RADICAL1

USER MANUAL

SoundRadix

break free.

Welcome to Radical1

Welcome to Radical1, Sound Radix's first dive into the wild, colorful world of additive synthesis.

We built Radical1 for sound designers, producers and creators to explore sound at its most fundamental level: the harmonics. Rather than tweaking another subtractive synth, Radical1 is about shaping the audible spectrum.

Installation & Authorization

Getting started is easy:

1. Download and install Radical1 from the Downloads page.
2. Open your DAW and load Radical1 as a plugin (VST3, AU, or AAX).
3. Follow the steps on the screen to activate your license or start your 14-day trial.

If anything goes sideways, our support team is a message away.

Radical1's Engine

At its core, Radical1 is an **additive synthesizer**, an instrument that builds sound from the ground up by combining simple sine waves (called **partials**) into complex structures. With enough partials, you can create any sound imaginable.

Radical1 is powered by a patent-pending **efficient spectral engine**, capable of handling **tens of thousands of partials** in real time. It provides ultra-fine spectral resolution, smooth, artifact-free harmonic motion, and immediate response to any hit note, modulation or gesture, all while staying light on CPU.

The powerful engine enables Radical1's modular architecture: In a single preset, you can combine multiple **spectral Layers**, each acting as a mini-synthesizer with its own harmonic world.

Radical1's interface is different. Instead of fixed panels for oscillators or filters, you get a modular canvas built around **spectral-domain Layers** and **Blocks**, **time-domain MIDI** and **Audio Effects**, and **Modulators**. Every part of the sound engine is visible and directly interactive.

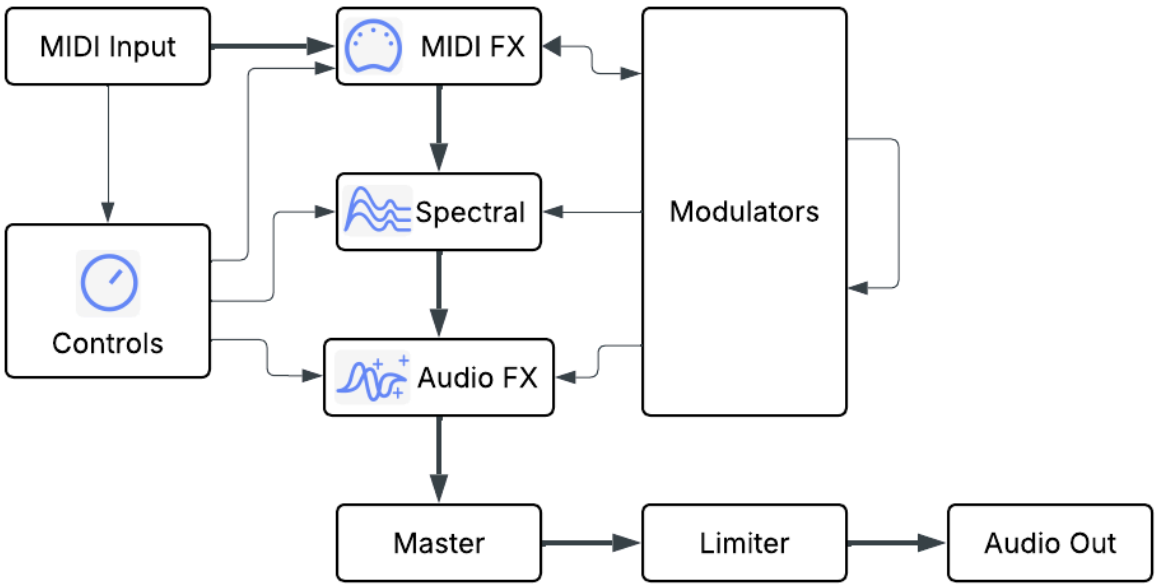
Interface elements:

1. **Undo/Redo Controls:** Experiment without having to worry about losing your current sound.
2. **View Toggles**: Hide less frequently accessed elements to make room for others (or to gaze at the pretty spectrogram).
3. **Presets Bar**: Browse, load, and save presets quickly, or click to access the **Presets Explorer** view.
4. **Global Section**: Master volume, limiter, CPU usage and misc. settings. The Panic button is also here in case things get too messy or loud.
5. **Spectrogram**: A real-time visualization of the harmonic content, available both in the background and in a dedicated pane to always have a clear view.
6. **MIDI FX**: Process MIDI/MPE prior to spectral processing using Arpeggiator, Glide, Tuning and more.
7. **Spectral Layers**: Add and edit Layers and Blocks to generate and process audio in the spectral domain.

8. **Modulators**: Envelopes, LFOs, and performance sources that modulate other parameters and bring sounds to life. Add as many as you want.
9. **Audio FX**: Process your sound after spectral processing using Delay, Chorus, Reverb, Compressor and more.
10. **Controls**: Star any parameter to control it using assignable **MIDI CC** or **automation**.
11. **MPE Keyboard**: A virtual MPE controller and display of played notes with pressure and velocity, pre- and post-MIDI FX. Next to the keyboard are the hold pedal, pitch bend and modulation wheels, and settings for pitch bend range and polyphony.

Architecture

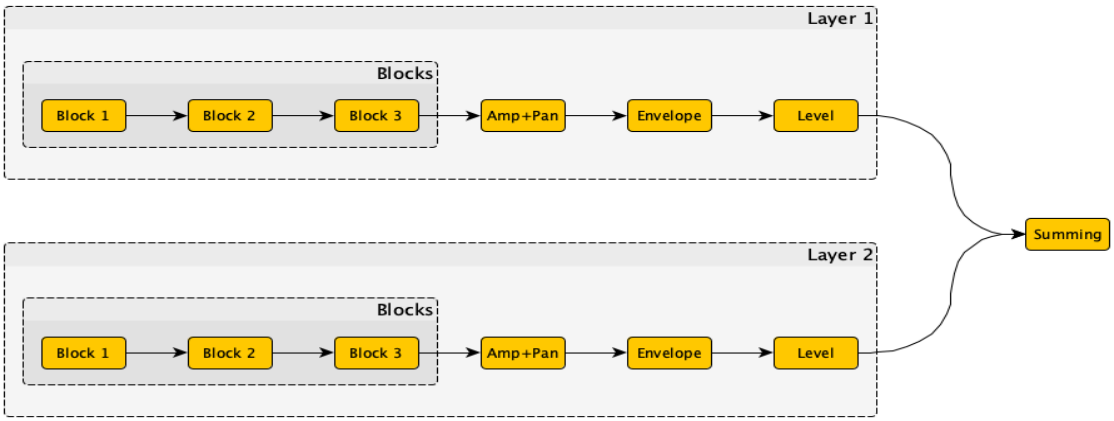
To make the most of its powerful engine, Radical1 is organized as a flexible, modular framework built on five core concepts: **Layers**, **Blocks**, **Effects**, **Modulators**, and **Modules**. Together, they form the structure of every sound you create, from a single tone to a full spectral composition.



Layers

Each **Layer** in Radical1 acts as a spectral-domain synthesis environment that can generate and process sound independently. Layers operate in parallel, allowing you to stack complex textures or design evolving multi-part performances. They can also be input into Blocks in other Layers, e.g., Mixer and Route Blocks, to create signal flow between the otherwise separate Layers. There's no limit to how many layers you can use besides your CPU and imagination.

For more on Layers, see Layers below.


Layer 1
Blocks
Block 1
Block 2
Block 3
Amp+Pan
Envelope
Level
Layer 2
Blocks
Block 1
Block 2
Block 3
Amp+Pan
Envelope
Level
Summing

Blocks

Every element inside a Layer is a **Block**. A Block performs a single, focused task, whether it's generating harmonics, applying spectral processing, or performing utility functions.

The two basic roles of Blocks are:

- **Generator Blocks**: Create and control harmonic spectra, e.g, via oscillation, based on a sample, or by routing and mixing outputs of other Layers or Blocks.
- **Spectral Effect Blocks**: Apply spectral-domain transformations such as filtering, resonance, or detuning and stretching partials.

Some Block types can function in either role.

For more on Blocks, see Blocks below.

Effects

Unlike Layers, Blocks and Modules that generate and process audio in the spectral domain, **Effects** process audio in the time domain. **MIDI Effects** apply to incoming MIDI/MPE notes and other events before spectral processing, e.g., by creating arpeggios and gliding between notes; they apply to the *input* to spectral processing. **Audio Effects** apply to the summed spectral *output* of all layers, performing additional time-domain processing such as applying delay or reverb.

For more on Effects, see Effects below.

Modulators

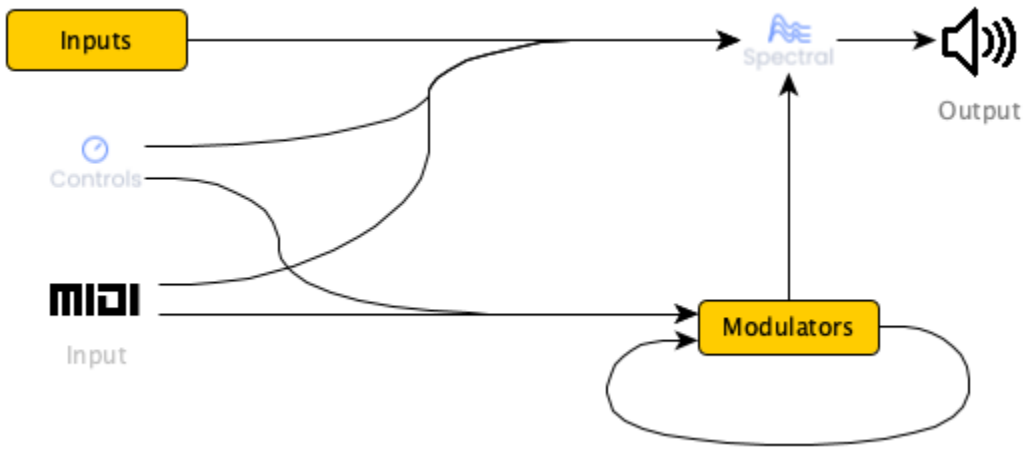
Every **Modulator** can be assigned to modulate one or more parameters, with every assignment creating a **Modulation** of some specified amount. A Modulation increases or decreases the value of a parameter statically or over time. Modulation amounts are themselves parameters which can be further modulated.

Some modulator types, such as an LFO, can be assigned to parameters in both the spectral domain (Layers and Blocks) and the time domain (Effects). Others, such as note strike Velocity, can only meaningfully be assigned to parameters in the spectral domain, with each note's voice being modulated separately.

For more on Modulators, see Modulators below.

Modules

A **Module** is a self-contained, spectral-domain Block, internally composed of Layers, Blocks, and Modulators and saved as a reusable unit. Modules let you encapsulate your favorite designs and reuse them across projects, layer them together for composite instruments, or share them with collaborators.



For more on Modules, see Modules below.

A Modular Playground

The combination of **Layers**, **Blocks**, **Modules**, **Effects** and **Modulators** makes Radical1 feel more like a creative environment than a fixed synthesizer. You can begin with a single harmonic idea, make it more interesting by adding more elements to work together, and keep refining or reshaping your sound in real time.

Layers

Overview

A **Layer** usually contains one Generator Block, followed by a series of Effect Blocks.

To add a new Layer, click the "Add Layer" button, which opens a combo box to choose the type of Generator Block at the head of the Layer. (Note that Layers have no intrinsic type; A Layer's behavior is determined by the Blocks that it contains, which do have different types).

To delete a layer, open the Layer additional actions menu by clicking the menu button on the right side of the header, then click "Delete". If you accidentally or immediately changed your mind after deleting a layer, clicking the Undo button at the top of the plugin view would immediately restore it.

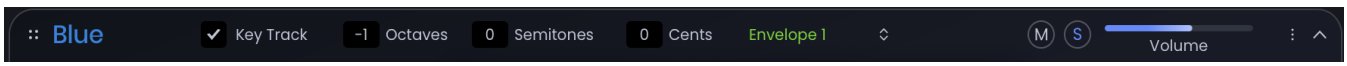
You can duplicate a Layer by clicking "Duplicate" in the same menu. Duplicating a Layer creates and adds a new Layer that's identical to the original except for the Layer name and color, preserving all of its settings, Blocks, and Modulations. Duplicating Layers makes it easy to create variations or parallel processing chains.

You can also reorder Layers: Simply drag-and-drop the drag button at the top left of the header of the Layer you'd like to reposition. Note that reordering layers, while helpful for organizing a preset, usually has no audible effect, because all Layers render in parallel.

If a Layer takes up too much space, you can collapse it using the collapse button at the right edge of the Layer header. Or, if you prefer hiding Layers altogether to focus on other elements of the preset, you can click the "Spectral" view toggle at the top of the plugin view.

Layer Controls

Every Layer has its own controls, with most of them such as pitch transposition, volume and amplitude envelope accessible via the Layer header, even when the Layer view is collapsed.

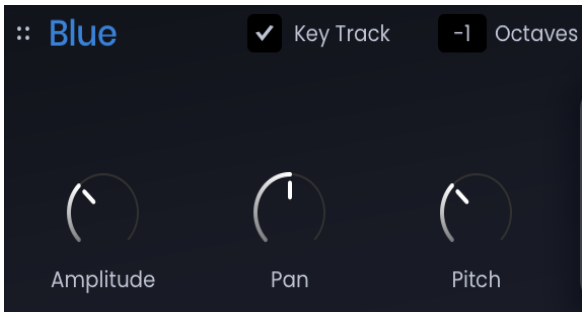


Layer Header Controls (left to right)

Drag Button	Drag-and-drop to reposition Layer (usually no audible effect; Layers render in parallel.)
Colored Layer Name	Shows the name and color of the Layer. Double-click to rename. The Layer's color is used in various places where it is referenced, helpful for easily associating color with sound as the number of Layers increases.
Key Track	Toggles key tracking for incoming MIDI notes: When enabled, the base pitch value of every note is its MIDI pitch; when disabled, it is fixed to C4. Disable it for drones, noise beds, or fixed-tuned textures.
Octaves / Semitones / Cents	Transposes the base pitch value of each note. With Key Track enabled, transposes every incoming note relative to its pitch; with Key Track disabled, transposes relative to C4, effectively setting an absolute rather than relative pitch. Always visible, but can't be modulated; to modulate pitch, use the Pitch inline Layer control.
Envelope	Sets the envelope applied to the Layer's Amplitude. You can assign any finite Envelope Modulator to control it. See below for a more detailed look at this control.
Mute	Mutes the Layer so that its output is not summed into the overall spectral output. A muted Layer's output can still be routed into Blocks such as Route or Mixer.
Solo	Soloes a single Layer's output so that it's the only one summed into the overall spectral output. Other Layers' outputs can still be routed into Blocks such as Route or Mixer.
Volume	Applied after the Layer's Amplitude (see below), setting a gain to the Layer’s output when summing into the overall

	spectral output (doesn't affect output level routed into other Blocks). Drag horizontally or double-click to set.
Menu Button	Opens the additional actions menu (Duplicate and Delete).
Collapse/Expand	Collapses an expanded Layer or expands a collapsed one.

In addition to the controls located in the Layer header, every Layer has three inline parameter knob controls:



Layer Inline Controls (left to right)

Amplitude	Sets a gain to the Layer's output. Modulated by the Layer's selected envelope, in addition to any other assigned Modulations. Unlike Volume, applies to the Layer's output regardless of whether it is summed into the overall spectral output or routed into another Block, e.g., Mixer or Route.
Pan	Stereo panning applied to the Layer's output.
Pitch	An alternative, modulatable control for the same transposition value referenced by the Octaves / Semitones / Cents header controls.

Blocks

Overview

Blocks generate and process audio in the **frequency** or **spectral domain**; Rather than shaping waveforms, you sculpt the harmonics and other partials directly.

The first Block in a Layer is usually a **Generator Block**, which outputs a continuously changing spectrum that is processed in sequence by the following **Spectral Effect Blocks**. Generator Blocks are focused and minimal by design, keeping them efficient while allowing you to further shape the tone using the Effect Blocks. In turn, Effect Blocks are designed to be modular, each having its function, with their order defining your tone (for example: placing a **Unison** before a **Distortion** will have the duplicated voices interfere and distort together as if through a single amplifier, whereas the opposite order sounds like a chorus of amplified signals).

Most Generator Block types continuously take MIDI/MPE events as input, some simply route and mix the outputs of other Layers or Blocks for further processing, and others still (Formula, Module) can take both kinds of inputs.

Spectral Effect Blocks always take the output of the previous Block in the Layer as their input. Some Effect Block types (Formula, Module) can also depend on MIDI/MPE events and outputs of other Layers or Blocks as their inputs.

Every Block's output is also affected by the movement of Modulators that are assigned to modulate any of its parameters (and Modulations elsewhere can also, of course, affect the signal input received by the Block).

Unlike traditional synthesizers where oscillators and filters are fixed components of a signal chain, Radical1 separates **source** (Generator) and **shaping** (Spectral Effects). This approach gives you complete creative freedom to decide *where* and *how* timbral transformations occur in a Layer.

Most commonly, a Generator Block is automatically added as the first Block when adding a new Layer using the "Add Layer" button. To add Effect Blocks to a Layer, click the "Add Block" button located on the bottom-right corner of the Layer view and choose the Block type to add. You can delete any Block, including Generator Blocks, by opening its additional actions menu and clicking "Delete". If a Layer is missing a Generator Block, the "Add Block" button will allow adding a new one.

You can duplicate a Block by clicking "Duplicate" in the additional actions menu. Duplicating a Block inserts a new Block after the duplicated one that's identical to the original.

You can change the type of an existing Block by clicking its type in the header, which opens a combo box to choose the new type. When switching from one Generator Block type to another, Radical1 will attempt to also **convert the existing output spectrum to the new generator type**. For example, you can transform a **AdditiveSample** block into a **DrawSpectrum** one to hear just the harmonic outline of a recorded sample. This is always approximate, but is a great tool for experimenting with variations on a sound.

To reorder Blocks, simply drag-and-drop the Block you'd like to reposition using the drag button on the left side of the header. Most commonly, this is useful to reorder Effect Blocks. In case a Generator Block is reordered to anywhere but the first position in the Layer, the output of Blocks preceding it will be discarded (unless otherwise routed).

Common Block Controls

Every Block header has the same common controls. Left-to-right, these are:

Drag Button	Drag-and-drop to reposition Block, commonly used to reorder Effect Blocks.
Block Type	Shows the type of the block. Click to open a dropdown to change to type.
Menu Button	Opens the additional actions menu (Duplicate and Delete).
Bypass Button	Removes the Block from the Layer's processing chain.

Generator Block Types

BasicOscillator	Generates harmonic spectra based on mathematical waveforms (sine, saw, square). Ideal for clean foundational tones.
ShapingOscillator	Generates harmonic spectra that correspond to classic PWM (pulse-width modulation) waves.
DrawSpectrum	Lets you sketch harmonic amplitudes directly by hand.
AdditiveSample	Reconstructs harmonic data from sampled material, blending additive synthesis with real-world complexity.
Formula	Generates harmonic spectra based on a user-specified mathematical formula.
WaveTable	Renders a WaveTable file from Radical1's bundled sample packs or from disk.
Module	A custom generator internally composed of its own set of Layers, Blocks, and Modulators (for organization and reusability).
Route	Outputs the spectral output of another specified Block or Layer for further processing.
Mixer	Mixes the spectral outputs of specified Blocks or Layers and outputs the result for further processing.

Effect Block Types

Amplitude Modulation	Utility to control or modulate the gain in the middle of a signal chain.
Distortion	Emphasizes and adds even harmonics to the input, simulating the effect of classic time-domain distortion.
Morphing Filter	A filter capable of low-pass, band-pass, high-pass, and notch filters, and continuous morphing between any of these.
HarmonicDetune	Randomly detunes each harmonic separately, creating grit and messiness in the sound.
Noisify	Introduces random noise into each harmonic, gradually transitioning from the original sound to noise/static of the same “shape”.
Resonator	Uses the input as the character of a resonating cavity, which is excited by a sidechain input, the *exciter*. Great for acoustic-style sounds like strings and winds.
SidechainFilter	Uses a sidechain input to dynamically design a filter to apply to the main input, so you can use the full power of the synthesis engine to design complex filters.
StretchTune	Expands or compresses harmonic spacing, bending perceived inharmonicity and introducing bell- or string-like character.

Transpose	Shifts the entire harmonic series up or down by musical intervals or continuous modulation.
Unison	Creates multiple detuned spectral copies for thick, animated sounds.

Modules

Overview

A **Module** is essentially a self-contained, spectral-domain Block. It is an internal composition of its own Layers, Blocks, and Modulators.

Modules can be used in a Layer's processing chain as either a Generator Block (to create spectra) or as a Spectral Effect Block (to process the output of a preceding Block).

To create a New Module and build from it from the ground up, add a Block to a Layer as usual selecting the "New Module" Block type, then click "Edit" in the Module Block view. Alternatively, to load an existing Module, select one in the submenu under the "Module" Block type. You can then use the Module as-is, or click "Edit" to peek at its internals or make modifications. You can also load a preset into a Module, but only its spectral Layers and Modulators will be imported, discarding any MIDI and Audio Effects.

When editing a module, you will notice a few differences: First, the Audio and MIDI FX sections will be hidden, since a Module is solely a spectral-domain element. Second, an area below the top bar will display the current Module's name (which you can click to rename) along with any parent Modules containing the one being edited; usually, the immediate container would be the preset, but you can actually nest Modules within Modules! To save your changes to the module, click the "Save Module" button. Each preset contains its own copy of the modules it uses, so don’t worry about breaking your existing presets by saving changes to your favorite module.

Modules can be controlled from the outside via exposed parameters. To create an external control for a Module, simply 'star' any parameter from its internal Layers, Blocks, or Modulators. Once starred, the parameter becomes an external Module parameter, appearing and behaving just like any other Block control. This is

different from the behavior of starring preset parameters (see Starred Control Parameters Workflow below), except that when loading a preset into a Module, its spectral starred parameters would function as the external parameters.

Effects

Overview

MIDI Effects are applied in sequence to incoming MIDI/MPE notes and other events. To reveal the MIDI Effects view (in case it's not already visible), click the **MIDI FX** view toggle in the top bar. To add a MIDI Effect, click the **+ MIDI FX** button in the bottom-right corner of the MIDI Effects view, then choose the effect type you'd like to add. To delete an Effect, click its additional actions menu button located in its header and choose "Delete". To reorder effects, simply drag-and-drop using the drag handle on the left side of the Effect header.

Every preset always has at least one **Pedals** MIDI Effect which cannot be deleted to apply the Sustain/Sostenuto pedals (it can still be bypassed, in case custom handling of pedal MIDI events is desired). Pedals is an Effect, rather than built-in, to enable different behaviors based on its positioning relative to other MIDI Effects. For example, Glide followed by Pedals will sustain released notes while applying a smoothing effect to the notes being played as a held finger travels over the keyboard, whereas Pedals followed by Glide will keep sustaining a single voice and gliding it to new notes as long as playing within the set glide range.

Audio Effects are applied in sequence to the summed spectral output. To add an Audio Effect, simply click the "Add Audio FX" button located on the bottom-right corner of the Audio Effects view and choose the Effect type to add. Deleting and reordering is similar to MIDI Effects as described above.

To toggle bypassing a single Effect, click the bypass button on the right side of the Effect header. To toggle bypassing all Audio Effects, click the bypass button on the top-right corner of the Audio Effects view.

To collapse either Effects view, click the collapse button on the top-right corner of the view. To expand it, click the same button again. Alternatively, you can completely hide either view by using the view toggle buttons at the top of the plugin view. When editing a module, the Effects views are always hidden to avoid confusion (toggling either view to show would exit to the top-level preset).

By default, both Effect views scroll along with the spectral Layers view. In case you prefer the Effects views to always be visible, you can set that behavior by turning on "Sticky FX" under the global settings.

MIDI Effects Types

Arpeggiator	Arpeggiator generates rhythmic patterns with adjustable speed and swing. Select between Ascending, Descending, As Played, or Random modes to define the note sequence and octave range.
DriftTune	Tune new notes in just-intonated intervals to preceding notes, gradually drifting into standard tuning (equal temperament unless set otherwise by a preceding Tuning effect)
Glide	Smoothly glides toward the target note: either newest, average, or pressure-weighted average of all playing notes within a given range.
Latch	Hold a group of played notes until a new note is played.
NoteContinuity	A repeated played note uses the same voice (similarly to piano or harp string) as the previous note-on of the same note.
Pedals	Applies the effects of the Sustain/Hold and Sostenuto pedals.
ToMonophonic	Sets polyphony to monophonic, only the last played note is audible.
Tuning	Set different tuning from the default A4=440Hz or switch to Primodal12 tuning.

Audio Effects Types

Chorus	Chorus creates a thicker, wider sound by mixing the original signal with a delayed copy whose delay time is modulated by an LFO, resulting in subtle pitch and timing variations.
Compressor	A transparent dynamic processor featuring tempo-synced release times for rhythmic precision and an integrated output limiter to prevent clipping.
Delay	Creates echoes with adjustable time and feedback, including tempo-sync, ping-pong stereo movement, and a reverse mode for more experimental textures.
Distortion	Applies a flexible shaping curve to the signal, adding harmonics with adjustable character and asymmetry. Useful for introducing gentle edges, focused saturation, or more pronounced distortion.
Equalizer	A two-band EQ based on SurferEQ's musical filter curves, with both bands offering full-range control for flexible tone shaping and precise adjustment.
Filter	Classic state-variable and ladder filter designs offering low-pass, band-pass, and high-pass modes.
Flanger	Creates a sweeping comb-filter motion by mixing the signal with a short, modulated delay. Adds a recognizable frequency sweep.
Limiter	Controls peak levels by reducing fast transients above a set threshold, helping maintain consistent output and prevent clipping.
Phaser	Shifts the signal through a series of all-pass filters to create moving spectral notches. Adds smooth, liquid motion ranging from subtle shimmer to deep, swirling sweeps.

Reverb	An algorithmic reverb capable of everything from subtle room ambience to vast spaces, adding depth and atmosphere to the signal.
Ring Modulator	Multiplies the signal with an oscillator to create sum-and-difference frequencies, producing metallic tones, tremolo-like motion, and inharmonic textures.

Modulators

Radical1's modulation engine is built for creativity and flexibility. Nearly every control can be modulated, and every Modulation can itself be modulated; there are no slots or hard limits.

To assign a Modulation to a knob, or to add a nested one to an existing modulation, hover over it and click the '**+**' button, choose a Modulator (either a new one or one that already exists), and then set the modulation amount by dragging the slider.

Alternatively, click the '**Assign**' button of a Modulator, and then drag the knobs you would like to modulate to set the desired modulation amount. To change or remove an existing modulation, hover over the modulation bar and click the combo box arrows on the right.

A modulated knob shows colored rings around it matching the colors of the assigned modulators. Each ring shows the range that the matching modulation can move the base value to. Modulations that are themselves modulated

similarly show this information using thin bars above the main modulation amount bar.

Modulator Types

Families of modulators and common use-cases:

Category	Types	Notes
Time-Varying	Envelope, MSEG, LFO (free or tempo-synced), Noise	
MIDI (Global)	PitchWheel, ModWheel, Expression	Affect entire patch
MIDI (Voice)	Velocity, Pressure, Timbre, KeyTrack	Per-note
Utility	Macro, Formula	
Other	Random	Per-note random value for humanization

Global Mode

Sometimes there is an occasion to modulate an audio effect by a per-note parameter such as velocity or pressure. This doesn't entirely make sense because all voices are summed together before they go through the effect chain, so it would be unclear which note's velocity to use, and so these modulators are disabled in the Audio and MIDI Effects sections by default.

However, there is an advanced workaround. Suppose you want to modulate an audio effect by velocity. Explicitly add the voice modulator by pressing the **Add Modulator** button and selecting Velocity. Then it's possible to assign this to any parameter, including Audio Effects and MIDI Effects parameters, by selecting it from the **+** menu on a knob or using the **Assign** workflow. Once you do, a new dropdown will appear next to the modulator panel: **Global Mode**, which essentially says which voice's parameter to use.

Max	Use the largest value of all the playing voices.
Min	Use the smallest value of all playing voices.

Latest	Use the value from the most recently played note.
Average	Average the values of all playing voices together.
VelWeighted	Average, but give notes with higher velocity more importance.
PressureWeighted	Average, but give notes with greater pressure/aftertouch more importance.

Modulator Effects

Just as spectral sounds can be modified with effect blocks to add character and specialized control, modulators themselves have their own set of effect blocks. These operate on the single scalar value of the modulator changing over time. To add a Modulator Effect, click the three-dot menu in the upper right of a Modulator on the Modulators Panel and choose **+ Modulator Effect**, and select an effect. A new block will appear within the modulator with its associated parameters. Every modulation by this parameter will be affected by this effect.

Sometimes you want to use both the original, unmodified modulator and also the modified one at the same time. This can be done with a simple technique: create a new Macro, modulate it fully by the original modulator, and then apply the modulator effect to the Macro instead. Now the Macro is the modulated version, leaving the original as-is.

Modulator Effects are currently an experimental feature.

Derivative	Measures the instantaneous change in time of the modulator. So if you apply Derivative to Pressure, the output will be zero except when the pressure is currently increasing or decreasing.
Approach	Gradually slides toward the value of the modulator over time. The slide time can be different when increasing vs. decreasing. (Good for fine-tuning the keyboard response of organic sounds)
Filter	Low- or high-pass filters the input. This is a general form of both Derivative (high-pass) and Approach (low-pass).
Curve	Tweaks the response curve of the modulator. The

	curve parameter is essentially the midpoint—where the value 0.5 gets mapped to, and the response curve smoothly adjusts around that.
Delay	Adds a delay line with feedback, just like a delay pedal. Nice to combine with Envelope modulators.

Starred Control Parameters Workflow

Hover over any knob or modulation and click on the star button to add it to the Controls section. Starred controls are saved with each preset, and can be used to control the preset using automation or MIDI-CC mapping.

Preset Manager

Click on the preset section on the top bar to switch to the preset manager view, where you can browse presets by Banks or Tags, search by name, and mark favorites.

Formula Reference

Formula Blocks and Modulators allow you to build custom modulators, transform signals, or design spectral behaviors in real time.

Safety Tip: Keep the limiter ON while experimenting; malformed equations can output extreme values.

Operators

`+ - * /`	Basic arithmetic
`**`	Power / Exponentiation
`%`	Modulo / Remainder
`== < >`	Comparators: Return 1 for true, 0 for false

`( )`	Grouping / Precedence

Variables

`h`	Current harmonic index (1 = fundamental) (Block only)
`ch`	Current channel (-1 = left, 1 = right) (Block only)
`freq`	Layer's fundamental frequency in Hz
`time`	Time since voice start
`gtime`	Global time (shared across voices)
`releaseTime`	Time since note release (0 while held)
`voiceCount`	Number of playing voices
`voiceIndex`	Voice index (0 to voiceCount-1)
`noteIndex`	Increments with each new note
`playhead`	Host playhead position (beats)
`bpm`	Host tempo (beats per minute)

Constants

`pi`	Pi (3.14159...)
`e`	Euler's Number (2.71828...)
`1j`	Imaginary unit (aka. *i*)

Functions

`sin(x), cos(x), tanh(x), exp(x), log(x)`	Core math / wave functions

`abs(x), arg(x), conj(x), Re(x), Im(x)`	Complex math tools
`round(x), max(x), min(x)`	Utility math functions
`limit(x)`	Clamp to ±1 range for stability (complex)
`noise(x)`	Smoothed noise (random at integers)
`input(h,ch)`	Access input signal at h'th harmonic (when used as effect (Block only)

Caveat emptor: when using Formula as an effect block, the input is *flattened* into a harmonic series from the fundamental, due to Formula's processing model. This creates some distortion when processing inharmonic inputs, such as those created from Unison or StretchTune.

Block Types In Detail

BasicOscillator

BasicOscillator is Radical1's most streamlined Generator.

At first glance, it offers familiar shapes, sine, triangle, saw, and square, but these are simply starting points.

Using **Brightness**, **Sharpness**, and **Balance**, you can continuously morph between these tonal families, sculpting nearly any classic waveform from a single harmonic model.

Rather than switching between static waveforms, the BasicOscillator defines a continuous spectral space where harmonic energy can be moved around smoothly.

Start from a selected **Preset**, which sets an initial harmonic distribution for Brightness, Sharpness, and Balance. From there, modify or modulate in real time.

BasicOscillator renders up to 256 partials by default, which is enough to capture any wave perfectly down to F#2. You can enable **Full Spectrum Mode** from the block's menu to increase this for more fidelity at low notes, up to 1024 partials.

Parameters

Brightness	Controls the tilt of harmonic energy across the spectrum. Increasing Brightness emphasizes upper harmonics, producing sharper, more open tones; reducing it darkens the sound.
Sharpness	Adjusts the slope of harmonic decay. Low Sharpness concentrates energy toward lower harmonics for warm, rounded tones; High Sharpness extends high-frequency harmonics for edgier textures.
Balance	Controls emphasis on odd or even harmonics.
Waveform / Shape	Defines the harmonic starting point: sine, triangle, saw, or square. Each serves as a preset configuration for the other parameters.

Nerd bonus: For the full technical detail of how the parameters affect the spectrum, try creating a BasicOscillator and then changing its type to Formula, and you will see the full Formula equivalent of this oscillator.

ShapingOscillator

The **ShapingOscillator** is a variation of the BasicOscillator that focuses on asymmetrical harmonic shaping.

Instead of using Balance to blend harmonic groups, it introduces a pulse-width style control in the spectral domain, allowing you to skew the harmonic distribution in a precise and controllable way.

This makes it especially useful for creating characterful tones, ranging from hollow and nasal to sharp and biting, while preserving the clarity and stability of additive synthesis.

ShapingOscillator starts from a harmonic base similar to the BasicOscillator, but introduces a **cyclic shaping system** inspired by pulse-width modulation. The levels of increasing harmonics are modulated by a cyclic wave in the spectral domain.

Parameters

Brightness	Controls the harmonic richness of the spectrum. Lower values emphasize the fundamental and lower harmonics; higher values extend harmonic energy toward the top end, the same way as in BasicOscillator
Sharpness	Adjusts the definition and slope of harmonics. Softer settings create rounder tones; higher settings tighten and focus upper harmonics, the same way as in BasicOscillator.
Cycle Pos	The starting position of the spectral wave.
Cycle Freq	The frequency of the spectral wave.
Presets	Provides a selection of parameters corresponding to classic wave shapes such as sine, triangle, sawtooth, and square.

ShapingOscillator renders up to 256 partials by default, which is enough to capture any wave perfectly down to F#2. You can enable **Full Spectrum Mode**

from the block's menu to increase this for more fidelity at low notes, up to 1024 partials.

DrawSpectrum

DrawSpectrum offers a direct, visual way to sculpt sound at its most fundamental level.

Instead of choosing a predefined waveform, you draw the harmonic balance yourself, designing the amplitude of each partial across the spectrum. This makes DrawSpectrum as much a visual instrument as a sonic one.

DrawSpectrum gives you hands-on control over the harmonic structure of a sound. Each vertical bar in the display represents a harmonic; its height defines the harmonic's strength.You can freely draw these values to create unique spectra that fall somewhere between natural resonances and purely synthetic shapes.

Because it operates entirely in the **spectral domain**, every edit updates in real time, even while notes are held. The result is a workflow that feels more like painting than programming.

For more fun, try selecting **Randomize** from the block's menu.

Parameters

Spectrum Editor	The main display where you draw or modify harmonic amplitudes. Drag vertically to change level; drag horizontally to shape multiple harmonics at once. Each of the vertical white lines marks an octave.

AdditiveSample

AdditiveSample lets you bring real-world audio into Radical1's spectral engine.

Browse Radical1's included sample library or load any audio file , and Radical1 translates it into the frequency domain, turning sound into a playable spectrum you can stretch, morph, and shape like any other Generator.

Unlike traditional samplers that replay recorded waveforms, Radical1's AdditiveSample works in the **spectral domain**. When you load a sample, it creates a spectral model of the sample. This allows you to further process the harmonic content of the sample with Blocks, in a way that would not be possible by simply playing the sample back.

You can start by clicking **Select or drop sample** to browse the sample library, or, as the name suggests, you can drop your own audio file here.

Once loaded, Radical1 converts the sample into spectral frames, a series of harmonic "snapshots" that can be scanned and shaped over time.

Spectral Effect Blocks can filter, stretch, detune, or resonate the harmonic information just like they would with generated spectra.

Parameters

Select or drop sample	Loads an audio file into the spectral engine. Supported formats include WAV, AIFF, and FLAC.

Start	Where to start when the sample is first triggered.
Loop	Enable loop parameters below.
Loop Start	After the playhead reaches the end of the loop (loop start + loop length), come back here.
Loop Length	Selects the length of the loop.

Pro tip: to scan the sample with a modulation like a graintable synthesizer, set Start its maximum value, and Loop Length to zero. Then Loop Start acts as a "scanner" playing just that slice.

WaveTable

The **WaveTable** generator loads any wavetable file and uses it as a generator, which can then be further sculpted with block effects. Radical1 includes a small pack of built-in wavetables, and there are tens of thousands more available for free on the internet.

Parameters

Position	The position to play in the wavetable. Modulate by a Ramp Envelope for a classic wavetable sweep, or modulate by anything else for more possibilities!

Third-Party Software

Radical1 includes third-party libraries. A complete list of third-party components and their respective licenses is available at:

https://www.soundradix.com/pages/open-source-license/

End of Manual