width than parallel routing. It's the default for pads, strings, and ensemble presets.*

3. Filters: Shaping the Tone

3.1 What Filters Do

A filter shapes the raw sound from the oscillators by removing or emphasizing certain frequencies. If oscillators are the vocal cords, filters are the mouth and throat. They turn a raw vibration into a tone with character. A low-pass filter cutting at 900 Hz can transform a buzzy saw wave into a warm, round tone that sits like a Juno pad in the mix.

Moving the filter cutoff over time is what gives analog synths their expressive quality. A pad brightens on attack then settles into warmth. A pluck opens sharply and closes fast. A wah-wah sweeps with an LFO. The filter is usually where you'll spend the most time when you're shaping a preset's personality.

3.2 Two Filters, Four Modes

Zorba has two independent filters, both based on the 904-F State Variable Filter design. Each filter supports four modes:

- **Low-Pass (LP):** Keeps the lows, removes the highs. 24 dB/octave slope. The most-used mode: the classic warm-pad, warm-bass, classic-lead filter.
- **Band-Pass (BP):** Keeps a band of frequencies around the cutoff, removes everything above and below. 24 dB/octave slopes on each side. Useful for vocal formants, nasal leads, wah-style mids.
- **High-Pass (HP):** Keeps the highs, removes the lows. 24 dB/octave slope. Thins out the bottom, good for leads that need to sit on top of a mix without muddying the low end.
- **Notch:** Removes a narrow band at the cutoff while passing everything above and below. Good for phaser-like effects and broad timbral scooping.

Having two filters instead of one is what opens up split routing, parallel filtering with independent modes, and series chaining (filter into filter). One filter is enough for classic subtractive synthesis; two filters is what lets Zorba go into territory single-filter synths can't reach.

3.3 The Filter Controls

Each filter has the same set of knobs:

- **Cutoff:** Where the filter acts. For a low-pass, anything above this frequency gets removed.
- **Resonance:** Boosts frequencies right at the cutoff. At low settings, it adds a little emphasis; at high settings, the filter starts to sing on its own. (See the next section for more on this, one of Zorba's most expressive features.)
- **EG2 Amount:** How strongly the EG2 envelope moves this filter's cutoff. This is on the filter panel directly, not in the mod matrix; it's the fast, immediate way to shape filter motion.
- **Key Tracking:** How much the cutoff follows the keyboard pitch. Zero means the cutoff stays where you set it; higher values mean higher notes open the filter more. Useful for keeping tone balance across the keyboard.
- **Pan:** Where this filter sits in the stereo field.

> **Going Deeper — Filter cutoff dial reading**
>
> Zorba's 904-F filter uses a non-linear frequency taper modeled after hardware Moog filter behavior, so the audible −3 dB cutoff sits slightly higher than the number printed on the dial. This is intentional and is identical at both 44.1 kHz and 96 kHz. If you're matching a cutoff value across patches or coming from a synth with a strictly literal cutoff readout, set the cutoff by ear rather than by number.

3.4 Resonance: Four Zones of Character

Zorba's resonance control does more than add emphasis. Internally, the resonance feedback is pushed through a transformer saturation stage modeled on classic analog behavior. Turning resonance up takes the filter through four distinct regions, each with its own sound:

Zone	Range (knob %)	Character
1. Clean	0–44%	Gentle emphasis at the cutoff. Normal filter behavior.
2. Self-oscillation	44–56%	The filter starts singing a pure sine tone at the cutoff. Great for whistles and sine-lead hybrids.
3. Saturation	56–89%	The transformer model drives into a thick, aggressive character, like an MS-10 screaming filter. Pitch sag of more than an octave can occur at peak saturation.
4. Black Hole	90%+	The signal momentarily disappears as the transformer locks up, then rebounds in a death-and-rebirth arc. This is not a bug. It's a deliberate consequence of modeling real transformer physics in extreme saturation.

Zone 4 is something you won't find on most synths. It's a creative texture: EG2 or EG3 routed to VCF Resonance at high depth with a slow decay produces a bleep-silence-rebirth-decay arc that's unique to Zorba.

Tip: *For normal patches, keep resonance in Zone 1 or early Zone 2. For singing leads, sit in Zone 2. For acid bass and screaming leads, push into Zone 3. Save Zone 4 for pads and effects where you want the dramatic death-rebirth motion.*

Going Deeper — Resonance zones for patch design

The transformer rebirth in Zones 3–4 sings below the cutoff and climbs back into tune over roughly three seconds. This is a musical feature for long pad evolutions: the filter's internal voice arrives sagged and rises into its set pitch over time.

Mod matrix routes to VCF Resonance scale through these zones in proportion to depth. Subtle modulation (route amounts up to about 300) stays in Zones 1–2. Routes in the 500 range push into Zone 3 at the modulator's peak. Routes approaching 1000 reach Zone 4. The zone the resonance ultimately hits depends on the sum of the base

resonance setting and the modulation contribution — you can dial the expressive ceiling of a patch through route depth.

3.5 EG2 and the Filter: The Color Envelope

Every note has a shape in time, not just in volume, but in brightness too. A plucked string is bright on attack and darkens quickly. A bowed string opens gently over a second or two. A bell is bright at the start and stays bright through the decay. Zorba handles this with EG2, an envelope hardwired to both filter cutoffs.

Each filter has its own EG2 Amount knob. The amount controls how far the filter opens when a note is pressed; the envelope's Attack, Decay, Sustain, and Release control the timing.

A small amount of EG2 (around 5–10% on the GUI) gives a gentle warming as the note starts, barely noticeable but alive. Larger amounts (15–25%) produce obvious sweeps. Over 30% and you're in aggressive territory: good for acid bass, brass stabs, and dramatic patches.

The EG2 Amount knob is bipolar. Positive amounts open the filter on attack and let the envelope shape the brightness; negative amounts do the opposite — the filter starts open and the envelope closes it on attack, then reopens on release. Negative EG2 Amount is a less-common but legitimate design space for inverted-pluck and reverse-brightness effects.

One thing worth understanding: the Sustain stage of EG2 determines how much the filter stays open during a held note. If Sustain is zero, the filter opens on attack and then closes back down, even while you're still holding the key. Good for plucks and stabs. If Sustain is high, the filter stays bright as long as you hold the note. Good for pads and sustained tones.

3.6 Connecting the Two Filters

Zorba has a three-position selector that controls how VCF1 and VCF2 relate to each other:

OFF: Independent

The default. The two filters are completely independent. Use this when you want two different sound layers, for example VCO1 through a low-pass VCF1 and VCO2 through a band-pass VCF2 for a formant-like lead.

FOLLOW: Linked Cutoff

In FOLLOW mode, both filters still process audio in parallel (VCF1 doesn't feed into VCF2). What's linked is the cutoff: when VCF1's cutoff moves (from the knob, EG2, key tracking, or any modulation), VCF2's cutoff moves by the same amount. The two filters stay locked together at whatever distance you set between them.

Think of it like two spotlights mounted on the same rail. You can space them however far apart you like using VCF2's knob, but when you slide the rail (move VCF1), both spotlights move together with their spacing intact.

This is powerful for pads and layered sounds. Set VCF1 to LP and VCF2 to HP, space their cutoffs apart, and you get a bandpass-like window that opens and closes as a unit. Mod Wheel opens both filters together. Aftertouch brightens both at once. One gesture, two filters responding in lockstep.

In FOLLOW mode, both filters still have independent audio paths — VCF1's Pan and VCF2's Pan each work normally, exactly as they do in OFF mode. Only the cutoff is linked.

Tip: *When FOLLOW is active, modulation routes to VCF2 cutoff (Mod Wheel, Aftertouch, Arp Accent) are automatically disabled by the house map, because those gestures already reach VCF2 through the FOLLOW link. Routing them directly would double the movement.*

SERIES: Audio Chain (VCF1 → VCF2)

The audio from VCF1 is routed directly into VCF2. The signal path becomes: Oscillators → VCF1 → VCF2 → Output. This enables classic filter combinations like LP → HP (for a bandpass-like sound with separate cutoffs), LP → BP (double-filtered vocal formant), or HP → LP (shaped thin leads).

In SERIES mode, VCF1's Pan control is grayed out and cannot be adjusted — since VCF1's output feeds VCF2 rather than going to the VCA directly, its pan position no longer applies. VCF2's Pan determines the final stereo position of the combined signal.

The noise path is always independent in every mode, it never passes through the VCF1 → VCF2 chain.

4. Envelopes: Shaping the Note in Time

4.1 What an Envelope Does

Every musical note has a shape in time. A piano hits immediately: bang, then a slow fade until you lift the key. A brass player takes a moment to push air into the horn, then holds the tone steady, then lets it trail off. A harpsichord plucks instantly and drops away. A string section swells in gradually, sings, and fades. These are all different shapes.

In a synthesizer, that shape is controlled by an envelope. You press a key: the envelope rises (attack), falls to a holding level (decay to sustain), and fades away when you let go (release). Four stages, four characters, everything we recognize as a note's personality.

Zorba has three envelopes, each with its own job:

4.2 The Three Envelopes

EG1: The Volume Envelope

EG1 is hardwired to the VCA, the voice amplifier. It shapes how loud the note is over time. This is the envelope you hear most directly; every change to EG1 changes the basic feel of the note.

For a piano-like pluck, use a fast attack (near zero), a moderate decay (a few hundred milliseconds), low sustain, and a moderate release. For a brass note, a slightly slower attack (30–80 ms), high sustain, and a moderate release. For a string pad, a slow attack (100–300 ms), high sustain, and a long release.

EG2: The Color Envelope

EG2 is hardwired to both filter cutoffs, with a separate amount knob on each filter panel. It shapes how the tone's brightness changes over time, how the color of the note evolves. When you hear a pluck that starts bright and darkens, or a pad that blooms open slowly, that's EG2 moving the filter.

EG1 controls whether the note is there at all; EG2 controls what it sounds like while it is. The two are independent, which means you can have a note that's loud and steady (fast EG1, high sustain) but getting progressively darker (slow EG2 decay to zero sustain). Or a note that comes in softly but bright, then fades into a dark sustain. The combinations give each patch its feel.

EG3: The Wildcard

EG3 is the free envelope. It's not hardwired to anything. Instead, you assign it in the mod matrix to whatever you want: FM depth, pulse width, noise level, oscillator pitch, waveform morph, filter cutoff (as an additional motion layer over EG2), filter resonance for chirp gestures, sub gain — twenty-five destinations in all.

EG3 is the envelope for everything the other two can't reach. Want a pluck that starts with a noise click and quickly fades to clean tone? Route EG3 to Noise Level. Want a bell that blooms open in FM depth before settling? Route EG3 to FM Amount. Want a note that starts on sine and grows into a saw over its life? Route EG3 to VCO Wave with a negative amount.

4.3 The Four Stages: A, D, S, R

All three envelopes share the same four-stage ADSR control:

- **Attack:** How long the envelope takes to reach its peak after a key is pressed. Zero or near-zero is instant (percussion, plucks). Small numbers (20–50 ms) give a natural acoustic feel. Larger numbers (100–500 ms) produce swells and bloom.
- **Decay:** How long the envelope takes to fall from peak to the Sustain level. Short decays (50–300 ms) give plucked or percussive character. Long decays (1–5 seconds) produce slow filter evolutions or long amplitude tails.
- **Sustain:** The level the envelope holds at while a key is still pressed. Zero means the note fades completely after decay (piano-like, pluck-like). Full means the note stays at peak as long as you hold (organ-like, brass-like). Intermediate values give **all the shapes in between.**
- **Release:** How long the envelope takes to fade to zero after you let go of the key. Short release (10–50 ms) gives crisp endings; long release (500 ms to several seconds) gives tails that linger.

Going Deeper — Envelope ranges and default character

Attack can go up to 10 seconds. Decay and Release can each go up to 20 seconds. Sustain is a level between zero and full, not a time.

The envelope shape is one curve character — calibrated against the Pulsar P900 analog reference — applied uniformly across the full range, not a switchable option. It is slow to start, fast through the middle, and slow at the top, which is what gives the envelope its musical, gradual feel rather than a mechanical linear ramp.

All three envelopes share the same stage architecture but ship with different default values. EG1 defaults to a slow, amplitude-friendly shape; EG2 and EG3 default to fast-triggering shapes that suit filter motion and modulation. So a fresh INIT patch with no envelope changes will still feel musical: EG1 carries the note's body while EG2 and EG3 are ready to react quickly the moment you point them at something.

4.4 Combining the Three

Most expressive patches use at least two envelopes working together:

- **Brass stab:** Fast EG1 attack (hard note), moderate EG2 attack with high amount (filter opens brightly), EG2 sustain = 0 (filter closes while you hold the note). Result: initial pow, then warm held tone.
- **Bloom pad:** Slow EG1 attack (note swells in), slow EG2 attack with high sustain (filter gradually opens and stays open). Result: a sound that rises and brightens together.
- **Pluck with bloom click:** Fast EG1 attack, short decay, zero sustain (the note thumps). EG3 → Noise Level with very short attack and decay (a click of breath/noise at the start). Result: pluck with realistic transient air.

5. LFOs: Slow Movement

5.1 What an LFO Does

An LFO (Low Frequency Oscillator) produces slow, repeating motion — slow enough to hear as movement rather than pitch. It's how synths get vibrato (small pitch wobble), tremolo (volume pulse), or pad breathing (filter or pan slowly opening and closing).

Where envelopes shape a note over its single lifetime, LFOs cycle continuously. You can use them to keep something moving as long as a note is held — vibrato that never stops, a pad that breathes, a chorus that wanders.

Tremolo and Vibrato

Tremolo is amplitude modulation — the volume pulses up and down. To create tremolo, route a source (typically LFO1 or LFO2) to VCO1 Gain, VCO2 Gain, and/or VCO3 Gain. Alternatively, route to VCA OUT (Main Volume) for a single connection that affects all oscillators simultaneously.

Vibrato is pitch modulation — the pitch moves slightly sharp and flat. To create vibrato, route a source to VCO1 Tune, VCO2 Tune, and/or VCO3 Tune. Alternatively, route to Master Tune for a single connection that moves all oscillators together as one.

Tip: *Using VCA OUT for tremolo or Master Tune for vibrato saves mod matrix slots — one connection instead of three — and ensures all oscillators move in perfect unison.*

5.2 LFO Waveforms

Zorba's LFOs offer four waveforms:

- **Triangle:** Smooth, gentle motion. The standard choice for vibrato, pad breathing, chorus.
- **Sine:** Smoother still than triangle, more evenly curved. Often indistinguishable from triangle in practice; choose by feel.
- **Square:** Hard alternation between two values. Useful for trill-like modulation, on-off gating, or sharp pulse-width steps.
- **Sample & Hold (S&H):** Picks a new random value at each cycle. Produces vintage synth drift, random filter sweeps, glitchy pitch jumps, or classic sci-fi textures.

5.3 MONO vs POLY

When an LFO is set to MONO, there's one single LFO shared by every voice. Every note you play receives the same LFO motion at the same time. If the LFO is sweeping upward when you play a chord, all the notes sweep up together. This is essential for chorus and ensemble effects where you want the whole sound moving as one animated texture.

When an LFO is POLY, each voice gets its own independent LFO instance. They run at the same rate but start at different phases, depending on when each note was played. A chord gets organic scatter, with each note drifting slightly differently. This is what gives pads their "alive" feeling rather than sounding like one rigid block of sound.

5.4 Zorba's Two LFOs

- **LFO1:** Always MONO. Designed as the primary vibrato source. A single global instance ensures all voices vibrate in unison.
- **LFO2:** POLY by default, with a MONO switch. Designed for chorus, pulse width breathing, and general modulation. Set to MONO when you need all voices sweeping together; leave in POLY for organic per-voice scatter.

Both LFOs share these controls:

- **Rate:** In free-run mode, 0.01–30 Hz. In tempo sync mode, quantized to 30 musical divisions from 8/1 (very slow multi-bar sweeps) down to 1/64T (very fast).
- **Depth:** Base modulation intensity, 0–100 on the GUI. This is the always-on floor level.
- **Sync:** Locks the rate to your DAW tempo.
- **Trigger:** When ON, resets the LFO's phase on every note-on. When OFF, the LFO runs freely and notes catch it wherever it happens to be at that moment.
- **Delay:** Fade-in time in milliseconds. The LFO starts silent and gradually reaches full depth, useful for vibrato that builds naturally after a held note.

Tip: *LFO sync uses a different rate table than the arpeggiator. The LFO table includes extra slow divisions (8/1, 4/1, 2/1) for multi-bar evolving sweeps that the arp doesn't need.*

Note: *The LFO Depth knob must be above zero for any LFO modulation in the mod matrix to take effect. Even a very small value (like 0.01) is enough. An LFO can be set up with waveform, rate, and trigger all configured, but it will not produce any audible movement unless it is routed to a target in the mod matrix AND the Depth knob is raised above zero.*

5.5 Depth and the Mod Wheel

The LFO Depth knob sets the base level of modulation. When Mod Wheel is routed to LFO1 Depth in the mod matrix, the wheel scales that base level — it acts as a multiplier, not an additive offset. With the wheel at zero, the panel depth determines the modulation alone. Pushing the wheel up scales the panel depth upward.

Because the relationship is multiplicative, the panel depth must be above zero for the wheel to have any effect: a panel depth of zero multiplied by any wheel position is still zero. This is why Zorba's default patch ships with a small non-zero LFO1 Depth (GUI 3.14, stored 0.0314), so the wheel routing is immediately responsive when a user reaches for it.

In practice this gives performers a vibrato that's subtly present at rest (around 7 or 8 cents of pitch movement, enough to feel alive) and can be intensified expressively with the Mod Wheel when a phrase needs emphasis.

Going Deeper — Chorus rates from classic instruments

Zorba's LFO2 can produce convincing Juno-60 and Jupiter-8 style chorus effects when set to MONO and routed to VCO Tune and VCF Pan. Empirically measured reference rates:

Juno-60 Chorus I: LFO2 at 0.51 Hz, small depth (~9 cents of pitch modulation).

Juno-60 Chorus II: LFO2 at 0.86 Hz, slightly larger depth (~11 cents).

JP-8 Chorus I: LFO2 at 1.3 Hz, larger depth (~27 cents).

JP-8 Chorus II: LFO2 at 2.11 Hz, dramatic depth (~41 cents).

For all of these, use split routing (VCO1 → VCF1, VCO2 → VCF2) with filter pan at roughly ±0.35 and Ether noise at −28 dB for the BBD haze character.

6. The Modulation Matrix

6.1 What the Mod Matrix Does

The mod matrix is where Zorba's sound comes alive. It connects sources of movement (LFOs, envelopes, performance controls) to destinations all over the synthesizer: pitch, filter, volume, pan, and almost anywhere else you might want motion.

Without the mod matrix, Zorba's sound would be static: oscillators playing a fixed tone, filters holding a fixed cutoff, volume staying at one level. The matrix is what makes everything breathe, respond, and evolve.

Each connection is called a route. Each route has a depth that controls how strongly the source affects the target. Zorba provides 174 routes across 10 sources and 38 unique targets. Any source can be routed to any of its valid targets, and multiple sources can target the same parameter simultaneously, their contributions sum. There are no slot limits.

6.2 The Ten Sources

Sources fall into two groups: modulation sources that run automatically, and performance sources that respond to what you do with your hands.

Modulation Sources

- **LFO1:** 26 targets. Always MONO. Primary vibrato and cyclical motion. Reaches all three oscillators (VCO1/2/3 Tune), Master Tune, all PWM/Wave/Gain controls, FM Amount, Noise parameters, all VCF Cutoff/Resonance/Pan controls, and LFO2 cross-modulation. The VCO Wave targets let LFO1 cycle the waveform morph continuously.
- **LFO2:** 26 targets. POLY or MONO. Same target list as LFO1, plus LFO1 cross-modulation. Designed for chorus, PWM breathing, and per-voice scatter. POLY + LFO2 → VCO Wave gives each voice in a chord its own slow morph drift, producing wide, evolving pad textures.
- **EG1:** 5 targets. Noise HPF, LPF, HPF Resonance, LPF Resonance, and Pan.
- **EG2:** 7 targets. Noise HPF, LPF, HPF Resonance, LPF Resonance, Level, and VCF1/VCF2 Resonance.

- **EG3:** 26 targets. The most versatile envelope source, covering VCO1/2/3 Tune, Master Tune, VCO1/2 PWM, VCO1/2 Wave (morph), VCO1/2/3 Gain, FM Amount, Noise parameters (HPF, LPF, HPF Resonance, LPF Resonance, Level, Pan), VCF1/VCF2 Cutoff, VCF1/VCF2 Resonance (for envelope-driven resonance chirp gestures), and LFO1/LFO2 Rate and Depth.
- **Arp Accent:** 16 targets. Fires on accented arpeggiator steps for rhythmic emphasis on filter, volume, FM, and more.
- **Keyboard Tracking (KB):** 14 targets. Scales parameters based on which note you're playing. Faster vibrato up high, brighter noise in upper registers, filter resonance that changes with pitch, noise filter Q that tightens or opens based on register.

Performance Sources

- **Velocity:** 18 targets. How hard you press the key. VCA OUT, VCF1/VCF2 EG2 Amount, VCO1/VCO2/VCO3 Tune, Master Tune, VCF1/VCF2 Resonance, EG3 Amount, EG1/EG2/EG3 Attack time, EG1/EG2 Decay time, and Noise parameters (HPF, LPF, Level).
- **Mod Wheel:** 19 targets. Real-time expressive control. FM Amount, VCA OUT, EG2/EG3 Amount, VCF1/VCF2 Cutoff, VCF1/VCF2 Resonance, LFO1/LFO2 Depth, LFO1/LFO2 Rate, Noise HPF, Noise LPF, EG1/EG2 Attack and Decay times (so the wheel can reshape envelope timing on the fly), and Master Tune.
- **Aftertouch:** 17 targets. Finger pressure after the key is down. The most flexible performance source, reaching FM Amount, VCA OUT, EG2/EG3 Amount, VCF Cutoff, VCF Resonance, VCO1/VCO2/VCO3 Tune, Master Tune, LFO Depth and Rate, VCO3 Gain.

Key tracking on the filter and EG2 filter amount are not Mod Matrix sources. They're handled directly by dedicated knobs on the VCF panels for immediate access.

6.3 The 38 Targets

The targets span every section of the synthesizer:

- **Oscillator pitch:** VCO1 Tune, VCO2 Tune, VCO3 Tune
- **Oscillator timbre:** VCO1 PWM, VCO2 PWM, VCO1 Wave, VCO2 Wave
- **Oscillator level:** VCO1 Gain, VCO2 Gain, VCO3 Gain
- **FM:** FM Amount
- **Noise:** Noise Level, Noise HPF, Noise LPF, Noise HPF Resonance, Noise LPF Resonance, Noise Pan
- **Filter:** VCF1 Cutoff, VCF2 Cutoff, VCF1 Resonance, VCF2 Resonance, VCF1 Pan, VCF2 Pan
- **Envelope amount (VCF-hardwired):** VCF1 EG2 Amount, VCF2 EG2 Amount
- **Amplitude:** VCA OUT (voice output level)
- **Envelope depth:** EG2 Amount, EG3 Amount
- **Envelope attack time:** EG1 Attack, EG2 Attack, EG3 Attack
- **Envelope decay time:** EG1 Decay, EG2 Decay
- **LFO intensity and speed:** LFO1 Depth, LFO2 Depth, LFO1 Rate, LFO2 Rate

6.4 Route Depth

Each route has a depth that sets the strength of the connection:

- **Bipolar targets (pitch, pan, filter cutoff):** depth ranges from −1000 to +1000. Negative values invert the direction of modulation.
- **Unipolar targets (gain, FM amount, resonance):** depth ranges from 0 to 1000.

A depth of 0 means the route exists but has no effect (you've armed it without committing). Small values produce subtle motion; large values produce dramatic sweeps. Negative values on bipolar targets are genuinely useful. A negative route of EG3 to VCO Wave, for example, makes the morph go from richer to simpler over the course of a note instead of the other way around.

6.5 How Routes Work Together

Two routes to the same target combine naturally. Set Mod Wheel → VCF1 Cutoff to a moderate amount, then also set Aftertouch → VCF1 Cutoff. Pushing the wheel opens the filter. Leaning into aftertouch opens it more. Both at once, it opens more still, each gesture adding to the other. The same is true on VCO Tune: LFO1 provides vibrato, and you can add Aftertouch → VCO Tune for a pressure-based pitch swell, and they work together. This applies to every target in the matrix: route as many sources as you want to the same destination and they combine.

6.6 Default Routings

Zorba comes with several routings pre-wired as the baseline so you get immediate musical feedback without any setup:

- **LFO1 → VCO1 Tune** and **LFO1 → VCO2 Tune:** Vibrato on both primary oscillators (always on, scaled by the panel Depth knob and the Mod Wheel)
- **Mod Wheel → LFO1 Depth:** Vibrato intensity control
- **Mod Wheel → VCF1 Cutoff** and **Mod Wheel → VCF2 Cutoff:** Subtle filter opening as the wheel rises
- **Velocity → VCA OUT:** Dynamic volume response to how hard you play
- **Velocity → VCF1/VCF2 EG2 Amount:** Velocity-sensitive filter envelope depth
- **Aftertouch → VCF1/VCF2 Cutoff:** Pressure-controlled filter opening
- **Arp Accent → VCF1/VCF2 Cutoff:** Rhythmic filter emphasis on accented steps (active even when the arp is off; the accent still fires on the note itself)
- **Pitch Bend → all oscillators:** Always active, always on

Note: *When the VCF1 → VCF2 selector is set to FOLLOW, the default routings to VCF2 Cutoff from Mod Wheel, Aftertouch, and Arp Accent are automatically suppressed by the house map. VCF2 already follows VCF1 through the FOLLOW link, so routing those gestures directly to VCF2 would double the movement.*

6.7 How the GUI Shows the Matrix

The mod matrix GUI is a three-panel display, stacked top to bottom. Each panel feeds the others, so you can navigate the entire connection graph through clicks alone — every source name and target name is itself a portal that takes you somewhere useful.

- **Source field (top):** Pick the source you're working with from a dropdown (LFO1, LFO2, EG1, EG2, EG3, Velocity, Mod Wheel, Aftertouch, Arp Accent, KB). An asterisk before a source name in the dropdown indicates that source has at least one active route in the current preset — a quick scan of the dropdown shows you which sources are doing work. To the right of the source name, the field shows "Target (N)" where N is the count of currently-connected targets for that source.
- **Target field (middle):** A horizontal strip showing the names of every target the current source is actively modulating. Each name is a clickable badge. Click the Target dropdown to open a full list of valid targets for the source: a search field at the top filters the list as you type (no need to click a search button), and a Clear button beside the search clears the search text to restore the full list. Each row in the dropdown has a checkbox for enable/disable on the left and a small depth control on the right — adjust depth right there in the row.
- **Reverse-lookup field (bottom):** When you click any target badge in the middle field, this bottom field populates with every source currently modulating that target. Click any source name in this list and that source jumps to the top, the middle field repopulates with its targets, and the cycle continues. Walking around the matrix this way is faster than scrolling — see what feeds VCA OUT, click EG2 from the result, see what EG2 feeds, click VCF1 Res, and so on. Useful when you're trying to understand why a parameter is moving, or to clean up routings.
- **Enlarged view:** Click the "MOD MATRIX" label on the right edge of the matrix area to scale the matrix display up by about 20%. Source names, target names, and depth controls all render larger for easier readability when working through complex routings. Click the label again to return to normal size. The enlarged state is held while you work in Zorba but is not saved with the preset and not stored in DAW state — close and reopen the plugin and you're back to normal size.

Going Deeper — Routing patterns that work well

Here are a few combinations that reward exploration:

• LFO2 → VCF1 Pan and LFO2 → VCF2 Pan in opposite directions: stereo chorus that moves the filters apart rhythmically.

• EG3 → FM Amount with a slow decay: FM bell that starts metallic and cleans up as it sustains.

• EG3 → VCF1 Resonance with a fast attack and short decay: a resonance chirp on attack — a momentary singing-filter ping that punctuates the note.

• LFO2 POLY → VCO1 Wave and VCO2 Wave at small depths: per-voice waveform drift that gives pads a constantly evolving harmonic texture.

• KB → Noise HPF: higher notes get brighter breath/click transients, just like a real acoustic instrument.

• LFO1 → Noise LPF Resonance: slowly breathing wind or ocean-wave textures as the Q opens and closes.

• EG3 → Noise LPF Resonance with fast attack and short decay: pitched toms and drums, where the resonance peak becomes the fundamental.

• Aftertouch → LFO1 Rate: pressing into a held note makes the vibrato speed up, a classic expressive trick from the Yamaha CS-80.

• Velocity → EG1 Attack (negative depth): playing harder gives a sharper attack while playing softly gives a slower, gentler attack. A touch-responsive envelope.

• Velocity → VCF Resonance: harder strokes produce more bite and edge, just like acoustic instruments that get more resonant when played aggressively.

• Arp Accent → FM Amount: metallic pulse on accented arpeggio steps for digital-flavored bass lines.

• Mod Wheel → EG3 Amount: wheel scales the entire EG3 envelope's impact across all its destinations at once.

• Mod Wheel → EG1 Attack: the wheel lets a player soften or sharpen the attack of every note on the fly.

7. Arpeggiator and Accent

7.1 What an Arpeggiator Does

An arpeggiator takes the notes you're holding and plays them one at a time, in a pattern. Hold three notes, get a three-note repeating pattern. It's one of the oldest and most immediate ways to turn a static chord into a rhythmic musical line.

7.2 The Basic Controls

- **Direction:** Up (ascending), Down (descending), Up-Down (alternating), Random, or As Played (in the order you pressed the keys).
- **Rate:** In free-run mode, 0.1–12 Hz. In sync mode, 21 musical divisions from whole notes down to 64th-note triplets.
- **Octave Range:** How many octaves the pattern traverses palindromically above the held notes. Four positions: 0 Oct (the held note retriggers at the arp rate, no octave motion); 1 Oct (one octave up and back, e.g. holding C2 produces C2-C3-C2-C3...); 2 Oct (three octaves up-and-back: C2-C3-C4-C3-C2-C3-C4-C3...); 3 Oct (four octaves: C2-C3-C4-C5-C4-C3-C2...). The traversal is always palindromic — the pattern goes up, then comes back down before repeating.
- **Gate:** How long each note holds before the next one starts. Short gates (10–30%) give staccato patterns; long gates (80–100%) give legato patterns.

- **Hold:** Latches the current note buffer so the arpeggiator keeps running after you release the keys. Press the H button again to release. The latch is internal to Zorba — it operates independently of your sustain pedal (CC64) and is not captured in MIDI track recording. The behavior is equivalent to the "Hold" function on Roland arps or "Latch" on Novation/Arturia arps. Two hold modes are available: in Classic mode (the default), pressing new keys while the latch is engaged replaces any released notes in the buffer — this matches the behavior most hardware arpeggiators use. In Stack mode, pressing new keys appends them to the buffer — the original notes keep arpeggiating and the new ones join in, useful for building up complex patterns by adding notes one at a time. To switch modes, right-click the H button: a small pop-up appears showing the action you can take ("Switch to Stack" if you're in Classic, or "Switch to Classic" if you're in Stack). The wording itself reveals the current mode, so you can right-click to peek at the state without committing to a switch — just dismiss the pop-up. The chosen mode saves with the preset.
- **Sync:** Locks the rate to your DAW tempo.

7.3 The Accent System

Zorba's arpeggiator has a feature most don't: a five-step accent pattern that emphasizes certain steps of the arp. Each of the five steps can be set to OFF, HALF, or FULL. An accented step hits a little harder, by default, the accent is routed to VCF cutoff, which brightens the filter momentarily. But you can route the accent to many other places too.

Polymetric Magic

Here's where the accent system becomes something special. The accent pattern loops independently of the number of notes you're holding. Accent Steps controls how long the accent pattern is, 1 to 5 steps. If you hold a 4-note chord and set Accent Steps to 3, the accent pattern (3 long) doesn't line up with the chord (4 long). As the arp plays forward, the accents land on different chord notes each cycle.

This creates grooves that evolve over many bars. A 4-note chord with a 3-step accent takes twelve notes to return to where it started. A 5-note chord with a 3-step accent takes fifteen. The groove keeps shifting, producing motion you didn't program. It's like having two different rhythms playing against each other inside one pattern.

Tip: *Try Accent Steps = 3 or 5 over a 4-note chord for classic polymetric motion. Try Accent Steps = 5 over a 3-note chord for a slower, more contemplative drift.*

7.4 Routing Accent in the Mod Matrix

Arp Accent is a mod matrix source. Beyond the default VCF cutoff brightening, it can drive 16 targets:

- **VCF1/VCF2 Cutoff:** Classic filter accent (the default).
- **VCF1/VCF2 Resonance:** Punchy resonance ping on accented steps.
- **VCO1/VCO2 Gain:** Volume accent. With the base gain set lower, the accent pushes up for a sidechain-style pumping effect.
- **VCO3 Gain:** Sub bass pulsing. Good in arpeggiated bass lines.
- **VCO1/VCO2 Tune:** Pitch accent. Small amounts for expressive swells, larger for percussive pitch blips.
- **VCO3 Tune:** Sub-octave pitch accent. Small amounts add subtle low-end shimmer on accented steps; larger amounts give percussive sub blips.
- **VCO1/VCO2 PWM:** Timbral accent. Pulse width shifts on accented steps.
- **FM Amount:** Metallic rhythmic pulses, especially striking on linear FM patches.
- **VCA OUT:** Overall volume accent.
- **Noise Level:** Noise burst on accented steps: percussive texture, hi-hat-like character.

8. Performance Controls

8.1 Velocity

Velocity is how hard you strike the key, MIDI's way of capturing touch. In Zorba, velocity affects EG1 amplitude by default, so playing harder gives louder notes (as you'd expect). Velocity is also a mod matrix source with seventeen targets: VCA OUT, VCF1/VCF2 EG2 Amount, VCO1/VCO2/VCO3 Tune, VCF1/VCF2 Resonance, EG3 Amount, EG1/EG2/EG3 Attack time, EG1/EG2 Decay time, and Noise HPF, Noise LPF, Noise Level.

The VCF EG2 Amount target is particularly musical: when routed, harder playing opens the filter more, so a hard stroke is both louder and brighter, just like an acoustic instrument.

8.2 Channel Aftertouch

Aftertouch is finger pressure after the key is already down. It's the most expressive MIDI control on many keyboards, and Zorba gives it sixteen possible destinations, more than any other source. Lean into a held note and you can:

- Brighten the filter (VCF1/VCF2 Cutoff)
- Add resonance (VCF1/VCF2 Resonance)
- Add vibrato depth or speed (LFO1/LFO2 Depth, LFO1/LFO2 Rate)
- Bend the pitch subtly (VCO1/VCO2/VCO3 Tune)
- Push FM amount up for growl or shimmer (FM Amount)
- Swell the volume (VCA OUT)
- Scale envelope depth (EG2 Amount, EG3 Amount)
- Bring up the sub (VCO3 Gain) for organ-style swells

Tip: *Aftertouch is perfect for layered expression: route it to three or four things at once (a little filter opening, a little vibrato intensity, a little FM) and a single gesture (pressing harder) delivers a complex, musical change.*

8.3 Mod Wheel

The Mod Wheel is a continuous controller you move with your thumb on most keyboards. It has eighteen targets on Zorba: FM Amount, VCA OUT, EG2/EG3 Amount (so the wheel scales envelope impact), VCF1/VCF2 Cutoff, VCF1/VCF2 Resonance, LFO1/LFO2 Depth (vibrato and chorus intensity), LFO1/LFO2 Rate (speed control), Noise HPF, Noise LPF, and EG1/EG2 Attack and Decay times — the wheel can reshape envelope timing in real time.

By default, Mod Wheel is routed to LFO1 Depth, the classic vibrato control, along with a subtle filter opening on both VCFs. Push the wheel up and vibrato intensifies while the filter brightens.

8.4 Pitch Bend

Pitch Bend is always active and always affects all oscillators uniformly. The Bend Range setting lets you choose how far it bends, from ±1 semitone (subtle) up to ±12 semitones (full octave bends for extreme leads). Default is ±2.

9. Glide (Portamento)

9.1 What Glide Does

Glide (also called portamento) slides the pitch smoothly from one note to the next instead of jumping. It's the sound of a synth bassline sliding between notes, a lead weeping from pitch to pitch, or a TB-303 slurring in and out of tune. The PORTA section on the panel has three controls: an upper switch (RATE | TIME) that selects how the glide duration is measured, a lower switch (OFF | LEG | ALW) that selects when the glide engages, and the PORTA knob (MIN to MAX) that sets the actual glide amount.

9.2 Glide Modes

- **OFF:** No glide. Every note snaps instantly to its pitch. The PORTA knob has no effect in this mode.
- **LEG (Legato):** Glide happens only when you play notes overlapping (legato: finger still on the previous key when the next is pressed). Staccato notes snap immediately. The sustain pedal counts as legato — if the pedal is held, every new note glides from the previous one regardless of whether the previous key is physically held. This is the most musical setting for most playing, slides happen when you slur, not when you don't.
- **ALW (Always):** Glide happens on every note, regardless of playing style.

9.3 Glide Types

- **TIME:** Fixed glide duration. Regardless of whether you're jumping a semitone or an octave, the glide takes the same amount of time. This is the Roland-style portamento.
- **RATE:** Constant glide speed. The pitch slides at a fixed rate per semitone, so an octave glide takes longer than a whole-step glide. This is the Prophet-5, CS-80, Korg MS-style portamento, generally felt as more musical because small intervals glide quickly and wide intervals take time.

Tip: *Try Rate mode for bass lines and expressive leads where small intervals should feel quick and large intervals should have weight. Use Time mode when you want consistent portamento feel regardless of the interval you play.*

9.4 Retrigger Behavior

Two combinations have special behavior:

- **Glide = ALWAYS with Time = 0:** Produces multi-trigger behavior. Every note retriggers the envelope, even during held passages.
- **Glide = LEGATO with Time = 0:** Produces single-trigger legato. Overlapping notes share the envelope without retriggering; the envelope only fires on the first note of a legato phrase.

10. Reverb and Global Controls

10.1 Reverb

Zorba includes a single built-in reverb, a small plate algorithm with one control, the Plate Decay knob. The decay knob sets the size of the space, from tight room to cathedral. Wet/dry balance is internally fixed so the reverb feels coherent across its whole range without needing extra controls.

Setting the Plate Decay knob to 0 bypasses the reverb entirely, no processing at all, for patches where you want to leave space for your own reverb later.

Here's how the knob maps to decay time and character:

Decay setting	RT60	Character	Good for
0	OFF	Bypass	Using an external reverb
5	0.47 s	Tight room	Bass, percussion
10	0.60 s	Tight room	Bass, percussion
15	0.72 s	Small room	Keys, plucks
20	0.86 s	Small room	Keys, plucks
30	1.19 s	Medium room	Keys, brass
40	1.47 s	Medium room	Keys, brass
50	1.81 s	Hall	Pads
60	2.42 s	Hall	Pads
70	3.18 s	Large hall	Strings, ambient
80	4.30 s	Large hall	Strings, ambient
90	6.95 s	Cathedral	FX, drones
100	9.31 s	Cathedral	FX, drones

The decay follows an exponential curve, so small changes at low settings produce noticeable differences while the upper range opens up dramatically.

10.2 Master Tune

Master Tune shifts the global pitch reference, in cents, with a range of ±100 cents (one semitone in each direction). A value of 0 corresponds to A = 440 Hz. Use this to match other instruments, vintage recordings, or non-standard tunings.

10.3 VCA Out

The VCA Out knob controls the master voice level. It is the target for dynamic expression in the mod matrix: Velocity, Mod Wheel, Aftertouch, and Arp Accent can all modulate it for per-note loudness shaping.

10.4 Playing Mode

- **POLY:** Polyphonic. Multiple voices sound simultaneously.
- **MONO:** Monophonic. A single voice with last-note priority. The right choice for most leads and basses.

10.5 Unison

Unison stacks two voices for every note you play, with an internally calibrated detune amount that gives a thick, lively character. There is no detune knob on the panel; the spread is fixed by design and chosen by ear. Unison is a simple on/off control. When OFF, you get standard MONO or POLY voicing per the VOICE switch. When ON in MONO, the single mono voice becomes a 2-voice stack. When ON in POLY, polyphony is preserved and each voice becomes a 2-voice stack — so a four-note chord uses eight voices total, all detuned. Note that the TUNE knob immediately below the UNISON button is Master Tune (the global pitch reference of the instrument, ±100 cents around A = 440 Hz). It is unrelated to Unison detuning, despite their visual proximity.

10.6 Bend Range

Sets how far the Pitch Bend wheel shifts oscillator pitch. Ranges from subtle (±2 semitones) to extreme (±12 semitones). Pitch bend always affects all oscillators uniformly.

11. Sound Design Techniques

11.1 Hard Sync Textures

Hard Sync produces distinct characters depending on the pitch relationship between VCO1 and VCO2. A VCO1 tune offset of about 0.22 gives a clean, stable sync lock for aggressive leads. An offset of about 2.27 produces a unique sync-derived unison chorus with doubled harmonics. Use an LFO or EG3 routed to VCO1 Tune to animate the sync sweep for evolving, talking-synth leads.

11.2 FM Bell Tones

Set VCO1 to Sine (the carrier), VCO2 to Sine with Key-Off enabled (fixed-pitch modulator). Use Linear FM with a moderate FM Amount (2–6 on the GUI). The fixed modulator creates naturally varying inharmonic ratios across the keyboard, low notes sound bassy and clean, middle notes sound like bells, high notes sound like celesta or wind chimes.

For an extra layer of life, route EG3 to FM Amount with a fast attack and medium decay, the bell will have a metallic bloom at the start that cleans up into clean tone.

11.3 Noise Transients and Key Click

Route EG3 → Noise Level with a fast attack, short decay (around 80 ms), and zero sustain. You get realistic plucks, breath sounds, percussive hits, or organ key click. Shape the transient character with the Noise HPF and LPF, high-pass around 2 kHz gives sharp click; low-pass around 500 Hz gives thump or body.

11.4 Waveform Evolution

Route EG3 to VCO1 Wave or VCO2 Wave to sweep the waveform morph position over the life of a note. A negative amount with a decaying EG3 starts the note at a sine-like state and enriches toward saw-like harmonics as the envelope decays: a reverse-brightness effect that no filter envelope can replicate, because it's changing the source rather than filtering what comes after.

Positive amounts do the opposite, start at richer harmonics and simplify toward sine as the envelope decays. Particularly effective on pads where you want the note to start with air and settle into purity.

LFO1 and LFO2 can also reach VCO Wave for continuous cyclical morphing rather than one-shot envelope motion. Set LFO2 to POLY with a small Wave depth and each voice in a chord drifts through its own morph cycle independently, producing wide, constantly-evolving pad textures.

11.5 Polyrhythmic Motion

Set Accent Steps to 3 or 5 while holding a 4-note chord. The accent pattern and note count are coprime, creating shifting rhythmic emphasis that takes twelve or twenty notes to repeat. This is a way to get generative-feeling motion out of a simple arpeggio.

11.6 Evolving Dual Filter Layers

Using split routing: assign EG2 to VCF1 cutoff and route EG3 to VCF2 cutoff with a different envelope shape. Pan the filters to ±0.35. The result is rich evolving stereo motion, two independent filter sweeps across the stereo field, each with its own shape, creating a sound that's alive and three-dimensional.

11.7 Chorus and Ensemble

Zorba doesn't have a dedicated BBD chorus module, but it simulates classic chorus using VCO2 as a detuned copy with LFO2 animating the pitch. Split routing (VCO1 → VCF1, VCO2 → VCF2) with opposing pan modulation via LFO2 creates genuine stereo width. Add Ether noise at −28 dB with HPF 400 / LPF 8 kHz for analog haze. Set LFO2 to MONO for coherent sweep across all voices.

11.8 The Black Hole Pad

Route EG2 to VCF1 Resonance at maximum depth, with EG2 Decay set to 6–20 seconds. As you hold a note, the resonance climbs through the four zones. Around zone 3 the filter screams; crossing into zone 4, it locks up briefly and rebounds as a pitched tone an octave below the cutoff, slowly climbing back into tune. A texture no other synth produces.

EG3 → VCF Resonance is also available for a shorter, more rhythmic resonance gesture — a chirp ping on attack rather than the long death-rebirth arc.

12. Patch Recipes

These are starting points, use them as the first move in a sound-design session, not as finished patches. Every one of them rewards tweaking.

12.1 Warm Analog Pad

For a pad that breathes and fills the stereo field:

- VCO1: Saw, 8′
- VCO2: Pulse with slight detune (+0.008)
- Split routing: VCO1 → VCF1, VCO2 → VCF2, pan ±0.35
- LFO2: Triangle, MONO, 0.51 Hz → VCO2 Tune + VCO2 PWM for chorus animation
- Ether noise at −28 dB for air
- EG1: Slow attack (~100 ms), high sustain, long release (~800 ms)
- EG2: Medium attack, low amount (0.10–0.15), moderate sustain

12.2 80s Brass

For a Jupiter-style brass stab:

- VCO1 & VCO2: Saw, unison with slight detune (+0.004)
- Slight VCO2 → VCO1 FM (Linear, Amount ~3) for metallic edge
- EG2: Fast attack, strong amount to cutoff, medium decay, zero sustain
- EG1: Fast attack, high sustain
- Aftertouch → VCF Cutoff for expressive swells

12.3 Bell FM Tone

For a clean bell or electric piano character:

- VCO1: Sine (carrier)
- VCO2: Sine, Key-Off ON (fixed-pitch modulator)
- FM Mode: Linear. FM Amount: 3–6
- EG1: Fast attack, medium decay, low sustain for bell envelope
- EG3 → FM Amount with fast attack and decay for bloom

Tip: *Use 96 kHz session rate for clean FM patches to avoid aliasing in the upper register.*

12.4 Minimal Techno Arp

For an evolving rhythmic arpeggio:

- Any lead-type patch (VCO1 Saw, LP filter, fast EG1)
- Arp ON, Up direction, synced rate (1/16)
- Accent Steps = 3, pattern: FULL / OFF / HALF
- Accent → VCF1 Cutoff (pre-wired) for rhythmic brightness
- Add Accent → FM Amount for metallic pulses on the accented steps
- Hold a 4-note chord for polymetric accent drift

12.5 Ensemble Strings

For a lush string ensemble:

- VCO1: Saw. VCO2: Pulse, detune +0.008
- Split routing with pan ±0.35
- LFO2 MONO, 0.51 Hz (Chorus I), depth at ensemble level (~0.68)
- Ether noise −28 dB, HPF 400, LPF 8000
- EG1: Slow attack (~100 ms), high sustain, long release (~800 ms)
- EG2: Gentle, low amount (0.08–0.12), moderate sustain

12.6 Classic Sub Bass

For a deep, focused low end:

- VCO1: Pulse (width ~0.5)
- VCO3: Sine, 32′, gain −18 dB
- LP filter, low cutoff (~400–600 Hz)
- Mono mode
- Glide: Legato, Rate type, moderate time

12.7 Vocal Formant Pad

For a choir-like vowel character:

- Both VCOs: Pulse waveform
- VCF1 → VCF2: FOLLOW mode
- VCF1 and VCF2: Band-Pass mode, resonance set to 35–50 on the GUI knob (mid-Zone 1) for vowel formants
- Space VCF1 and VCF2 cutoffs apart (e.g., VCF1 at 800 Hz, VCF2 at 2 kHz)
- Aftertouch → VCF1 Cutoff shifts both formants together via the FOLLOW link

12.8 Sync Lead

For a cutting, aggressive lead:

- VCO1: Saw, 8′ (master)
- VCO2: Saw, 8′, H-Sync ON
- VCO1 Tune: 0.22 for clean hard lock
- LFO or EG3 → VCO1 Tune for animated sync sweep
- Mono mode, Bend Range = 7 semitones

12.9 Gain Pump Arp

For a sidechain-style pumping arpeggio without needing external sidechain:

- Split routing
- VCO1 gain −8 dB, VCO2 gain −10 dB (lower base so the accent pushes up)
- ARP → VCO1 Gain + VCO2 Gain at 250 each for sidechain-style pumping
- Accent Steps = 3 for polymetric emphasis

12.10 Evolving Drone

For a slowly morphing ambient drone:

- VCO1 Saw, VCO2 Triangle, VCO3 Sine at 32′
- LP filter, resonance in Zone 2 (46–54%) for subtle filter singing
- EG1: Very slow attack (~800 ms), full sustain, very long release (~3 s)
- LFO2 slow and POLY → VCO1 Wave + VCO2 PWM for per-voice waveform drift
- Reverb Decay at 70–90 for cathedral space
- Hold a chord and let it evolve

Appendix A: Modulation Matrix Quick Reference

This table summarizes all 10 modulation sources, their target counts, and key destinations for quick reference during sound design.

Source	Group	Targets	Key destinations
LFO1	Modulation	26	VCO1/2/3 Tune, Master Tune, VCO1/2 PWM, VCO1/2 Wave, Gain, FM Amt, Noise (incl. HPF/LPF Res), VCF Freq/Res/Pan, LFO2 cross-mod
LFO2	Modulation	26	Same as LFO1 plus LFO1 cross-mod (POLY or MONO)
EG1	Modulation	5	Noise HPF, LPF, HPF Res, LPF Res, Pan
EG2	Modulation	7	Noise HPF/LPF/Res/Level, VCF1/VCF2 Res
EG3	Modulation	26	VCO1/2/3 Tune, Master Tune, VCO1/2 PWM, VCO1/2 Wave, VCO1/2/3 Gain, FM Amt, Noise (incl. HPF/LPF Res), VCF Freq/Res, LFO Depth/Rate
Arp Accent	Modulation	16	VCF Freq/Res, VCA OUT, FM Amt, VCO Gain/Tune/PWM, VCO3 Tune, Master Tune, Noise
KB (Key Track)	Modulation	14	Noise HPF/LPF/Res/LVL, VCO Gain, VCF Res, LFO Rate, FM Amt, EG2 Amt
Velocity	Performance	18	VCA OUT, VCF EG2 Amt, VCO1/2/3 Tune, Master Tune, VCF Res, EG3 Amt, EG1/2/3 Attack, EG1/2 Decay, Noise HPF/LPF/Lvl
Mod Wheel	Performance	19	FM Amt, VCA OUT, EG2/EG3 Amt, VCF Freq/Res, LFO Depth/Rate, Noise HPF/LPF, EG1/2 Attack/Decay, Master Tune
Aftertouch	Performance	17	FM Amt, VCA OUT, EG2/EG3 Amt, VCF Freq/Res, VCO1/2/3 Tune, Master Tune, LFO Depth/Rate, VCO3 Gain

Total: 174 routes across 10 sources and 38 unique targets.

Appendix B: Keyboard Shortcuts

Zorba includes a few keyboard and mouse shortcuts that speed up sound-design work. They fall into two categories: temporary knob bypass for A/B comparison, and panel-copy shortcuts for mirroring settings between paired sections.

B.1 Temporary Knob Bypass

Hold the modifier keys below while clicking or hovering on a supported knob to temporarily send that knob to a reference value. The knob turns gray while the modifier is held, and returns to its original position when you release the keys. This is useful for quickly auditioning a patch without a specific element: mute an oscillator to hear what it contributes, bypass the reverb to check the dry sound, flatten a gain stage to compare levels.

Modifier keys:

- **Mac:** Cmd + Option
- **Windows:** Ctrl + Alt

Supported knobs and their bypass values:

Knob	Bypass value	Effect
VCO1 Gain	−40 dB (minimum)	Mutes VCO1
VCO2 Gain	−40 dB (minimum)	Mutes VCO2 (and kills FM if VCO2 is the modulator)
VCO3 Gain	−40 dB (minimum)	Mutes the sub oscillator
Noise Level	−90 dB (minimum)	Mutes the noise generator
VCA OUT	0 dB (unity)	Removes any VCA OUT boost or cut, useful for level matching
Plate Decay	0% (OFF)	Bypasses the reverb circuit entirely
Noise HPF Resonance	0.71	Returns resonance to the filter's natural curve (no emphasis)
Noise LPF Resonance	0.71	Returns resonance to the filter's natural curve (no emphasis)

Tip: *The bypass is momentary, not a toggle. Release the modifier keys and the knob snaps back to whatever value you had before. This makes it a fast A/B tool: hold the keys to hear "without," release to hear "with."*

B.2 Panel Copy Shortcuts

Zorba has several paired panels where copying settings from one to the other speeds up sound design: matching two oscillators for unison, mirroring two LFOs for chorus work, or duplicating an envelope shape from one stage to another.

Right-click directly on the panel's title (the bold name at the top of the panel, like "LFO," "VCO," "EG," or "VCF") and a small pop-up appears with a single option: Copy from [other panel]. Choose it and all settings in the current panel are mirrored from its counterpart in a single action. Right-clicking on the knobs themselves does nothing — the popup only appears on the title.

Supported pairs:

From	To	What gets copied
VCO1	VCO2	All oscillator settings (Range, Tune, Morph, PW, Gain, routing)
VCO2	VCO1	Same, reverse direction
LFO1	LFO2	Waveform, Rate, Depth, Sync, Trigger, Delay
LFO2	LFO1	Same, reverse direction
EG1	EG2 or EG3	Attack, Decay, Sustain, Release
EG2	EG1 or EG3	Same
EG3	EG1 or EG2	Same

Tip: *A common workflow: dial in VCO1 exactly how you want it, then right-click on VCO2 → Copy from VCO1 to match. Now detune VCO2 slightly for chorus thickness without having to reset every parameter by hand.*

13. Managing Presets

13.1 Factory and User Presets

When installing an update, the installer will overwrite factory presets unless you deselect the "Install Presets" option during installation. Your own user presets are never affected by updates.

To protect any modifications you have made to factory presets, save them with new names using the "Save As" option in the preset browser before updating.

Tip: *The preset browser captures keyboard focus while open, which means the spacebar will not pass through to your DAW transport. To audition presets in context, start playback in your DAW first, then open the preset browser and navigate. Playback continues uninterrupted while you browse.*

13.2 Backing Up Presets

Presets are stored as files on your computer and can be backed up by copying them to any location you choose.

- **Windows:** C:\Users\Public\Documents\Pulsar Modular\Zorba\Presets
- **macOS:** /Users/Shared/Pulsar Modular/Zorba/Presets

14. Uninstalling Zorba

14.1 Windows

- **VST3:** C:\Program Files\Common Files\VST3\Pulsar Modular: delete Zorba.vst3
- **AAX:** C:\Program Files\Common Files\Avid\Audio\Plug-Ins\Pulsar Modular: delete Zorba.aaxplugin
- **Shared files:** C:\Users\Public\Documents\Pulsar Modular: delete the Zorba folder

14.2 macOS

- **AU:** /Library/Audio/Plug-Ins/Components: delete Zorba.component
- **VST3:** /Library/Audio/Plug-Ins/VST3/Pulsar Modular: delete Zorba.vst3
- **AAX:** /Library/Application Support/Avid/Audio/Plug-Ins/Pulsar Modular: delete Zorba.aaxplugin
- **Shared files:** /Users/Shared/Pulsar Modular: delete the Zorba folder

Contributing Sound Designers

The Zorba factory library was curated by Ziad Sidawi, the designer of Zorba, in collaboration with a select group of musicians, synthesists, performers, and sound designers from different musical backgrounds.

Each contributor brings a distinct sonic perspective to the instrument, with their presets organized into dedicated folders within the Zorba library, allowing users to explore individual artistic approaches and sound design styles.

Pim Schilperoort

Pim Schilperoort is a sound designer and record producer from Amsterdam. He was involved in the development of some legendary synthesizers like the Alesis Andromeda and Hartmann Neuron. Zorba is the first software synthesizer that Pim thinks is so good that he forgets it's not a piece of vintage hardware.

Maik Schott

Maik Schott is a German keyboardist, composer, producer, and sound designer with a long career spanning touring, television productions, jazz performance, and modern synthesizer sound design.

Born in 1969 in Gevelsberg, Germany, Maik studied Jazz Piano at the Conservatory of Jazz in the Netherlands between 1993 and 1997. Throughout his career, he has worked with artists including Sasha (Dick Brave), Max Mutzke, Rea Garvey, Gregor Meyle, Roachford, Chuck Berry, and Renee Olstead, while also contributing to numerous live tours and television productions.

Since 2020, Maik has focused extensively on modular synthesis, cinematic composition, and professional sound design for KORG synthesizers including the WaveState, ModWave, and Multi/Poly.

Maik also operates his own sound design shop, offering professional preset libraries and sound collections: maikschott-sounds.myshopify.com

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Please kindly report any errors or omissions in this user guide to psupport@pulsarmodular.com.

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